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Supplemental Environmental Impact Statement/ Program Environmental Impact Report for the Sale of NPR-1

Sale of Naval Petroleum Reserve No. 1 (Elk Hills) Kern County, California

DOE/SEIS/PEIR-0158-S2

October 1997

Volume II

FINAL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ PROGRAM ENVIRONMENTAL IMPACT REPORT

Lead Federal Agency: U.S. Department of Energy
Washington, DC

Lead State Agency: County of Kern
Bakersfield, California

Proposed Action: Sale of Naval Petroleum Reserve Number 1 (Elk Hills)
Amendment of Kern County General Plan
Kern County, California
DOE/SEIS/PEIR-0158-S2

Location: The proposed site is located in Kern County, California, about 25 miles southwest of the City of Bakersfield and approximately 100 miles north of Los Angeles, in a predominantly rural area.

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Abstract:

The Proposed Action is the sale of all right, title and interest of the United States in Naval Petroleum Reserve Number 1 (NPR-1) in accordance with the National Defense Authorization Act for Fiscal Year 1996 (Public Law 104-106). The Proposed Action is also DOE's Preferred Alternative. DOE has determined that the sale of NPR-1 as required by Public Law 104-106 constitutes a major Federal action which may have a significant impact upon the environment within the meaning of the National Environmental Policy Act of 1969 (NEPA) and the California Environmental Quality Act of 1970 (CEQA). Significant impacts may occur because private-sector operation of the NPR-1 oil field could result in accelerated levels of development and different types of activities than under continued government ownership. This SEIS/PEIR assesses the potential environmental impacts from the Proposed Action, a No Action Alternative under which NPR-1 would continue to be operated by DOE, and an Alternative to the Proposed Action under which some form of government control would be maintained.

This document assesses the environmental impacts on: geology and soils; hazardous materials and waste management; air; water; biology; cultural and historical resources; land use; noise; socioeconomics; risk assessment; energy conservation; and environmental justice.

Pursuant to §1503.4(c) of the CEQ NEPA regulation, DOE is not revising and recirculating the full text of the DSEIS/PEIR as a FSEIS/PEIR. CEQA does not require the recirculation of the DPEIR.

Document Date:

October 1997

Public Comments:

In preparing the Draft SEIS/PEIR, DOE and Kern County considered both written comments submitted during the scoping period and oral comments received at the public scoping sessions on April 16, 1996.

The period for submission of public comments on the Draft SEIS/PEIR was 45 days from July 27, 1997, until September 8, 1997. Public hearings were held on the Draft SEIS/PEIR on August 26, 1997. In preparing the Final SEIS/PEIR, DOE and Kern County considered all public comments received, including comments received after September 8, 1997, as well as the oral comments made during the public hearings.

No Action Period:

No action will be taken with respect to the alternatives described in this document until the Record of Decision is published in the Federal Register, which can occur no earlier than 30 days after the Environmental Protection Agency's Notice of Availability of this Final SEIS/PEIR document appears in the Federal Register.

Summary

Purpose And Need For Agency Action

Naval Petroleum Reserve Number 1 (NPR-1, also called "Elk Hills"), a Federally-owned oil production field in Kern County, California, was created by an Executive Order issued by President Taft in 1912. NPR-1 was not developed until the 1973-74 oil embargo demonstrated the nation's vulnerability to oil supply interruptions. Following the embargo, Congress passed the Naval Petroleum Reserves Production Act of 1976 (Public Law (P.L.) 94-258), which directed that the reserve be explored and developed to its full economic potential, the "maximum efficient rate" (MER). Since Elk Hills began full production in 1976, it has functioned as a commercial operation, with total revenues to the Federal government through FY 1996 of $16.4 billion, compared to total exploration, development and production costs of $3.1 billion.

In February 1996, Title 34 of the National Defense Authorization Act for Fiscal Year 1996 (P.L. 104-106) directed the Secretary of Energy to sell NPR-1 by February 10, 1998, unless the Secretary advised Congress that another course of action would be "in the best interests of the United States." The Secretary was also directed to study options for enhancing the value of the other NPRs and Naval Oil Shale Reserves. The purpose of these actions was to remove the Federal government from the inherently non-Federal function of operating commercial oil fields while making sure that the public would obtain the maximum value from the reserves.

President Taft's 1912 Executive Order established other oil reserves in addition to NPR-1, including NPR-2, located immediately south of NPR-1 and containing portions of the town of Taft, California. DOE's report to Congress, as required by P.L. 104-106, recommends that Congress enact legislation authorizing the transfer of most of the government's interest in NPR-2 to the Bureau of Land Management (BLM) in accordance with the Federal Land Policy and Management Act. This transfer would include possible leasing of the remaining unleased lands under the Mineral Leasing Act, with the exception of certain lots located in Ford City, California, which would be sold.

NEPA/CEQA Review

The proposed sale of NPR-1 may have significant environmental impacts for two reasons. First, the private operation of NPR-1 could lead to faster development and different activities than those that would occur under continued government ownership. For example, a private owner might drill more wells and inject more water to force out increased amounts of oil. The additional wells would require more pipelines, access roads and other infrastructure within and outside the current area of operations of NPR-1. Second, Section 7 of the Endangered Species Act (ESA) requires the Federal government to actively protect threatened and endangered species living in areas under government ownership. Because the ESA generally imposes less stringent requirements on private parties than on the government, selling NPR-1 could increase impacts on biological resources.

DOE has therefore determined that the sale of NPR-1 as authorized by P.L. 104-106 is a major Federal action that may have significant impacts on the environment within the meaning of the National Environmental Policy Act of 1969 (NEPA). Further, DOE and Kern County, California, have determined that the sale could have a significant effect on the environment within the meaning of the California Environmental Quality Act of 1970 (CEQA). DOE and Kern County have prepared this Supplemental Environmental Impact Statement/Program Environmental Impact Report (SEIS/PEIR) to address the

requirements of NEPA and CEQA. The Proposed Action for this SEIS/PEIR is the sale of all of the Federal government's right, title, and interest in NPR-1 as directed by P.L. 104-106. As required by NEPA and CEQA, this document also examines alternatives to the proposed action, including the no-action alternative, and analyzes cumulative impacts of the proposed action and alternatives when added to other past, present and reasonably foreseeable activities in the region. In addition, while the implementing regulations for NEPA only require the identification of mitigation measures, CEQA requires assurances that the feasible mitigation measures will be implemented before any state or local agency can approve the project. To meet this CEQA requirement, the SEIS/PEIR contains specific information on the implementation of mitigation.

DOE's first EIS analyzing impacts of NPR-1 was issued in 1979 in response to the 1976 Naval Petroleum Reserves Production Act's requirement to produce oil at the maximum efficient rate. This EIS included the drilling, construction, operations and maintenance activities associated with developing the oil field. Major impacts addressed included land disturbances, waste generation and disposal, and air quality. A 1993 Supplemental EIS (1993 SEIS; DOE/EIS-0158) revised and updated the 1979 analysis and considered the impacts of several alternatives for further development for the oil field. In conjunction with the 1993 SEIS, the Department of the Interior Fish and Wildlife Service (USFWS) issued a Biological Opinion in 1995 describing mitigation requirements for protecting threatened and endangered species within NPR-1. This SEIS/PEIR is a supplement to the 1993 SEIS, which did not consider the sale of NPR-1. In addition to meeting the requirements of NEPA and CEQA, this document is also a floodplain/wetlands assessment for the Proposed Action, as required by the DOE Floodplains/Wetlands regulation, 10 CFR 1022. The potential for impacts to floodplains and wetlands are evaluated in Section 4.4 of this document; in general, the Proposed Action is not expected to have any significant impacts on this issue.

NPR-1 Proposed Action and Alternatives

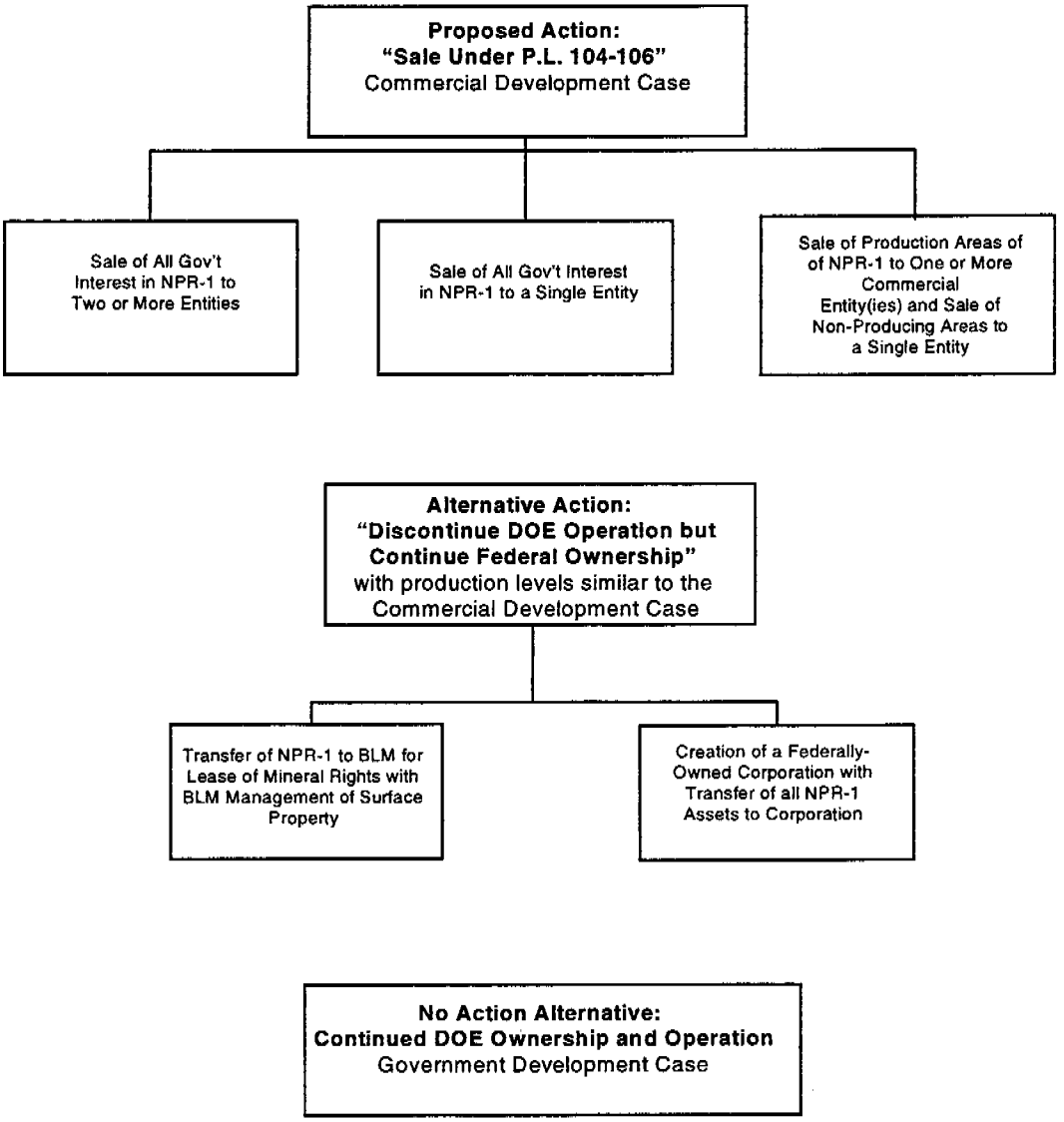
Alternatives to satisfy DOE's purpose and need for action (response to Congressional direction to sell NPR-1) were constructed from possible development cases for oil production (a Reference Case, a Government Development Case, and a Commercial Development Case) that differ in the extent, timing, and pace of development, leading to varying total production. One case, the Commercial Development Case, in turn includes several possible sale scenarios. The alternatives (cases and scenarios) are discussed below and illustrated in Figure S-1.

NPR-1 Proposed Action: Sale of All Government Interest as Directed by P.L. 104-106

The Proposed Action for this SEIS/PEIR is the sale of all of the Federal government's right, title, and interest in NPR-1 as directed by P.L. 104-106. DOE has selected the Proposed Action as its Preferred Alternative. Since NPR-1 would then be developed by the private sector, future development of NPR-1 under the Proposed Action is assumed to follow the Commercial Development Case.

The Commercial Development Case assumes that the oil field will be developed to a greater extent and more quickly than the other two cases, due to the private sector's easier access to capital for development and the demand to generate a return on the investment. This results in potentially much greater production, although the Commercial Development Case overlaps the Government Development Case. Estimated total production for the Commercial Development Case ranges from approximately 849 to 1,225 million barrels of oil equivalent from 1997 to 2034.

Figure S-1
Matrix of NPR-1 Proposed Actions and Alternatives



Three sales scenarios are possible for the Proposed Action:

(1) Sale of All Government Interest in NPR-1 to Two or More Entities would involve DOE selling all Federal ownership in NPR-1 to two or more private entities under separate sales contracts. The largest segment would include an "operating working interest," whose buyer would become the field operator. The buyers of the smaller segments would own the oil and gas produced but have no input into operation decisions. DOE has announced that this is the strategy for selling NPR-1.

(2) Sale of All Government Interest in NPR-1 to a Single Entity would involve DOE selling all Federal ownership in NPR-1 to one buyer under a single contract. This could occur if a single bidder offered a price that exceeded the highest bids for all the individual segments.

(3) Sale of Production Areas of NPR-1 to One or More Commercial Entities and Sale of Non-producing Areas to a Single Entity would involve DOE selling a portion of NPR-1 to commercial entities for continued production and selling a conservation area to a private nonprofit organization or Federal or state conservation agency. The conservation entity would then manage its area as wildlife habitat to support threatened and endangered species and other biological resources. The agency or nonprofit organization would restrict or exclude oil and gas exploration on its portion of NPR-1.

NPR-1 Alternative to the Proposed Action: Transfer Involving Retention of Some Government Ownership at Commercial Development production levels (Requires Additional Legislation)

Under this alternative, the Federal government would take some action other than that required by P.L. 104-106 to transfer part, but not all, of its ownership of NPR-1, with the same objective of maximizing its value to the government. This would require additional legislation. Future development of NPR-1 under this alternative is assumed to follow the Commercial Development Case described above under either of two possible sale scenarios:.

(1) Transfer of NPR-1 to the Bureau of Land Management (BLM) for Lease of Mineral Rights with BLM Management of Surface Property would require the Secretary of Energy to recommend that Congress enact legislation transferring NPR-1 to BLM for leasing of mineral rights under the Mineral Leasing Act and management of the surface under the Federal Land Policy and Management Act. This is similar to the government's management of most oil and gas resources on Federal lands.

(2) Creating a Federally-owned Corporation with Transfer of all NPR-1 Assets to the Corporation would require the Secretary of Energy to recommend that Congress enact legislation establishing a government-owned corporation and authorizing the transfer of NPR-1 assets to the corporation. The corporation would be responsible for generating its own capital and operating funds, and any profits would be deposited in the U.S. Treasury.

NPR-1 No Action Alternative: Continued DOE Ownership and Operation

The No Action alternative assumes continued Federal ownership of NPR-1 with ongoing responsibility for the field assumed by DOE. This could occur if any of several conditions for the sale are not met. First, the total bid(s) for NPR-1 must exceed a minimum acceptable price, to be set using an appraisal process established by the law. Second, the sale must achieve a price reflecting the full value of Elk Hills, or the Secretary of Energy may suspend the sale if he and the Director of the Office of

Management and Budget jointly recommend suspension. The Secretary may also suspend the sale if he believes that a course of action other than immediate sale is in the best interest of the United States. Only a separate Congressional action can then authorize further action.

However, under the No Action Alternative, continued DOE operation would not necessarily follow the development plans analyzed in the 1993 SEIS, referred to as the Reference Case. The Reference Case is based on continued production of NPR-1 at the maximum efficient rate (MER) in compliance with the Naval Petroleum Reserves Production Act. The Act defines MER as "the maximum sustainable daily oil and gas rate from a reservoir which will permit economic development and depletion of that reservoir without detriment to the ultimate recovery." DOE has interpreted this to mean that the operators must carefully monitor reservoir characteristics, technological advancements and economic conditions to maximize both economic return and ultimate recovery of oil and gas from the field. Estimated total production for the Reference Case is approximately 730 million barrels of oil equivalent (including oil, gas, and other non-gas liquids) from 1997 through 2034. DOE believes that P.L. 104-106 permits more aggressive development than in the Reference Case. Future development of NPR-1 under the No Action Alternative is therefore assumed to follow the Government Development Case.

The Government Development Case assumes that the MER constraints of the Reference Case have been relaxed. This assumption is based on Section 3412(h) of P.L. 104-106, which requires that, until NPR-1 is sold, DOE "continue to produce the reserve at the maximum daily oil or gas rate from a reservoir, which will permit maximum economic development of the reservoir consistent with sound oil field engineering practices." DOE has interpreted this as removing the limitations of production to a sustainable rate that permits economic development and depletion. Estimated total production for the Government Development Case ranges from approximately 689 to 950 million barrels of oil equivalents from 1997 through 2034. The Government Development Case thus bounds the estimated production level for the Reference Case.

NPR-1 Alternatives Considered but not Analyzed

Several alternatives to the No Action, Proposed Action, and Alternative Action for NPR-1 were considered but not analyzed.

1. **NPR-1 No Action/Shut-In** would return NPR-1 to shut-in reserve status except for production necessary for testing and reservoir maintenance. Surface facilities would be maintained to assure readiness for national defense needs. This alternative was not analyzed in detail because it would not achieve the objective of maximizing the economic value of NPR-1 to the government.

2. **NPR-1 Proposed Action/Sale to One or More Commercial Entities without a Unit Operating Agreement** is not analyzed because it is not a likely outcome of the sales process. This scenario envisions NPR-1 sold to two or more separate entities to allow more companies to buy smaller pieces of NPR-1. This could resolve some concerns of small California heavy crude producers who rely on NPR-1 production for diluent. However, increased infrastructure demands by multiple operators could increase production costs, which would likely lower the sales price to the government, frustrating the Congressional objective and possibly resulting in no sale.

3. **NPR-1 Alternative Action/Creation of a Federally-Chartered, Publicly-Traded Corporation With Transfer of all NPR-1 Assets to the Corporation** is not analyzed in detail because its potential impacts are not sufficiently different from other alternative sale scenarios to justify separate analysis. Under this plan, an act of Congress would transfer NPR-1 assets to a corporation that would issue stock to the public, with the proceeds deposited in the U.S. Treasury. Profits generated by the corporation would be distributed to stockholders.

4. **NPR-1 Alternative Action/Sale of Mineral Rights and Oil Production Facilities with Government Retention of Surface Rights** was raised as an alternative by the U.S. Fish and Wildlife Service (USFWS) in the 1995 Biological Opinion for NPR-1. It would sell the mineral rights to a private owner, with the Federal government retaining ownership of the surface. This would maintain the government's responsibilities to protect threatened and endangered species, but would reduce government control of impacts related to production. Since the first sale scenario described under the Commercial Development Case provides a more environmentally acceptable means of accomplishing the same objective, this alternative was not analyzed.

5. **NPR-1 Alternative Action/Conservation Preserve** would shut-in NPR-1 completely and convert the entire property to a conservation preserve. The 1995 Biological Opinion of the USFWS confirms that oil and gas development is not inconsistent with the objectives of the Endangered Species Act. Further, this alternative would not meet the objective of maximizing the economic value of NPR-1 to the government.

Possible NPR-2 Actions

Because Congress has not yet authorized DOE's Recommended Action (the transfer of NPR-2 to BLM), this transfer and the sale of NPR-1 represent separate Federal actions with separate timetables and decision points. However, both actions have the same general objective of maximizing the value of the oil fields to the Federal government; the two fields are adjacent to each other; and the two actions are likely to take place within the same general time frame. Therefore, the sale of NPR-1 and the transfer of NPR-2 are similar actions as that term is used in the Council on Environmental Quality regulations implementing NEPA (40 CFR 1500-1508). In addition, the two actions combined may have significant cumulative impacts. Therefore, DOE has determined that the similarity of the two actions and the potential cumulative impacts require that the NPR-2 transfer and possible alternatives should be analyzed in somewhat greater detail than would normally be undertaken to assure that the cumulative environmental consequences of the NPR-1 proposed sale and alternatives are fully addressed.

In 1994, DOE published an Environmental Assessment (EA) (DOE/EA-0997) analyzing the impacts of continued NPR-2 oil and gas production under Federal administration. However, the EA did not analyze transfer of NPR-2 to another agency.

Future development possibilities for NPR-2 oil production do not vary among alternatives, because NPR-2 is already being operated by private industry under long-term leases and is nearing the end of its productive life. Therefore, development cases and sale scenarios were not developed as a basis for alternatives. However, although the alternatives have similar oil production, they could have different environmental impacts.

NPR-2 DOE Recommended Action: Transfer of NPR-2 to BLM for Management Under Current BLM Programs

DOE's Recommended Action for NPR-2 is the transfer of DOE's interest to BLM for management in accordance with the Federal Land Policy and Management Act and possible leasing of currently unleased acreage under the Mineral Leasing Act. The exception is that surface rights to approximately 17 acres of government NPR-2 land in a residential area of Ford City would be sold. This action was recommended to Congress in DOE's report, required by P.L. 104-106, on maximizing the value of the reserves other than NPR-1. The Recommended Action is nearly identical to the No Action alternative, except that BLM would assume DOE's responsibilities. BLM would manage NPR-2 in accordance with its management plans for other Federal oil and gas properties in the San Joaquin Valley. The Recommended Action would require Congressional authorization.

NPR-2 Alternative to the Recommended Action: Sale of all Government Interest in NPR-2 to a Commercial Entity Subject to the Existing Leases

This alternative, which was among the options examined in DOE's report to Congress discussing NPRs other than NPR-1, is the sale of all of the Federal government's right, title, and interest in NPR-2, subject to existing leases. It is thus similar to the Proposed Action for NPR-1. Like the Recommended Alternative for NPR-2, this alternative would require Congressional authorization. Such authorization would include safeguards similar to those for the NPR-1 sale to assure that it is conducted in a fair manner and the government receives full value. Under this Alternative, non-oil field development is possible, particularly on lands with no recoverable oil and gas for several reasons: the government would no longer control how the land would be used; NPR-2 is close to the city of Taft; and NPR-2 is near the end of its productive life.

NPR-2 No Action Alternative: Continued DOE Leasing for Private Operation

The No Action alternative assumes that DOE would continue to administer the existing leases within NPR-2. Currently there are approximately 200 active wells, 225 abandoned or idle wells, 34 tank settings and six oil/water sumps on DOE lands within NPR-2. Expected activities in NPR-2 include drilling and completing approximately 75 new production wells. Lessees would continue to perform remedial well workovers to restore or increase oil production in older wells. Wells may be recompleted or redrilled, or enhanced recovery techniques such as water flooding or chemical injection may be used when production approaches economic limits. In addition, petroleum support facilities would be kept in good repair to ensure operation of tank settings and oil/water/gas hydration/lease automatic custody transfer (LACT) units. Unneeded facilities and equipment may be stored, abandoned, disassembled or salvaged. Inoperable facilities and equipment would be abandoned, disassembled or salvaged. The affected land may be reclaimed.

NPR-2 Alternatives Considered but not Analyzed

Several alternatives to the No Action, Proposed Action, and Alternative Action alternatives for NPR-2 were considered but not analyzed.

1. **NPR-2 No Action/Shut-In** would return NPR-2 to shut-in reserve status except for the production necessary for testing and reservoir maintenance. Surface facilities would be maintained to assure readiness for national defense needs. This alternative was not

analyzed in detail because DOE believes it is not likely that NPR-2 would be shut-in, even if none of the possible alternatives were adopted.

2. **NPR-2 Sale of Remaining Mineral Rights Subject to Current Leases and Transfer of Remaining Interest to BLM for Management of the Surface Interest in Accordance with Federal Law** would have DOE sell the remaining mineral rights in NPR-2, subject to existing leases, and then transfer DOE's current permitting and management responsibilities for the existing leases to BLM. BLM would continue to manage the NPR-2 leases as DOE currently does and would manage the surface facilities in a manner consistent with its existing Federal land management programs, as described under the Recommended Action. Impacts of this alternative are expected to fall within the range of impacts of other alternatives, so no value would accrue from a separate analysis.

3. **Transfer of NPR-2 to Another U.S. Agency for Management in Accordance with NPR Authority** would transfer management of NPR-2 to an agency other than BLM. DOE's report to Congress did not identify any agency that would provide any measurable management or environmental benefits compared to continued operation by DOE or transfer to BLM. Therefore, this alternative was not analyzed.

Principal Environmental Issues And Comparison of Environmental Impacts

NPR-1 is expected to remain exclusively an oil field for the next half century. The differences in environmental impacts among alternatives are driven by the extent, timing and pace of development. Commercial development under the Proposed Action or the Alternative Action would occur sooner and be more intense than under No Action, and would include the loss of the affirmative Federal obligation to mitigate the consequences of government actions. Continued government development under the No Action alternative would delay or reduce the intensity of some impacts and would maintain the affirmative Federal obligation to mitigate the consequences of government actions. Proposed mitigation measures could substantially reduce the impacts judged significant, in many cases to less than significant levels. Five major resource types may have impacts of concern, as described below. Key conclusions and comparisons for all resource types are listed in Tables S-1 and S-2.

Biological Resources

The most important impacts from the future development of NPR-1 would be on biological resources. NPR-1 serves as an important habitat for a number of threatened and endangered species, including the San Joaquin kit fox, the blunt nose leopard lizard, the giant kangaroo rat, the Tipton kangaroo rat, the antelope squirrel, and Hoover's woolly-star (a flowering plant). Oil and gas development on NPR-1 would continue to alter habitat and destroy or injure individuals of these species under No Action, the Proposed Action, or the Alternative Action. However, the latter two alternatives would have a greater impact on threatened and endangered species, because commercial development would be more intense, and the levels of mitigation required of private industry with respect to endangered species are lower than those required of the Federal government. Further, the impacts from future development following the depletion of the reserves and the end of oil and gas production cannot be predicted under the Proposed Action. Under No Action or the Alternative Action, NPR-1 would most likely be preserved as habitat.

Reasonable mitigation measures could reduce these impacts to a less than significant level. These measures include those outlined in the 1995 Biological Opinion issued by the Fish and Wildlife Service and a number of additional measures. A principal aspect of mitigation of impacts of the Proposed Action would be application of the terms and conditions of the Biological Opinion to the new owner(s) until they apply for a permit under Endangered Species Act Section 10, which contains requirements applicable to private land owners. Briefly the proposed mitigation measures include:

- Establishment of a 7,075-acre conservation area and habitat management program;
- Research, monitoring, and biological survey programs;
- A variety of measures to limit disturbance or destruction of individuals during operation and construction activities;
- Prohibitions of public access, hunting, and livestock grazing within NPR-1; and
- Restrictions on the use of pesticides, herbicides, and rodenticides.

Cultural Resources

The second major impact from the future development of NPR-1 would be on cultural resources. Approximately 50 percent of the area of NPR-1 has been subject to archaeological survey and inventory. There are 106 historic archaeological sites (including five historic components of prehistoric/historic multicomponent sites) and three isolated finds documented at NPR-1. These sites consist of artifacts relevant to the history of industrial development in the region. Fifty-seven (57) prehistoric sites and 35 prehistoric isolates are documented at NPR-1. These sites are represented by accumulations of flaked and ground stone, shell and bone artifacts, features, faunal dietary remains and human remains (at two known sites). These sites consist of artifacts that may be relevant to the prehistory of the area.

Preliminary surveys indicate that no impacts to significant historic archaeological sites or buildings are expected primarily because any such sites already have been so disturbed as to destroy their archaeological values. Preliminary results on prehistoric sites indicates that NPR-1 development may disturb five or more archaeological sites eligible for the National Register of Historic Places. The potential impacts cannot be fully determined until ongoing archeological work to identify their scope is completed. The survey and analysis is expected to be complete by August 1997. DOE will enter into a Programmatic Agreement with the State Historic Preservation Officer, as to the extent of the impacts and what mitigation, if any, would be required. This effort is expected to be completed before the Record of Decision for this SEIS/PEIR. Mitigation measures in the form of a data recovery program are expected to be implemented prior to the completion of the sale process. In general, there is greater potential for significant impacts and lower potential for mitigation under the Proposed Action than under No Action or the Alternative Action for the same reasons as for impacts on biological resources. Commercial development would likely result in earlier and more intense impacts and in the loss of the affirmative Federal obligation to mitigate impacts on cultural resources under the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act. Mitigation measures designed to reduce impacts on biological resources, described previously, might reduce the potential for disturbance of prehistoric archaeological sites under any of the alternatives, although some prehistoric sites could be destroyed in returning the land to its predevelopment condition.

Air Quality

The third major impact from the future development of NPRs would be the possibility that state ambient air quality standards for PM_{10} could be exceeded off-site and on-site Federal ambient air quality standards for NO_2 and state ambient air quality standards for PM_{10} and SO_2 might be exceeded. As stated in Section 4.3.1, for the two years analyzed, no violations of Federal or state ambient air quality standards were predicted in the areas surrounding NPR-1 with one exception: off-site particulate concentrations (PM_{10}) under all cases are estimated to exceed the state ambient air quality standards for both years. 2001 No_x emission concentrations on-site are also expected to exceed Federal ambient air quality standards; while 2001 SO_2 concentrations and PM_{10} concentrations for both years on-site are estimated to exceed state standards. The on-site exceedances are expected to occur where the public does not have access.

Oil Spills

The fourth major impact from the future development of NPR-1 would be the slightly increased probability of an oil spill from the increased production of oil. Oil production is expected to increase beyond the Reference Case under any of the three alternatives considered, including No Action (Government Development Case). The probability of a spill would be roughly proportional to the production level. Assuming an increase in future oil spills corresponding to increased production levels, oil spill risk levels are not considered significant. Any spills are unlikely to reach any body of water and would be cleaned up in accordance with the Spill Prevention Control and Countermeasures Plan required by the operator, whether it is owned by the government or a commercial entity.

Water Resources

The last major impact from the future development of NPR-1 would be the potential impact on water resources under any of the three alternatives considered. The upper bounds of both the Government Development (No Action) and Commercial Development (Proposed and Alternative actions) cases would increase water demand for water flood enhanced oil recovery and increase produced waters requiring disposal. Fresh water is a critical resource in Southern California, and the demand for additional water as well as the small risk of contamination to groundwater supplies from produced water disposal are both significant potential impacts. These impacts, which would be roughly proportional to oil production levels, can be mitigated through the ongoing NPR-1 program to treat produced waters for use in water flood projects and through compliance with California Division of Oil, Gas, and Geothermal Resources standards for underground injection disposal of produced waters. The risk of contamination is also mitigated somewhat by the fact that local water quality is typically nonpotable due to high total dissolved solids levels.

Other Resources

Additional areas of potential concern are geology and soils, hazardous waste management and disposal, land use, noise, socioeconomics, energy conservation and environmental justice. These impacts are not likely to be significant and do not help distinguish among the alternatives.

Potential erosion impacts are greater under the Proposed and Alternative actions because larger areas would be disturbed. Common erosion control, revegetation, and soil rehabilitation practices should make these effects short-lived and localized, but residual effects would nonetheless be higher for these two alternatives than for No Action.

The higher oil and gas withdrawal rates under the Proposed or Alternative actions may create a greater potential for subsidence than under the No Action Alternative. However, the greatest potential for subsidence at NPR-1 has already passed with the peak production period, and proper construction and monitoring of subsidence effects on structures would reduce the impacts to levels below significance for all three alternatives.

Potential impacts associated with hazardous waste management and disposal are not expected to be significant because enough regional capacity exists to handle the volume of conventional hazardous waste generated under any alternative.

No land use, noise, socioeconomic or energy conservation impacts are expected be significant. The Proposed Action would not have a disproportionately high or adverse impact on minority or low-income populations. There would be no change in onsite land use and negligible land use changes adjacent to the site under any alternative. The distance between site equipment and residences would minimize noise impacts. The initial ten years of production under the Proposed Action, if near the upper bound of the Commercial Development Case, might require noise mitigation because the equipment could be closer to residences.

With three exceptions, no cumulative impacts are expected as a result of the Proposed Action or alternatives for NPR-1 in combination with past, present and reasonably predicted future actions, including the transfer of NPR-2. The sale of NPR-1 and transfer of NPR-2 are likely to have significant impacts on threatened and endangered species and on archaeological resources. This holds true for the same reasons that individual impacts are considered significant -- increased development activity and the loss of the affirmative Federal obligation to protect those resources. However, mitigation measures described previously would reduce cumulative impacts on biological and cultural resources to less than significant. The third cumulative impact of concern, the possible loss of access to NPR-1 oil for use in other reasonably foreseeable oil development projects, could lead to a premature loss of production from those projects. Some small producers of heavy crude are dependent on NPR-1 oil as a diluent, and the proposed sale could limit their access to the oil. Allowing multiple buyers to bid for future NPR-1 production (as described in the first sales scenario involving multiple entities with a single operator) would address the concerns of small producers in maintaining access to light crude oil.

TABLE S-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

	Reference Case	No Action Alternative	Proposed Action:
		Government Development Case	Sales Scenario: Sale of all Gov't Interest in NPR-1 to 2 or more Commercial Entities
Geology and Soils			
Fault rupture and seismicity	◍ Less than significant impact for structures built according to Uniform Building Code	◍ Same as Reference Case	◍ Same as Reference Case
Erosion	◍ Increased erosion due to additional temporary disturbance of 1065 acres over 30 years. Erosion-control and site-rehabilitation activities will reduce impact to levels below significance	◍ Increased erosion due to additional temporary disturbance of 602-1171 acres over 30 years. Impacts mitigated to below significance	◍ Disturbed area higher than Reference Case 1080-1500 acres. Impacts mitigated to below significance. Potential impacts in non-producing areas depend on future commercial activities.
Subsidence	◍ Potential risk of subsidence due to hydrocarbon production will continue at same levels. Monitoring and prompt response will reduce impacts to levels below significance	◍ Same as Reference Case	◍ Same as Reference Case
Hazardous Materials and Waste Management	◍ Industry practices and regulations will reduce potential levels to below significance	◍ Same as Reference Case	◍ Same as Reference Case for oil and gas development activities. May differ for new commercial activities in non-producing areas
Air Resources	Previous EIS impacts estimated using different methodology, cannot compare impacts	◍ Emissions increases expected with increased production levels through 2001, emission limited by air quality permits (SJVUAPCD/EPA) - no off-site NAAQS violations	◍ Same as No Action Alternative
Water Resources			
Change in surface runoff and flooding potential	○ No Impact due to very small increase in impervious areas	○ Same as Reference Case	○ Same as Reference Case for oil and gas development activities. May differ for new commercial activities in non-producing areas
Decrease of surface water quality	⊕ Less than significant impact due to small quantity of runoff and waste management practices	⊕ Same as Reference Case	⊕ Same as Reference Case
Impacts on ground-water quantity	⊕ .Continuous decrease of annual volume of water needed for injection program. Available water expected to cover needs	⊕ Continuous decrease of annual volume of water needed for injection program after 1999 peak of 51.2 MMB (upper bound). Available water expected to cover needs	⊕ Decrease of annual volume of water needed for injection after 2004 peak of 93.6 MMB (upper bound). Available water expected to cover needs of hydrocarbon activities. More water may be needed if commercial activities arise in non-producing areas.
Impacts on ground-water quality due to well drilling and pipeline construction	⊕ Less than significant impact due to industry practices and State well drilling regulations	⊕ Same as Reference Case	⊕ Same as Reference Case
Impacts to ground-water quality off-site due to injection of produced water	◍ Annual injection of less than 51.3 MMB expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures.	◍ Annual injection of less than 73.1 MMB (upperbound) expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures	◍ Annual injection of less than 120 MMB (upperbound) expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures
Impacts to wetlands	○ No jurisdictional wetlands have been identified on NPR-1.	○ Same as Reference Case	○ Same as Reference Case
Flooding Potential and impacts to floodplains	○ No significant differences are expected in the amount and rate of surface runoff or existing topography. Adequate management of the floodplain is expected to continue.	○ Same as Reference Case	○ Same as Reference Case
Biological Resources			
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	◍ 400 acres disturbed out of 800 acres allowed in BO	◍ 263 acres less than maximum in the BO and 355 acres greater than BP maximum	◍ 263 - 684 acres beyond BO maximum

Legend
○ No Impact
⊕ Less Than Significant Impact
◍ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE S-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

Commercial Development Case		Alternative Actions	
Sales Scenario: Sale of all Gov't Interest in NPR-1 to a Single Commercial Entity	**Sales Scenario: Sale of Production Areas of NPR-1 to a Commercial Entity(ies) and Sale of Non-Producing Areas to a Conservation Entity**	**Sales Scenario: Transfer to BLM for Mineral Leasing and Management of the Surface under Federal Law**	**Sales Scenario: Creation of Federally-Owned Corporation with Transfer of all NPR-1 Assets to Corporation**
◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as first Sales Scenario	◎ Disturbed area higher than Reference Case 1080-1500 acres. Impacts mitigated to below significance. No impacts in non-producing areas.	◎ Same as Sales Scenario 3 of Proposed Action	◎ Same as Sales Scenario 3 of Proposed Action
◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as first Sales Scenario	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as No Action Alternative	◎ Same as No Action Alternative	◎ Emissions increases expected with increased production levels through 2001, emission limited by air quality permits (SJVUAPCD/EPA); increases in mobile emissions (higher # employees)	◎ Same as previous column
○ Same as first Sales Scenario	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊕ Same as first Sales Scenario	⊕ Same as first Sales Scenario in producing areas. No significant additional water needs expected in non-producing areas.	⊕ Same as Sales Scenario 3 of Proposed Action	⊕ Same as Sales Scenario 3 of Proposed Action
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
◎ Same as first Sales Scenario	◎ Same as first Sales Scenario	◎ Same as first Sales Scenario	◎ Same as first Sales Scenario
○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum

TABLE S-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

	Reference Case	No Action Alternative	Proposed Action:
		Government Development Case	Sales Scenario: Sale of all Gov't Interest in NPR-1 to 2 or more Commercial Entities
Loss of affirmative federal obligations to protect, conserve, and help recover T&E species and their habitats	N/A Federal agency would be responsible for NPR	N/A Federal agency would be responsible for NPR	◍ ESA does not require private entities to conduct these activities
Loss of protection of T&E plants from habitat loss, damage, or destruction	N/A	N/A	◍ ESA does not require private entities to conduct these activities
Costs for acquisition, protection and management by a conservation entity	N/A	N/A	N/A
Unfunded protection and management of DOE established conservation	N/A	N/A	◍ New owners would need to bear the costs of maintaining the conservation area
Reduced potential for recovery of listed species and increased potential for listing additional species	○ No Impact	○ No Impact	◍ Additional acreage disturbed and potential loss of affirmative government role to conserve and restore species
Mortality, injury, displacement	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Loss or destruction of dens and burrows	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Local Hoover's woolly-star population lost and seed bank diminished	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Cultural Resources			
Destruction or damage to significant paleontological localities	⊕ Expected production will not destroy the only two known significant localities	⊕ Same as Reference Case	⊕ Same as Reference Case
Destruction or damage to significant or important archaeological sites	○ No impacts under current DOE procedures	○ Same as Reference Case	◍ No impact to significant historic archeological sites or buildings. Potential for impacts to five or more significant prehistoric sites.
Destruction or damage to places of traditional or cultural importance	◍ Impacts uncertain but not expected to be significant	◍ Same as Reference Case	◍ Same as Reference Case
Land Use	⊕ No change in on-site land use; insignificant land disturbance; negligible indirect impacts on land uses adjacent to site	⊕ Same as Reference Case	⊕ Same as Reference Case
Noise	⊕ Because of distance between equipment and residences, change in noise levels would not be noticeable	⊕ Same as Reference Case	◍ Initial 10 years of upper-bound production with equipment closer to residences might require noise mitigation
Socioeconomics			
Fiscal Impacts	○ No Impact	○ No Impact	○ No Impact
Employment	○ No Impact	○ No Impact	○ No Impact
Risk Assessment	○ Increased risks associated with aging equipment and facilities offset by declining production levels and associated site activities	⊕ Slightly higher incidence of spills due to increased production levels but adequate containment and response measures in place to limit impact. Also, lack of vulnerable receptors, i.e., surface water.	⊕ Elevated production and activity levels result in greater risk in terms of spills and accidents, however, adequate contingency measures and lack of vulnerable receptors limit impact to less than significant levels.
Energy Conservation	⊕ Less than Significant Impact	⊕ Potential for minor increase in energy consumption	⊕ Same as No Action Alternative
Environmental Justice	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

Legend
○ No Impact
⊕ Less Than Significant Impact
◍ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE S-1

Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

Commercial Development Case		Alternative Actions	
Sales Scenario: Sale of all Gov't Interest in NPR-1 to a Single Commercial Entity	**Sales Scenario: Sale of Production Areas of NPR-1 to a Commercial Entity(ies) and Sale of Non-Producing Areas to a Conservation Entity**	**Sales Scenario: Transfer to BLM for Mineral Leasing and Management of the Surface under Federal Law**	**Sales Scenario: Creation of Federally-Owned Corporation with Transfer of all NPR-1 Assets to Corporation**
⊛ ESA does not require private entities to conduct these activities	⊕ A conservation entity would conduct these activities on the non-producing areas	N/A Federal agency would be responsible for NPR	N/A Federal agency would be responsible for NPR
⊛ ESA does not require private entities to conduct these activities	⊕ A conservation entity would conduct these activities on the non-producing areas	N/A	N/A
N/A	⊕ Conservation entity would have to bear these costs unless funding came from elsewhere	N/A	N/A
⊛ New owners would need to bear the costs of maintaining the conservation area	⊕ Conservation entity would have to bear these costs unless funding came from elsewhere	N/A	N/A
⊛ Additional acreage disturbed and potential loss of affirmative government role to conserve and restore species	⊕ The impacts would only occur on the producing portion of the field	N/A	N/A
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊛ Same as previous column	⊛ Same as previous column	○ Same as Reference Case	○ Same as Reference Case
⊛ Same as Reference Case	⊛ Same as Reference Case	⊕ Presumes that BLM will apply its Native American Consultation procedures to NPR-1	⊛ Same as Reference Case
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊛ Same as previous column	⊛ Same as previous column	⊕ Same as Reference Case	⊕ Same as Reference Case
○ No Impact	○ No Impact	○ No Impact	○ No Impact
○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Same as previous column	⊕ Same as previous column	⊕ Same as previous column	⊕ Same as previous column
⊕ Same as No Action Alternative	⊕ Same as No Action Alternative	⊕ Same as No Action Alternative	⊕ Same as No Action Alternative
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

TABLE S-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

ENVIRONMENTAL CONSEQUENCE	Cumulative Projects, NPR-1 Reference Case & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Government Development & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Sale & NPR-2 Transfer
Geology and Soils			
Fault rupture and seismicity	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Erosion	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Subsidence	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Hazardous Materials and Waste Management	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Air Resources	Previous EIS impacts estimated using different methodology, cannot compare impacts	◎ Emissions increases expected with increased production levels through 2001, however basin-wide emissions decreasing for most regional pollutants (ozone, particulates)	◎ Same as NPR-1 Government Development and NPR-2 No Action (previous column)
Water Resources			
Change in surface runoff and flooding potential	○ No Impact	○ No Impact	○ No Impact
Decrease of surface water quality	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts on ground-water quantity	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts on ground-water quality due to well drilling and pipeline construction	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts to ground-water quality off-site due to injection of produced water	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts to wetlands			
Flooding potential and impact to floodplains			
Biological Resources			
Plant and Animal Communities			
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
Loss of plant communities due to exploration and maintenance	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
Mortality, injury, displacement of animals	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
T&E Species			
Loss of Federal obligation to protect, conserve, and help recover T&E species and their habitats	N/A because Federal Government continue to own NPR-1&2	N/A	◎ Potentially significant but can be mitigated to less than significant
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Loss of protection of T&E plants from damage or destruction	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Mortality, injury and displacement of T&E species	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Change in regional biological baseline with reduced recovery potential for T&E species	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
Potential for increased limits on other projects in region	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant

[1] It is unlikely that any action would be taken on NPR-2 if, as a result of the statutory process, no action is taken on NPR-1. Therefore those combinations are not considered in this chart or this document.

Legend
○ No Impact
⊕ Less Than Significant Impact
◎ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE S-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

Cumulative Projects, NPR-1 Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Sale & NPR-2 Sale	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Transfer	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Sale
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Emissions increases expected with increased production levels through 2001, however basin-wide emissions decreasing for most regional pollutants (ozone, particulates); Increased particulate impacts	◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Same as NPR-1 Government Development and NPR-2 No Action
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant
⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant

TABLE S-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

ENVIRONMENTAL CONSEQUENCE	Cumulative Projects, NPR-1 Reference Case & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Government Development & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Sale & NPR-2 Transfer
Potential for increased financial needs for conservation area acquisition/management	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
Species of Concern			
Impacts on species of concern (plant and animal species)	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
Total Impacts (past and future)	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
Growth Inducing Impacts	○ No Impact	○ No Impact	○ No Impact
Cultural Resources			
Destruction or damage to significant paleontological localities	⊕ Assumes NEPA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	⊕ Same as previous column
Destruction or damage to significant or important archaeological sites	○ No Impact	○ No Impact	◎ No impact to significant historic archeological sites or buildings. Potential for impacts to five or more significant prehistoric sites.
Destruction or damage to places of traditional or cultural importance	◎ Impacts uncertain but not expected to be significant	⊕ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	◎ Same as previous column
Land Use	○ Primary land use remains petroleum production with no cumulative indirect effects on adjacent land use	○ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	○ Same as previous column
Noise	○ Noise impacts of cumulative projects not additive to specific receptors	○ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	○ Same as previous column
Socioeconomics			
Fiscal Impacts	○ No Impact	○ No Impact	○ No Impact
Employment	○ No Impact	○ No Impact	○ No Impact
Risk Assessment	○ No Impact	⊕ Spills and accidents are discrete events. Negative impacts from such events are quickly corrected. Cumulative impacts from spills highly unlikely as there are no common water courses. Groundwater impacts pose minimal risk to health or environment	⊕ See text under previous column for explanation
Energy Conservation	⊕ Less than Significant Impact	⊕ Potential for minor increase in energy consumption	◎ Potential impact on heavy crude production from loss of NPR-1 crude as diluent/mitigated by split sale of NPR-1
Environmental Justice	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

[1] It is unlikely that any action would be taken on NPR-2 if, as a result of the statutory process, no action is taken on NPR-1. Therefore those combinations are not considered in this chart or this document.

Legend
○ No Impact
⊕ Less Than Significant Impact
◎ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE S-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

Cumulative Projects, NPR-1 Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Sale & NPR-2 Sale	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Transfer	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Sale
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant	◎ Potentially significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
◎ Potentially significant	● Significant Impact	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Same as previous column	⊕ Assumes CEQA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action	⊕ Assumes CEQA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action
◎ Same as previous column	◎ Same as previous column	○ Same as Reference Case	○ Same as Reference Case	◎ Impacts unknown until consultation with SHPO completed
◎ Same as previous column	◎ Same as previous column	◎ Same as previous column	◎ Same as previous column	◎ Same as previous column
○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column
○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation
◎ Same as previous column	◎ Same as previous column	⊕ Potential for minor increase in energy consumption	⊕ Potential for minor increase in energy consumption	⊕ Potential for minor increase in energy consumption
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

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LIST OF ACRONYMS AND ABBREVIATIONS

$\mu G/m^3$	Microgram per cubic meter
AAQS	Ambient Air Quality Standards
ACE	Army Corps of Engineers
ACHP	Advisory Council on Historic Preservation
AML	Above Mean Sea Level
ANSI	American National Standards Institute
API	American Petroleum Institute
ARPA	Archaeological Resources Protection Act
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATC	Authority to Construct
BACT	Best Available Control Technology
Bcf	Billions of cubic feet
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BO	Biological Opinion
BOE	Barrel of Oil Equivalent
BP	Years Before Present (used in archaeological dating, instead of BC and AD)
BPD	Barrels per Day
BPOI	Bechtel Petroleum Operations, Inc.
CA	California
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
Cal-OSHA	California Occupational Safety and Health Administration
CCCOGP	Conservation Committee of California Oil & Gas Producers
CCP	Corrosion Control Program
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEPA	California Environmental Protection Agency
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CH_4	Methane
CNEL	Community Noise Equivalent Level
CO	Carbon Monoxide
COE	Corps of Engineers
COH	Coefficient of Haze
CRWQCB	California Regional Water Quality Control Board
CUSA	Chevron U.S.A.
CWA	Clean Water Act
DGZ	Dry Gas Zone
DOE	United States Department of Energy
DOGGR	California Division of Oil, Gas and Geothermal Resources
DOI	Department of the Interior
DSEIS/PEIR	Draft Supplemental Environmental Impact Report/Program Environmental Impact Report

LIST OF ACRONYMS AND ABBREVIATIONS

DTSC	Division of Toxic Substances Control (Cal-EPA)
EA	Environmental Assessment
EPA	United States Environmental Protection Agency
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive Order
EOR	Enhanced Oil Recovery
ERCs	Emission Reduction Credits
ESD	Environmental Services Department at NPR-1
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
FHWA	Federal Highway Administration
FRP	Facility Response Plan
FSEIS/PEIR	Final Supplemental Environmental Impact Report/Program Environmental Impact Report
FWS	Department of the Interior Fish and Wildlife Service
FY	Fiscal Year
GIS	Geographical Information System
HAPs	Hazardous Air Pollutants
HC	Hydrocarbons
HDDT	Heavy Duty Diesel Truck
HGOR	High Gas to Oil Ratio
H_2S	Hydrogen Sulfide
IC	Internal Combustion
Inc.	Incorporated
I-O	Input-Output
ISC3ST	Industrial Source Complex Short Term - version 3
KCAPCD	Kern County Air Pollution Control District
KCDEHS	Kern County Department of Environmental Health Services
KCWA	Kern County Water Agency
L_{dn}	day-night sound level
LACT	Lease Automatic Custody Transfer Meter
LAER	Lowest Achievable Emission Rate
LPG	Liquefied Petroleum Gas
LRP	Long Range Plan
LTS	Low Temperature Separation
MAOP	Maximum Allowable Operating Pressure
MBB	Main Body B Reservoir
MBD	Thousands of Barrels per day
MMBOE	Millions of Barrels of Oil Equivalent
MCFD	Thousands of Cubic Feet per day
MED	Maximum Economic Development
MER	Maximum Efficient Rate
MMB	Million Barrels
MMBO	Million Barrels of Oil
MMCF	Million Cubic Feet
MMCFD	Million Cubic Feet Per Day
MMG	Million Gallons
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NACE	National Association of Corrosion Engineers
NAGPRA	Native American Graves Protection and Repatriation Act

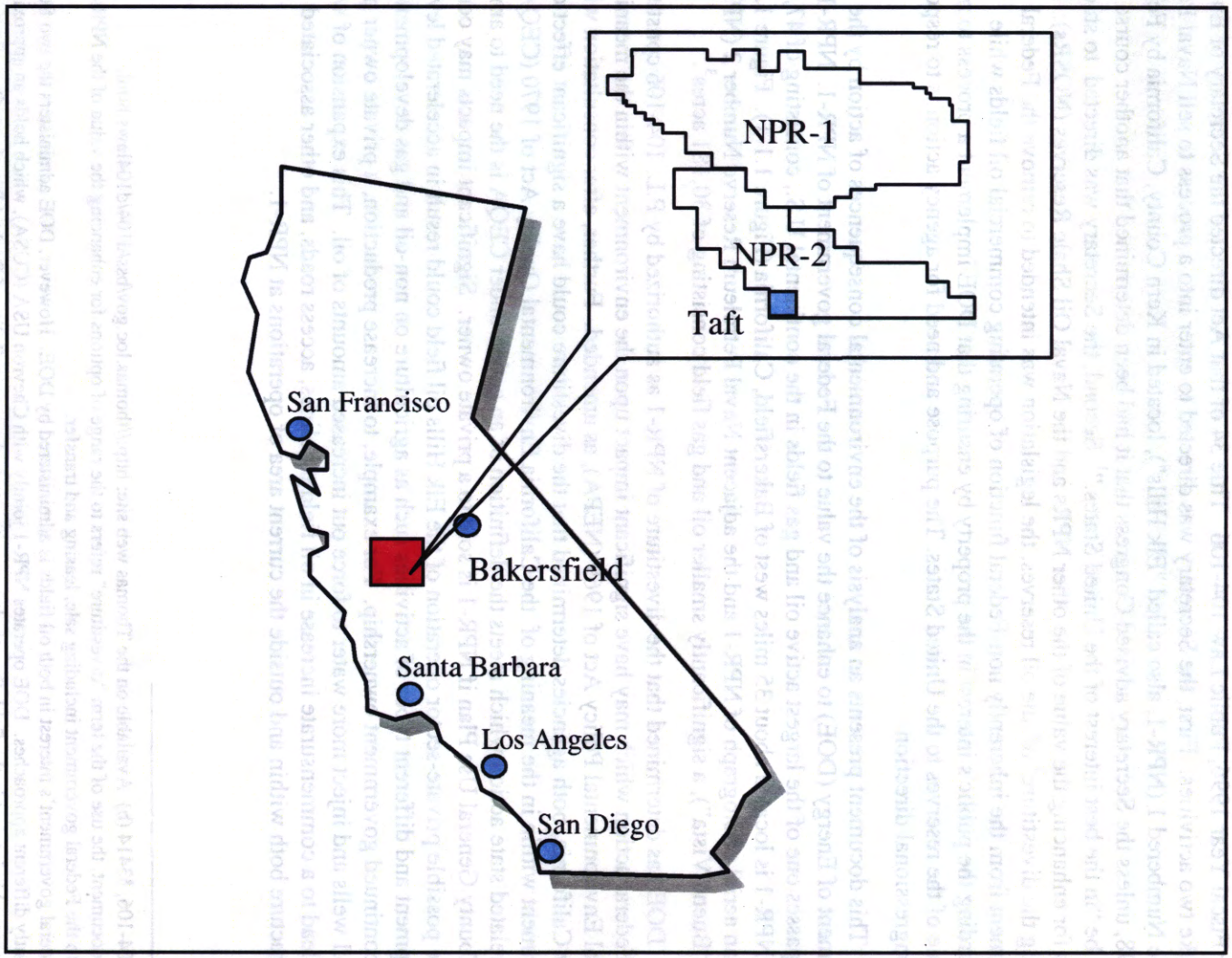
LIST OF ACRONYMS AND ABBREVIATIONS

NEPA	National Environmental Policy Act
Neph	Nephelometer
NFPA	National Fire Protection Academy
NGL	Natural Gas Liquid Products
NHPA	National Historic Preservation Act
NO_3	Nitrate
NO_x	Nitrogen Oxides
NOP	Notice of Preparation
NORM	Naturally Occurring Radioactive Materials
NOSR	Naval Oil Shale Reserves
NPDES	National Pollutant Discharge Elimination System
NPR-1	Naval Petroleum Reserve Number 1
NPR-2	Naval Petroleum Reserve Number 2
NPRC	Naval Petroleum Reserves California
NPV	Net Present Value
NRC	National Response Center
NRHP	National Register of Historic Places
NSR	New Source Review
O_3	Ozone
OCS	Outer Continental Shelf
OES	Office of Emergency Services (Kern County)
O&M	Operations and Maintenance
OPA	Oil Pollution Act
OSCP	Oil Spill Contingency Plan
OSHA	Occupational Safety and Health Administration
PAH	Poly Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyls
PG&E	Pacific Gas and Electric Company
$PM_{2.5}$	Particulate Matter (2.5 microns or smaller)
PM_{10}	Particulate Matter (10 microns or smaller)
PPM	Parts per Million
PSD	Prevention of Significant Deterioration
PTO	Permit to Operate
RCRA	Resource Conservation and Recovery Act
RIMS	Regional Input-Output (I-O) Modeling System
ROG	Reactive Organic Gases
SARA	Superfund Amendments and Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SCS	Soil Conservation Service
SEIS/PEIR	Supplemental Environmental Impact Statement/Program Environmental Impact Report
SHPO	State Historic Preservation Officer
SIPs	State Implementation Plans
SJVAB	San Joaquin Valley Air Basin
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SPCC	Spill Prevention Control and Countermeasures
SO_2	Sulfur Dioxide
SO_4	Sulfate
SO_x	Sulfur Oxides
SOZ	Shallow Oil Zone
SPCC	Spill Prevention, Control and Countermeasure

LIST OF ACRONYMS AND ABBREVIATIONS

TDS	Total Dissolved Solids
THC	Total Hydrocarbons
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSP	Total Suspended Particulates
UIC	Underground Injection Control
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
VFHCP	Kern County Valley Floor Habitat Conservation Plan
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WKWD	West Kern Water District

Figure 1.1-1
Location Of NPR-1 And NPR-2



1. PURPOSE AND NEED FOR AGENCY ACTION

1.1. PURPOSE AND NEED FOR AGENCY ACTION

In February 1996, Congress passed, and the President signed, the National Defense Authorization Act for Fiscal Year 1996, Public Law 104-106. Title 34 of that Act directed the Secretary of Energy to undertake two activities. First, the Secretary was directed to enter into a process to sell Naval Petroleum Reserve Numbered 1 (NPR-1, also called "Elk Hills"), located in Kern County, California by February 10, 1998, unless the Secretary advised Congress that it had been determined that another course of action would be "in the best interest of the United States."[1] Second, the Secretary was directed to study options for enhancing the value of the other NPRs and the Naval Oil Shale Reserves (NOSRs). In initiating the divestiture[2] of the oil reserves, the legislation was intended to remove the Federal government from the inherently non-Federal function of operating commercial oil fields while safeguarding the public's interest in the property by ensuring that DOE implement a process to maximize the value of the reserves to the United States. The purpose and need for agency action is to respond to this Congressional direction.

This document presents an analysis of the environmental consequences of action by the U.S. Department of Energy (DOE) to enhance the value to the Federal government of NPR-1. NPR-1 encompasses one of the largest active oil and gas fields in the continental U.S., consisting of 47,409 acres. NPR-1 is located about 35 miles west of Bakersfield, California (Figure 1.1-1). Figure 1.1-2 shows an aerial photograph of NPR-1 and the adjacent Naval Petroleum Reserve Number 2 (NPR-2, also called "Buena Vista"), a significantly smaller oil and gas field consisting of 30,181 acres[3].

DOE has determined that the divestiture of NPR-1 as authorized by P.L. 104-106 constitutes a major Federal action which may have significant impact upon the environment within the meaning of the National Environmental Policy Act of 1969 (NEPA), as amended. Further, after consultation with Kern County California, both agencies determined that the divestiture could have a significant effect on the environment within in the meaning of the California Environmental Quality Act of 1970 (CEQA). The initial related state action which meets the definition of an action under CEQA is the need to amend the Kern County General Use Plan if NPR-1 is sold to a private owner. Significant impacts may occur because possible private-sector operation of the Elk Hills oil field could result in accelerated levels of development and different types of activities such as agriculture on non-oil and gas developmental than under continued government ownership. For example, to increase production, a private owner might drill more oil wells and inject more water to force out increased amounts of oil. This expansion of wells would lead to a commensurate increase in oil field pipelines, access roads, and other associated infrastructure both within and outside the current area of operations at NPR-1.

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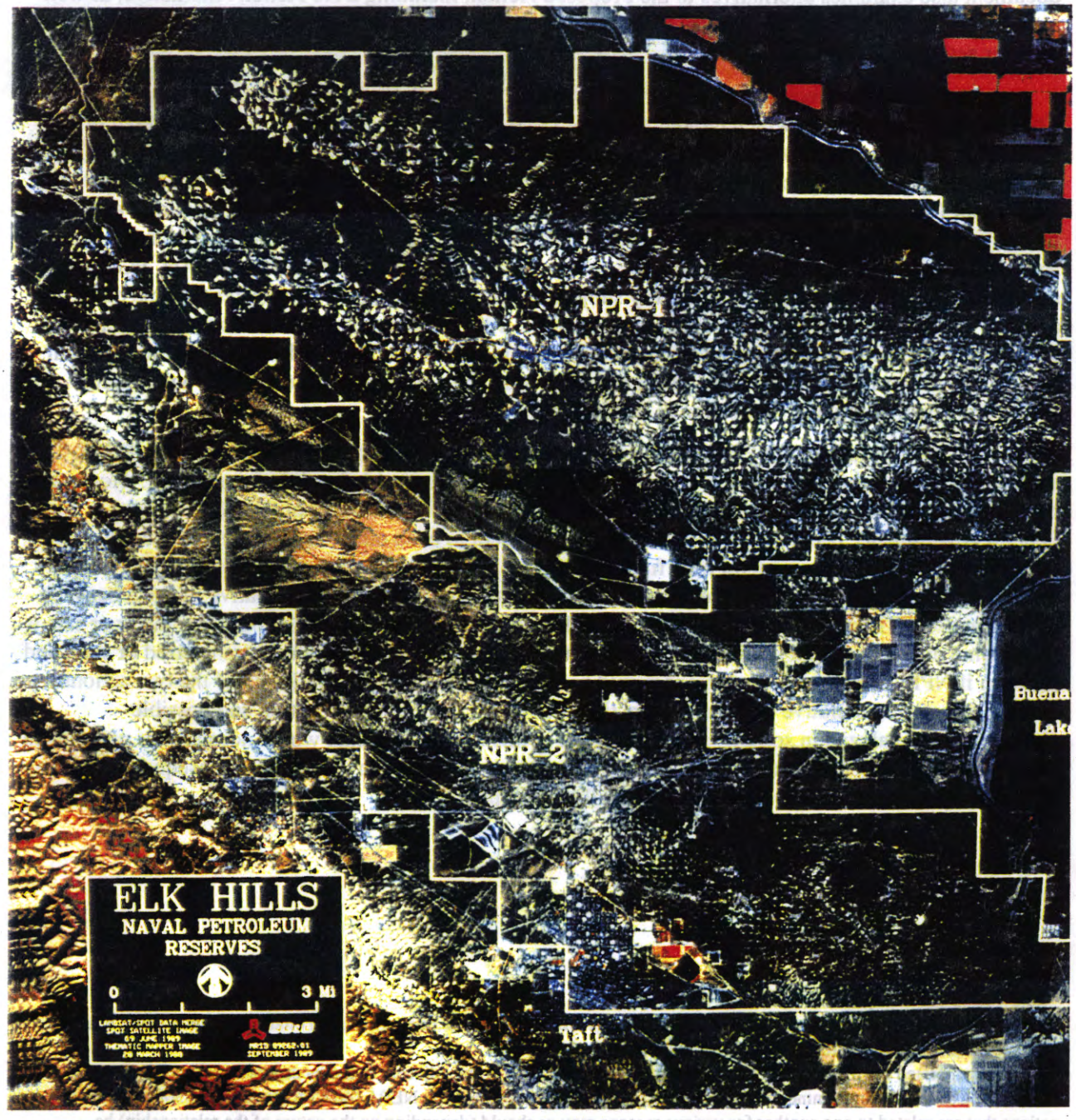
[1] P.L. 104-106, §3414 (b). Available on the Thomas web site: http://thomas.loc.gov/bss/d104/d104laws.html.

[2] In this document, the use of the term "divestiture" refers to the range of options for enhancing the value of the NPRs and NOSRs to the Federal government including sale, leasing and transfer.

[3] The Federal government's interest in both oil fields is administered by DOE. However, DOE administers the two fields under significantly different approaches. DOE operates NPR-1 jointly with Chevron USA (CUSA), which holds an approximately 22 percent ownership interest in the field. Day-to-day operations are the responsibility of Bechtel Petroleum Operations, Inc., DOE's management and operating contractor. Net oil and gas production, as well as the expenses of running the field, are shared by DOE and CUSA in accordance with their ownership percentages. At NPR-2, where the producing reservoirs are nearing the end of their useful life and the level of production is only a small fraction of NPR-1 production, the Federal government owns approximately 35 percent of the acreage in a checkerboard arrangement. The oil and gas rights associated with 9,224 of these acres have been leased to seven oil companies under 15 active leases. The Federal government receives a royalty interest equal to approximately 4 percent to 14 percent of production depending on the lease and the type of production, but has no active role in the day-to-day operations.

Figure 1.1-2
Aerial Photograph Of NPR -1 And NPR -2



This document comprises a Supplemental Environmental Impact Statement/ Programmatic Environmental Impact Report (SEIS/PEIR) pursuant to NEPA and CEQA which analyses the environmental impacts of the divestiture of NPR-1. The Proposed Action for this SEIS/PEIR is the sale of all of the Federal government's right, title and interest in NPR-1 as directed by the National Defense Authorization Act for Fiscal Year 1996, Public Law 104-106. As required by NEPA and CEQA, this document also examines alternatives to the Proposed Action, including a No Action Alternative, as well as the potential for cumulative impacts from the Proposed Action and alternatives when analyzed in light of other activities in the region.

In addition to directing the sale of NPR-1, P.L. 104-106 also required that DOE report to Congress on the manner in which the remainder of the NPRs and NOSRs should be administered or divested in order to maximize the value of the reserves to the government and required that DOE analyze certain options. Those options were: (1) continued operation by DOE; (2) transfer to the Department of the Interior (DOI) Bureau of Land Management for management under BLM's current policies and procedures for Federal oil and gas lands in accordance with the Federal Land Policy and Management Act [4] including possible leasing of remaining unleased lands under the Mineral Leasing Act [5]FGN[5] (3) sale of remaining interests to a private party subject to existing leases; and (4) transfer to some other agency. DOE has sent such a report to Congress (DOE 1997)[6]recommending that Congress enact legislation to transfer most of the government's interest in NPR-2 to BLM with the exception of certain lots located in Ford City, California,[7]which would be sold. This possible future action would require additional Congressional authorization to implement.

As the divestiture of NPR-2 has not yet been authorized by Congress, the divestiture of NPR-1 and of NPR-2 represent separate Federal actions with separate timetables and decision points. However, because both actions have the same general objective (maximizing the value of the oil fields to the Federal government), because the two facilities are adjacent to each other, and because they are likely to take place within the same general time frame, these two actions are similar actions as that term is used in the CEQ regulations.[8] Further, there remains the potential for significant cumulative impacts between the two actions. Therefore, DOE has determined that despite the fact that (1) the NPR-2 transfer or sale is at this time only a possibility, with uncertainty as to if, how, and when it might be transferred or sold, and (2) even if NPR-2 were sold, the actions would be two separate sales, the similarity of the two actions and the potential cumulative impacts require that the NPR-2 recommended action and possible alternatives be analyzed in somewhat greater detail in this SEIS/PEIR than would normally be undertaken for cumulative impact analysis in order to assure that the cumulative environmental consequences of the NPR-1 Proposed Action and alternatives are fully developed.

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[4] 43 U.S.C. § 1701 *et seq.*

[5] 30 U.S.C. § 181 *et seq.*

[6] March, 1997. Report available on the DOE Fossil Energy web site: www.fe.doe.gov. For all citations (author, date), a full reference is included in the reference subsection(s) of each chapter.

[7] An unincorporated town located on the government portion of NPR-2 and adjacent to the incorporated town of Taft.

[8] The U.S. Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500-1508) provide that actions that are related to one another for various reasons may or should (depending on the nature of the relationship) be addressed in the same impact statement. The regulations (40 CFR 1508.25(a)) provide, in part, that such actions may include: (3) Similar actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined. In its written scoping comments, the (EPA) recommended the inclusion of NPR-2 in the analysis of the proposed sale of NPR-1. The approach discussed is, in part, in response to that comment. Impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement

1.2. NEPA AND CEQA PROCESS

As discussed above, these actions come under the purview of NEPA, which establishes national policies and goals for the protection of the environment and a process to ensure that environmental consequences are considered in Federal agency decision-making. The process that NEPA defines is intended to help Federal officials make decisions based on a full disclosure of the environmental impacts of their actions in order to "protect, restore and enhance the environment."

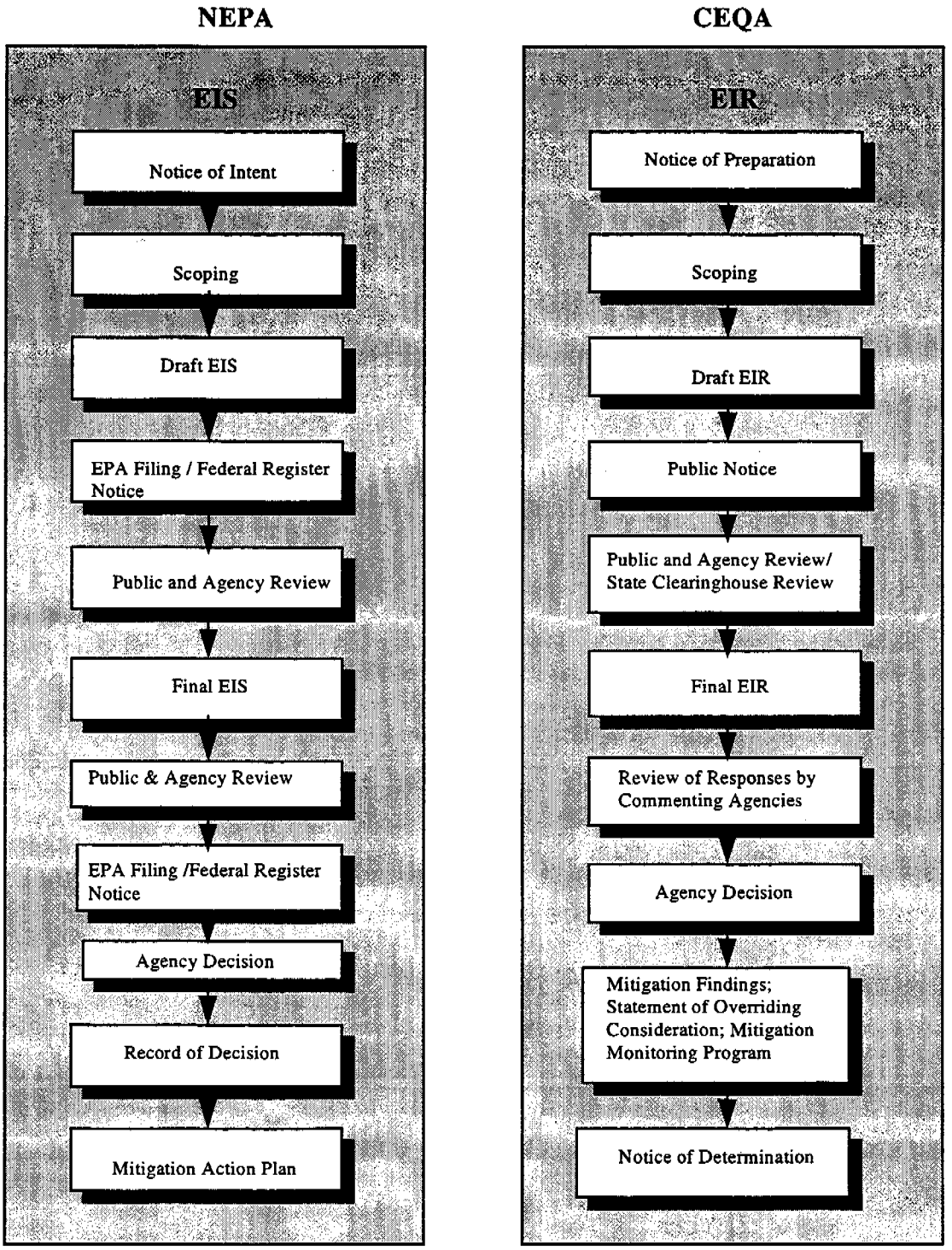
In addition to the requirements of NEPA, actions to be undertaken by California state and local agencies in conjunction with the Proposed Action fall under the requirements of CEQA, the state equivalent of NEPA. The Proposed Action that initially triggers CEQA involves amending the Kern County General Plan Use, Open Space and Conservation Element for NPR-1 from a "State or Federal Land" designation to a "Mineral or Petroleum" land use designation, which requires approval by the Kern County Board of Supervisors. Since a general plan amendment meets the definition of a project, the action must comply with the requirements of CEQA. The Kern County Planning Department is serving as the lead agency for the CEQA process. In addition to the general plan amendment, future oil and gas well activity approvals for the privatized NPR-1 by the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) and the California Department of Fish and Game (CDFG) might also trigger CEQA.

Section 1506.2 of NEPA requires Federal agencies to cooperate with state and local agencies "to the fullest extent possible to reduce duplication between NEPA and comparable state and local requirements." Such cooperation "shall to the fullest extent possible include joint environmental impact statements." In addition, CEQA provides that in the event that a project requires both an EIR pursuant to CEQA and an EIS pursuant to NEPA, the lead agency should, whenever possible, use the EIS as the EIR.

There are many similarities between the NEPA and CEQA processes (see Figure 1.2-1). For example, the Federal Notice of Intent is analogous to the State Notice of Preparation; although the Notice of Preparation and Initial Study is much more detailed then the Federal Notice of Intent, the Federal Notice of Availability serves the same purpose as the State Notice of Completion; and both initial study processes offer the opportunity for other agencies and the public to comment on the environmental document through a "scoping process." The Federal Emvironmental Impact Statement (FEIS) is analogous to the state EIR, defined by CEQA as "an informational document which will inform public agency decision makers and the public generally of the significant environmental effects, and describe reasonable alternatives to the project." However, the CEQA regulations note that NEPA does not require separate discussions of mitigation measures or growth-inducing impacts and suggest that these points of analysis might need to be added, supplemented or identified before a Draft EIS can be used as an EIR.[9] This is because of the significant difference between the two statutes with respect to mitigation measures. It should be noted that although NEPA itself does not address mitigating measures, the NEPA implementing regulations at 40 CFR § 1502.16(n) do require their discussion in an EIS, but not their implementation. CEQA, on the other hand, declares it to be state policy to not approve projects if alternatives or mitigation measures are available to lessen the significant impacts of a project, unless specific economic, social or other conditions make the adoption of those mitigation measures infeasible.[10] Mitigation measures are discussed in Section 4.

[9] Title 14, California Code of Regulations, Section 15221.
[10] California Public Resources Code, Division 13, Chapter 1, § 21002.

Figure 1.2-1
NEPA And CEQA Parallel Processes



In addition to these differences between an EIS and EIR, this SEIS/PEIR is a program EIR under CEQA. A program EIR is one that analyzes a series of related actions characterized as one large project (in this case, a number of future state and local agency actions necessary to the future development of NPR-1 as discussed later in the document). A program EIR allows an agency to evaluate and approve an overall project but gives the agency the ability to assess individual activities when they are proposed. If the individual activities would have no effects beyond those analyzed in the program EIR, no further CEQA compliance would be required. If individual activities are determined to have effects that were not examined in the program EIR, a new Initial Study would need to be prepared leading to either an EIR or a Negative Declaration. It should be noted, however, that although this document is a program EIR, it is not a programmatic EIS. It is expected that future activities at NPR-1 would require additional state action after the sale of NPR-1; therefore, a program EIR is appropriate. However, no further EISs will be prepared for the divestiture of NPR-1.

Table 1.2-1 sets out the NEPA documents relevant to this SEIS/PEIR and the key dates in their preparation. In 1979, DOE issued the original NPR-1, EIS (DOE/EIS 0012) analyzing the production activities on NPR-1 at the "maximum efficient rate"[11] (MER) in accordance with the requirements of NPR-1's authorizing legislation, the Naval Petroleum Reserves Production Act. The 1979 EIS included all of the drilling, construction, operations and maintenance activities normally associated with developing a large and complex oil field using generally accepted oil and gas production technologies. Among other impacts, the 1979 EIS addressed significant land disturbances, waste generation and disposal and increases in air emissions.

In 1993, DOE published the supplement (DOE/EIS-0158) to the original 1979 NPR-1 EIS, revising and updating the 1979 analysis of the impacts of oil and gas production on NPR-1 under continued Federal ownership and operation. That document analyzed a proposed action and three alternative actions. The proposed action was to continue production at MER with some additional development projects including enhanced oil recovery projects, a natural gas processing plant and a cogeneration plant intended to increase the net revenues to the government from NPR-1. The alternatives included various combinations of continued production and those projects. Sale of NPR-1 was not analyzed in the 1993 SEIS. The proposed action was adopted in the Record of Decision (see Table 1.2-1).

This document constitutes a supplement to the 1993 SEIS. As such it relies on the descriptions and impact analysis of the 1993 SEIS with respect to ongoing operations at NPR-1 which is incorporated by reference. Much of the discussions of current operations in this SEIS/PEIR is summarized from that prior document, updated for events that have occurred since 1993. This SEIS/PEIR does not focus on those detailed descriptions and impacts of oil and gas operations available in the 1993 SEIS, but instead describes the change in operations and impacts from the accelerated development of the field by either the government or a private owner that would occur from the proposed action or the alternatives, as well as their total and cumulative impacts.

In 1994, DOE published an Environmental Assessment (EA) (DOE/EA-0997) analyzing the impacts of oil and gas production at NPR-2 under continued Federal administration.[12] Transfer of NPR-2 was not analyzed in the 1994 EA.

[11] The concept of MER is explained further in Chapter 2 and in Appendix B.

[12] This is the most recent NEPA document covering NPR-2; it was distributed for public comment on December 16, 1994. The EA examined a proposed action, continued development of the field and three alternatives. Due to issues concerning the sale of NPR-1 and their possible relevance to NPR-2, the NEPA process was never completed for this document, and no change in management or operations has occured.

Table 1.2-1
NEPA/CEQA Documents Relevant to the SEIS/PIR

	Draft	Final	Record of Decision
U.S. Department of Energy, 1993, Final Supplement to the 1979 Final Environmental Impact Statement, Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California (DOE/EIS-0158). Washington, D.C.	June 5, 1992	March 1993	June 15, 1994
U.S. Department of Energy, 1979, Final Environmental Impact Statement, Petroleum Production at Maximum Efficient Rate, Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California (DOE/EIS-0012). Washington, D.C.	June, 1978	August, 1979	N/A
U.S. Department of Energy, 1994, Environmental Assessment for Continued Exploration, Development, and Operation, Naval Petroleum Reserve Number 2 (Buena Vista Hills), Kern County, California, (DOE/EA-0997). Elk Hills, CA.	September 21, 1993	N/A	None
Kern County Planning Department, Notice of Preparation of a Draft Program Environmental Impact Report and Initial Study for Sale of Naval Petroleum Reserve Number 1.	December 3, 1996	N/A	N/A

As neither of the documents addressed possible state actions, neither met the requirements of a joint EIS/EIR. For these reasons, DOE and Kern County are preparing this joint supplement to the 1993 SEIS under NEPA and a PEIR under CEQA to present foreseeable impacts from the proposed sale, as well as from reasonable alternatives, including the cumulative impacts from certain other past, present and reasonably foreseeable future actions, such as divesting NPR-2.

1.2.1. EIS Scoping

In compliance with NEPA and CEQA regulations in preparing this draft SEIS/PEIR, DOE and Kern County conducted the following scoping activities. On March 21, 1996, DOE published a Notice of Intent to Prepare an SEIS in the *Federal Register* (96 FR 6837) for the Proposed Sale of the Naval Petroleum Reserve Number 1. Also in March, DOE published a fact sheet entitled "Proposed Sale of Naval Petroleum Reserve No. 1: Information and Opportunities for Public Involvement." Both documents invited written comments until May 6, 1996, and announced two public scoping meetings to provide information to the public on the proposed activity and to elicit input from the public (both oral and written comments) regarding issues and concerns. DOE distributed the Notice of Intent to state and Federal agencies, local, state, and Federal government representatives, environmental groups, petroleum industry associations, and concerned individuals. DOE also published a public notice announcing the scoping meetings in the *Taft Daily Midway Driller* and the *Bakersfield Californian* newspapers.

DOE held two public scoping meetings on April 16, 1996 at the Red Lion Inn in Bakersfield, California. A total of twenty-four commenters participated during the scoping period. Seven people provided comments at the afternoon scoping meeting, and five people provided comments at the evening

meeting. Fourteen written comments were received subsequent to the scoping meetings. Two people commented both orally and in writing.

DOE also held scoping meeting on April 17, 1996 at the Federal Center in Sacramento, California for Federal and State agencies. Representatives from the following agencies attended the meeting: U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Water Resources, California Air Resources Board (also representing California Environmental Protection Agency), and California Energy Commission. On May 3, 1996, DOE held a teleconference with the U.S. Environmental Protection Agency EPA Region 9 Office, whose representative was not available for the April 17 meeting. Information on the organizations and individuals that commented during the scoping period, including a transcript of the scoping meeting, is available at the DOE headquarters and from the local Kern County information repository. DOE prepared an Implementation Plan for completing the NEPA/CEQA process, which was distributed in November 1996.

1.2.2. EIR Notice of Preparation

Kern County conducted an initial study and prepared a Notice of Preparation (NOP) for a draft Program EIR analyzing the impacts of the proposed action under CEQA, the processing of an amendment to the Kern County General Plan. This Notice was circulated for public and agency comments for a thirty day period of time beginning December 3, 1996. As a result of this circulation, comments were received from eight public agencies and one private corporation. The NOP and resulting comments are available at the information repositories.

It should be noted that an amendment of the Kern County General Plan would not be required for the transfer of NPR-2 because the property would remain with the Federal government and its land use designation would not change. However, the sale of NPR-2, or just the Ford City portion, would require a General Plan amendment. Nonetheless, as sale has not yet been authorized by Congress, the possible action is not yet sufficiently advanced to trigger the application of CEQA to the divestiture of NPR-2. This conclusion is consistent with the preparation of a program EIR under CEQA, which contemplates additional analysis as a program proceeds and Proposed Actions are identified.

1.2.3 Future NEPA/CEQA Documentation for NPR-2

Depending on what Congressional action is taken with respect to DOE's recommendation for NPR-2, additional analysis under NEPA may also be required before any legislated direction can be implemented with respect to NPR-2. In addition futher CEQA analysis may also be required with respect to NPR-2. Although further NEPA/CEQA action may be required, this document undertakes a more detailed examination of NPR-2 than is undertaken for the rest of the projects that are analyzed for the purpose of determining the cumulative impacts of the possible sale of NPR-1. This additional analysis was undertaken for the purpose of determining the cumulative impacts of the NPR-1 alternatives in conjunction with the NPR-2 recommended action, as well as alternatives to the recommended action. This was done because DOE determined that these alternatives are reasonably foreseeable within the meaning of that term as used by the NEPA and CEQA regulations.

1.3. FORMATION AND DEVELOPMENT OF NPR-1

1.3.1. History and Background of NPR-1

The following discussion summarizes the history of NPR-1 as it was described in detail in the NPR-1 1979 EIS (DOE 1979) and the 1993 supplement (DOE 1993) to that EIS.

NPR-1 was created by an Executive Order issued by President Taft in 1912 to provide an emergency source of liquid fuels for the military. Except for brief periods of production in the 1920s and during World War II, Elk Hills was maintained in an essentially undeveloped state until the 1973-74 oil embargo demonstrated the nation's vulnerability to oil supply interruptions. As a result of the embargo, Congress passed the Naval Petroleum Reserves Production Act of 1976 (P.L. 94-258), which authorized and directed that the reserve be explored and developed to its full economic and productive potential. P.L. 94-258 required that Elk Hills be produced for six years at the "maximum efficient rate" consistent with sound engineering practices. The law also provided the President discretionary authority to extend production subsequently, in increments of up to three years each, if continued production were found to be in the national interest. Such findings have been made and production is presently authorized through April 5, 2000. Operation and production at NPR-1 was transferred to DOE with its establishment in October, 1977.

Following the opening of NPR-1 to full production in July 1976, oil production increased to a peak of about 180,000 barrels per day in 1981 and has been on a downward trend since that time (Figure 1.3-1). All of the government's share of net production (not including on-site use for reinjection to maintain reservoir pressure and operating a cogeneration plant and some compressors) is sold on the open market via competitive bids, and all revenues from these sales are deposited into the Miscellaneous Receipts Account in the U.S. Treasury. Since the opening of Elk Hills to full development in 1976, the field has functioned as a commercial operation generating significant revenues for the Federal government (although its expenditures are still subject to annual appropriation by Congress). Revenues through FY 1996 from the sale of hydrocarbon products produced from the field have totaled $16.4 billion, against total exploration, development, and production costs of $3.1 billion.

The NPR-1 site comprises approximately 74 square miles of the Elk Hills, a long narrow ridge about 16 miles long by 6 miles wide, oriented generally east-west in the southern San Joaquin Valley. NPR-1 includes land in seven townships, identified in Figure 1.3-2 by the letters Z, R, S, T, B, G, and M. A township is a division of territory in surveys of U.S. public land comprising 36 one-mile-square sections numbered 1 through 36. Each section is uniquely identified by section number and township: e.g. 35R. NPR-1 contains production development at various levels in 90 percent of the 78 sections that lie partially or entirely within its boundaries. Within the boundaries of NPR-1, CUSA owns 10,360 acres (about 22 percent), and the remaining 37,149 acres are owned by the Federal government (about 78 percent). NPR-1 is surrounded on three sides by extensively developed oil and gas fields that have been in production since the early 1900s. NPR-2 is south of NPR-1 and shares a common border with NPR-1 in Township B.

Both the government's and CUSA's NPR-1 lands have been developed and operated as a unit pursuant to a Unit Plan Contract (UPC) authorized and approved in 1944. The purpose of the UPC is to enhance recovery and efficiency by eliminating the possibility of applying competitive production strategies on a single oil and gas reservoir underlying separately owned lands.

Figure 1.3-1
Historical Production of NPR-1 & NPR-2

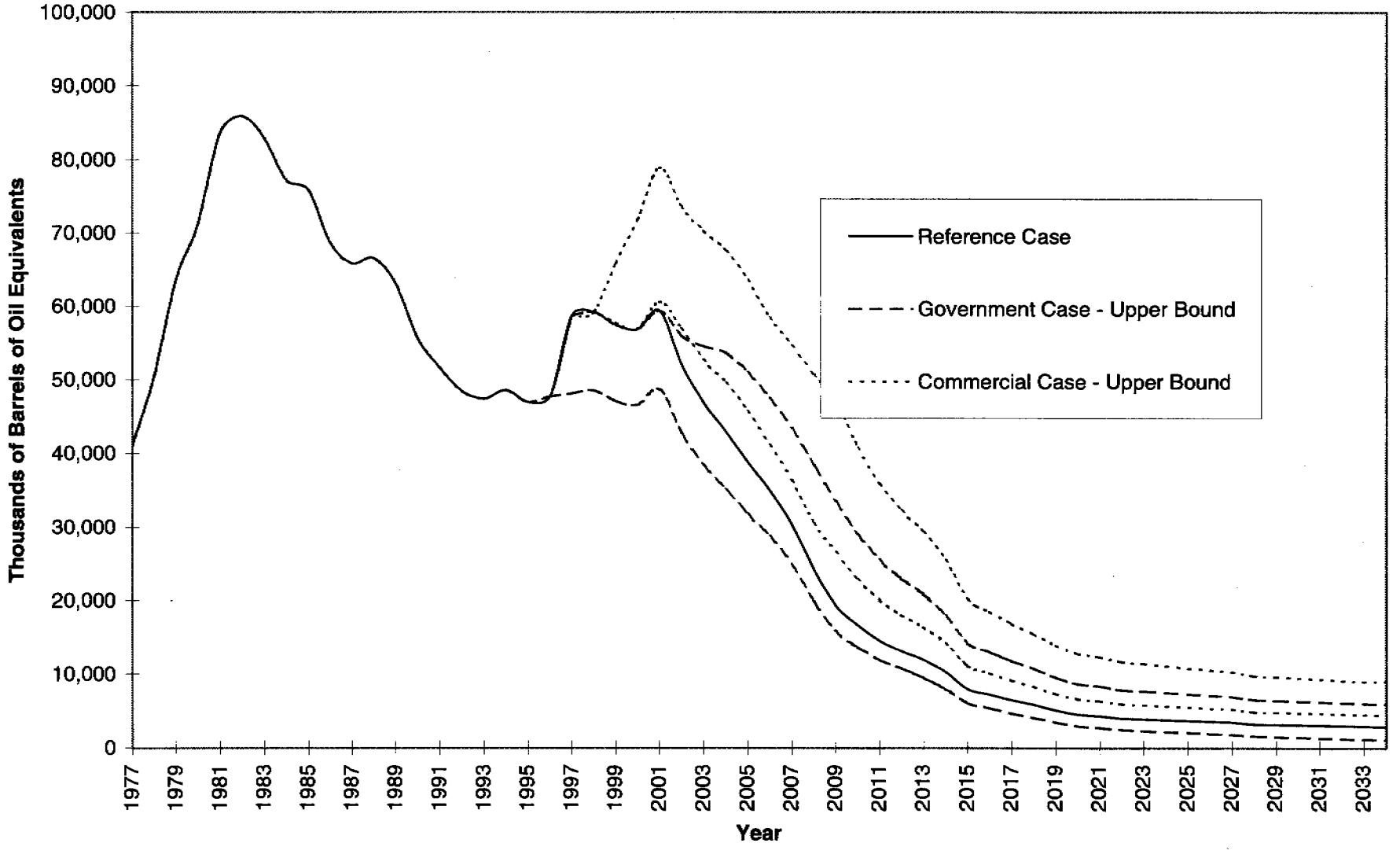
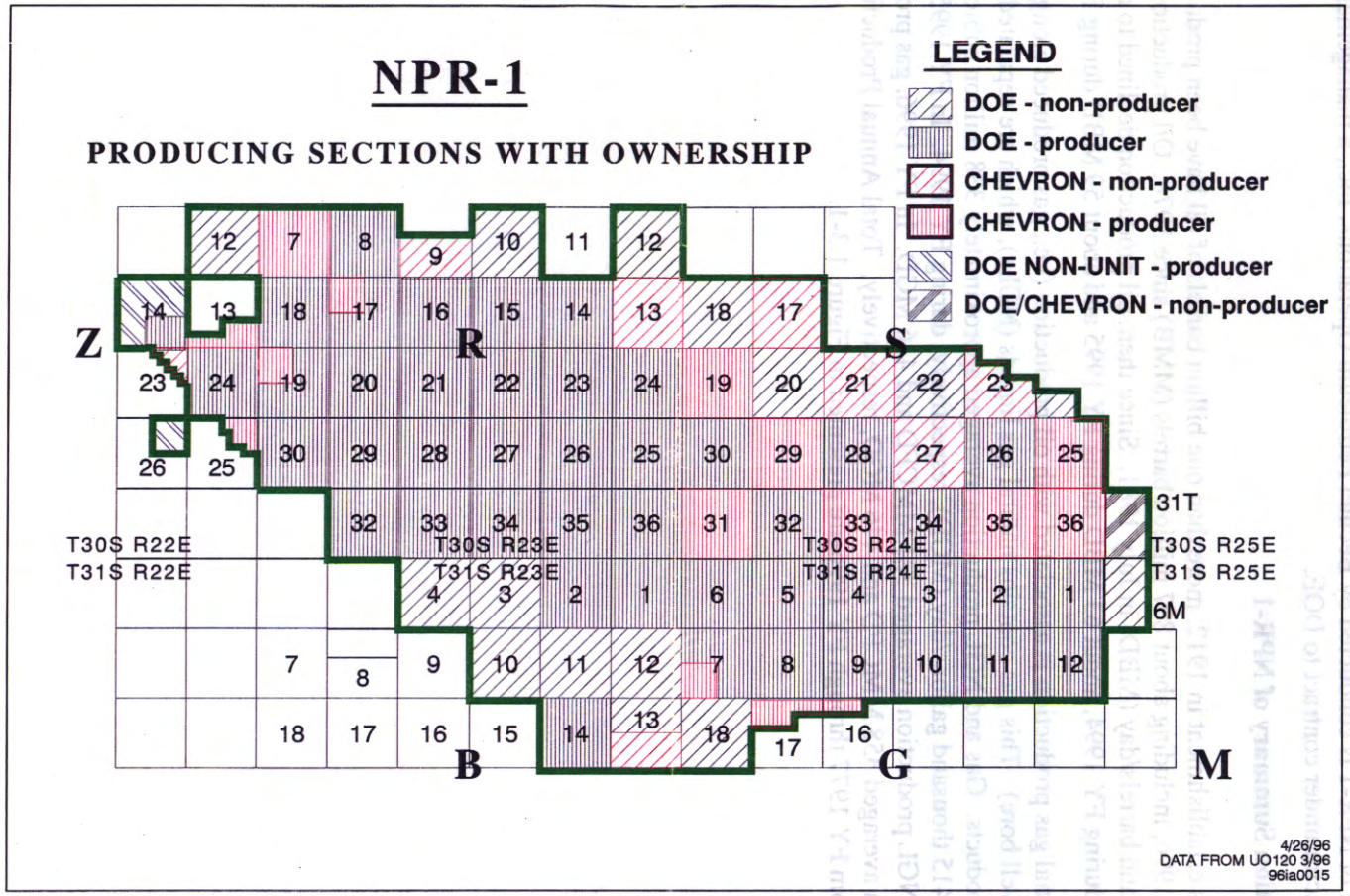


Figure 1.3-2
Map of the NPR-1 Site



Under the UPC, the time and rate of production are the exclusive right of the government. In addition, the government has the exclusive right to carry out the actual operation of the unit. However, unit production decisions usually are made by an operating committee consisting of one member representing the government and one member representing CUSA, each member having an equal vote. Some NPR-1 reservoirs that lie exclusively under government lands were excluded from the UPC. These primarily include Asphalto Zone production in Sections 14Z and the NE 1/4 of 26Z. Generally, the day-to-day operation of NPR-1 is conducted by Bechtel Petroleum Operations, Inc., a management and operating contractor under contract to DOE.

1.3.2. Production Summary of NPR-1

Since its establishment in 1912, more than one billion barrels of oil have been produced from NPR-1 through 1996, including about 807 million barrels (MMB) since 1976. Oil production peaked at about 180 thousand barrels/day (MBD) in July 1981. Since then, oil production declined to an average of about 66 MBD during FY 1994, about 63 MBD during FY 1995 and about 59 MBD during FY 1996.

Substantial gas production is associated with oil production (i.e., gas produced along with the oil from the same well bore). This gas contains natural gas liquids (NGLs), which are separated from the gas into NGL products. Gas and NGL production averaged approximately 338 million cubic feet/day (MMCFD) and 415 thousand gallons/day (MGD), respectively, during FY 1994. In FY 1995, gas production and NGL production averaged 321 MMCFD and 416 MGD. In FY 1996, gas production and NGL production averaged 358 MMCFD and 446 MGD, respectively. Total Annual Production for NPR-1 and NPR-2 from FY 1977 through FY 1996 are presented in Figure 1.3-1.

1.4. FORMATION AND DEVELOPMENT OF NPR-2

1.4.1. History and Background of NPR-2

The following discussion summarizes the history of NPR-2 as it was described in the NPR-2 1994 EA (DOE 1994).

NPR-2 is located in Kern County, California, immediately south of NPR-1 and contains portions of the town of Taft, California. Current land holdings, ownership, and leases reflect the historic development of the area. NPR-2 was established by Executive Order of the President in 1912 and is defined in 10 U.S.C. §7420. Under 10 U.S.C. §7421, the Secretary of the Navy had exclusive jurisdiction and control over lands inside NPR-2 covered by leases granted under the Mineral Leasing Act, 30 USC §181 *et seq.*, with responsibility for administering those leases.

In 1920, the Mineral Leasing Act and the Naval Appropriations Act were signed into law. These acts conveyed to private lessees the "exclusive right and privilege to drill for, mine, extract, remove, and dispose of all oil and gas deposits" located within the areas covered by the leases. The leases conveyed to the lessees the right to construct and maintain "all works, buildings, and plants; waterways; roads; telegraph or telephone lines; pipe lines, reservoirs, tanks, and pumping stations; or other structures necessary to the full employment" of the leases. Furthermore, the leases required the lessees to carry out all reasonable orders and requirements relative to waste prevention, property protection, and worker health and safety and "to abide by and conform to regulations in force at the time the lease is granted." In addition, the leases reserved to the United States the right to lease, sell, or otherwise dispose of the surface of the lands embraced by the lease as long as the surface was not needed by the lessee to extract and remove oil and gas. The leases were for a primary term of 20 years with the preferential right to renew them for successive ten-year periods.

The Naval Appropriations Act gave authority to the Secretary of the Navy to administer the lands and leases within NPR-2. This Act broadly authorized the Secretary of the Navy to conserve, develop, use, and operate all properties within the naval reserve directly or by contract, lease or otherwise. Although these powers were vested by law in the Secretary of the Navy, responsibility for administration of the lands and leases was transferred to DOI in 1921. In 1921 and 1922, DOI issued 17 leases authorizing oil and gas operations at NPR-2. Responsibility for the properties was restored to the Department of Navy in 1927.

In 1935, the U.S., through the Secretary of the Navy and the Secretary of the Interior, entered into a comprehensive agreement (U.S. Army, 1935, "Agreement") with several of the lessees at NPR-2 to provide for the cooperative development of the oil and gas resources within NPR-2. One of the purposes of the Agreement was to conserve and protect oil, gas, and other hydrocarbon resources. The lessees agreed they would develop and operate their respective operating units to prevent the U.S. lands from being disproportionately drained by the development and operation of lands not owned by the U.S. They also agreed to ensure that the area was developed and that oil and gas was produced in a manner to minimize or eliminate waste, consistent with good oil field engineering practice.

Regulations referenced in the Agreement established comprehensive requirements governing the activities of lessees at NPR-2. These regulations authorized the DOI supervisor of oil and gas activities at NPR-2 to inspect and supervise the lessees' oil and gas operations to prevent oil and gas waste; damage to formations or deposits containing oil, gas, or water; and injury to life or property. Oversight of NPR-2 was transferred to DOE with its establishment in October, 1977.

Similar to NPR-1, NPR-2 is also subject to the President's discretionary authority to extend production, in increments of up to three years each, if continued production is found to be in the national interest. Such findings have been made and production is presently authorized through April 5, 2000.

The result of the historical formation and development of NPR-2 is a checkerboard of land ownership, mineral leases and land uses, encompassing 30,181 acres (Figure 1.4-1). DOE administers the 10,446 acres of land owned by the U.S. Government. The remaining 19,735 acres, which are outside the scope of this SEIS/PEIR except for cumulative impacts analysis under CEQA, are owned by the City of Taft, private companies and private citizens. The oil and gas rights associated with 9,224 acres of the DOE-administered properties have been leased to seven oil companies under 15 active leases (DOE-leased lands). Oil and gas rights on the remaining 1,222 acres have been retained by DOE (DOE-unleased lands), and the surface rights of about 360 acres on these lands were sold in 1984 to private citizens residing in Ford City (Private Law 9832). About 16.7 acres of surface rights were retained in this residence area.

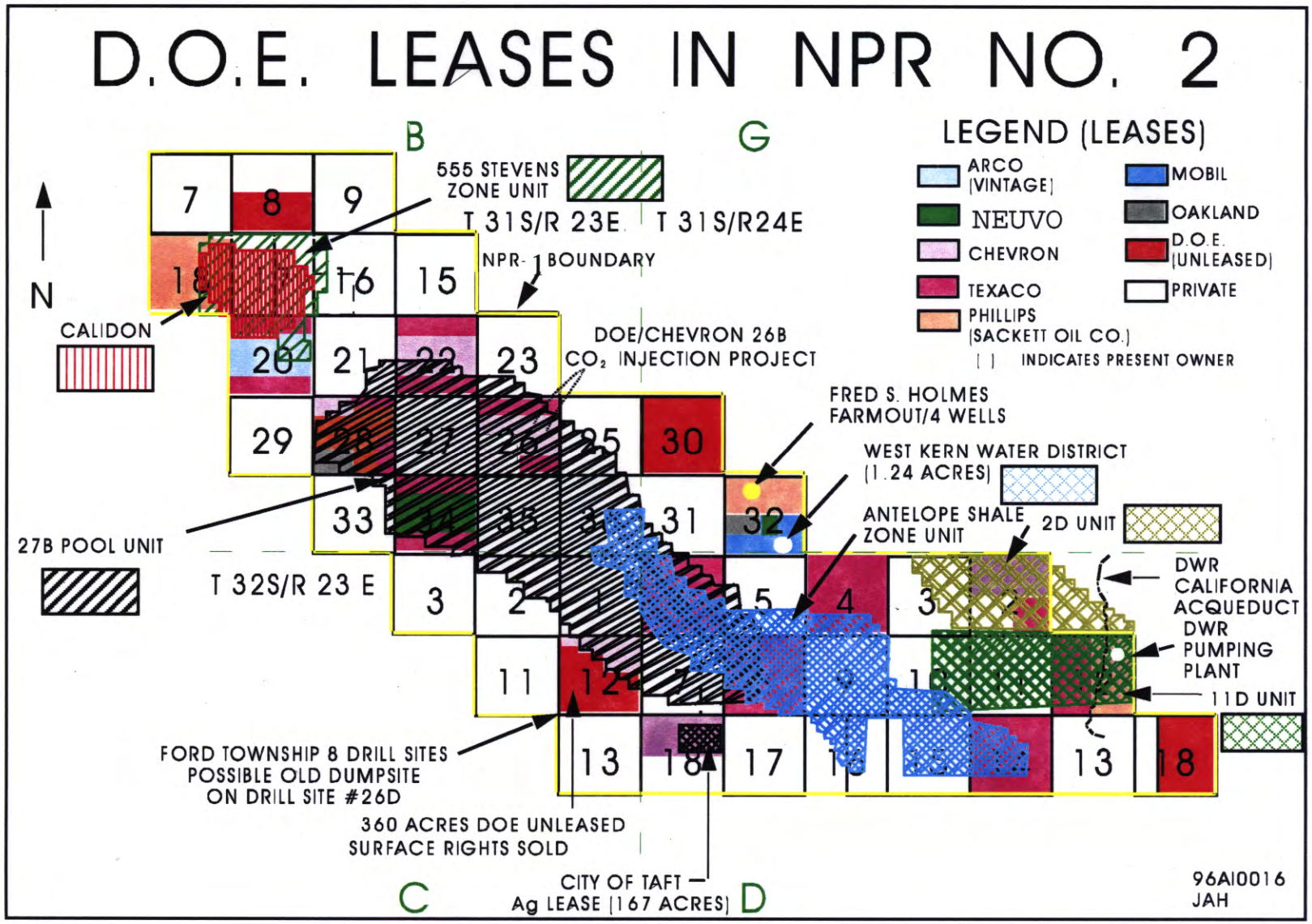
Under the terms of the leases, DOE receives royalty revenues from 4.7 percent to 14 percent of the production of the various NPR-2 units depending on the type of production and the unit from which it is produced. The NPR Annual Report lists the pool units and the royalty rates.

1.4.2. Production Summary of NPR-2

Since its establishment in 1912, approximately 651 MMB of oil were produced from NPR-2 through 1996. Oil production peaked long ago and has declined to an average of about 1.8 MBD during FY 1994, about 1.6 MBD during FY 1995 and about 1.4 MBD during FY 1996.

Gas and NGL production averaged approximately 5.4 MCFD and 9.1 MGD, respectively, during FY 1994. In FY 1995, gas production and NGL production averaged 5.3 MCFD and 5.6 MGD. In FY 1996, gas production and NGL production averaged 5.3 MCFD and 4.2 MGD, respectively. Total Annual Production for NPR-1 and NPR-2 from FY 1977 through FY 1996 are presented in Figure 1.3-1.

Figure 1.4-1
Map of the NPR-2 Site



1.5. OVERVIEW OF OIL AND GAS PRODUCTION OPERATIONS

The petroleum industry explores, develops and produces oil and natural gas resources in the United States. In 1995, there were approximately one million producing oil and gas wells in this country, with an output of 3,400 MMB of oil (in the U.S., including Alaska), 18.9 TCF of natural gas, and 700 MMB of natural gas liquids. The petroleum industry supports nearly every industrial and commercial activity in the U.S.

The work within the oil and gas industry can change markedly depending on location. Many aspects of the work must be engineered to meet the conditions where resources are discovered. The basic procedures employed to find oil and gas remain the same. New exploratory methods or past experience at nearby production fields are analyzed to determine if gas and oil might exist beneath the surface. If so, exploratory or "wildcat" wells are drilled to "prove up" the theory of hydrocarbon resources in a particular area. If commercial quantities of oil and gas are present, "development" wells will be drilled to define the field size and increase production to economic levels. Additional production procedures will be employed to maintain production as the reservoir production declines. These procedures include injecting gas to maintain field pressure and waterflooding for secondary recovery. If the field is large enough, it may be economic to construct oil and gas processing facilities on the location. Pipelines, above and below the ground level, are used to transport the oil and gas away from the production area for sale to others. For wells with lower production levels, trucks may be used to transport the oil.

All of the oil and gas exploration, production and processing activities require the use of the land surface and subsurface. Activities that generate potential impacts to the environment include:

- Disturbance of ground water supplies;
- Surface subsidence;
- Disposal of fluids and rock cuttings from drilling and remedial activities;
- Disturbance of animal and plant wild life ; and
- Air pollution.

Oil and gas operations can be divided into surface and subsurface operations. Surface operations consist of drilling the well and maintaining the surface area and equipment for the productive life of the well. Drilling activities include building an access road to the drilling site and preparing the area for the drilling rig and equipment. Most access roads are "established" by the imprint left on the ground from moving the heavy drilling equipment over the ground surface. At times an access road must be built of wood, gravel or concrete across soft surface areas to carry the heavy equipment. Preparing the drilling site consists mainly of making a level area big enough for the drilling rig and the equipment used during the drilling operations. This work could be as simple as skinning the surface of a flat area in West Texas or it could involve removing several hundred cubic yards of earth from a hillside in the Rocky Mountains. The area necessary to set up the drilling rig and equipment is approximately one acre for a small drilling rig capable of drilling less than 10,000 feet. The controlling factor is the projected well depth and the size of the equipment needed to accomplish the work. Earthen pits, large enough to hold several thousand barrels of drilling fluid (mud), may have to be dug if portable pits cannot be used. These mud pits can be shallow and cover a few feet square or reach the size of a football field and be several feet deep. The controlling factor is the depth of the well. The purpose of the pit is to hold the drilling fluid and rock cuttings from the drilling operation.

The operation of drilling a well is to bore (or drill) a continuous hole from the surface to the depth of the oil and gas reservoir. A rotating cutting tool (bit) on the end of steel (drill) pipe breaks up the rock and "cuts" the borehole to the desired depth. Drilling fluid (mud) circulates down through the hollow drill pipe and back up through the annular space between the drill pipe and the borehole wall to the surface. On the surface, the drill cuttings are removed and the "clean" mud is recirculated back to the bottom of the borehole. The purpose of the drilling mud is to wash the rock cuttings out of the borehole as the drill bit breaks up the rock into small pieces. The volume of the drilling fluid is usually two to four times the volume of the borehole and can be several hundred (or thousand) barrels. The amount of rock cuttings are measured in hundreds (or thousands) of pounds, depending on the depth of the well. The drilling fluid and rock cuttings are usually deposited in the mud pits. If the drilling fluid has been contaminated with oil it is transported to a processing plant where the oil is removed and the mud is sent to a disposal well completed in a highly porous reservoir designated for this purpose. A typical drilling operation is illustrated in Figure 1.5-1.

Subsurface operations involve "completing" the well or making the final preparation to flow oil and gas from the reservoir. This includes lining the wellbore with steel casing that protects freshwater aquifers and serves as a conduit for oil and gas to flow from the reservoir to the surface. The other primary subsurface operation is to open up or fracture the rock reservoir with explosives around the bottom of the wellbore, making it easier for the oil and gas to flow to the well. Completion operations also require the use of special fluids. Unlike drilling mud, which contains special chemicals to thicken and add weight, the consistency of completion fluids is closer to that of water, and are much more likely to become contaminated with oil. The completion fluids are usually processed to remove the oil and then taken to appropriately permitted disposal wells.

Production operations also include facilities to transport and process the oil and gas. Pipelines are laid above or below ground to carry the oil and gas to processing plants and make deliveries to sales locations on and off the production site. This infrastructure includes a pipeline gathering system in the production field and a mainline pipe to transport the production off the reserve. The gathering system can range from small diameter pipeline sections (two inches or greater) to carry production from each well to storage tanks or the mainline transport system, to larger lines (12 inches or more) that make up the mainline transport system.

Depending on the Maximum Allowable Operating Pressure (MAOP), the pipeline will be buried at various depths or be permitted to be laid along the surface of the ground. Subsurface burial requires a trench several feet deep and one and one-half to two times as wide as the diameter of the pipeline. As hydrocarbons are brought to the surface the oil, gas and water are separated and stored or piped for processing or disposal. A typical production operation is illustrated in Figure 1.5-2. Installation of compressor and pump stations are necessary to move the oil and gas along the pipelines. These facilities can be established, uncovered, in an open space the size of a one-car garage, or take up two acres under roof (for a major compressor station). The prime movers that turn the pump and compressor units are either natural gas driven engines or electric motors that contribute very little pollutants to the atmosphere. Crude oil and gas production must be processed before use as a final end product. This is done in processing plants or refineries where the crude oil and gas is "divided" into the various hydrocarbon constituents (propane, butane, ethane, etc.). Some processing can occur at the field, particularly the processing of natural gas liquids, if the field is large enough. A processing plant can be as small as the area needed to operate a single dehydration unit used to remove water from natural gas (less than an acre) to a facility as large as a major refinery that takes up several hundred acres.

Figure 1.5-1
Typical Drilling Operations

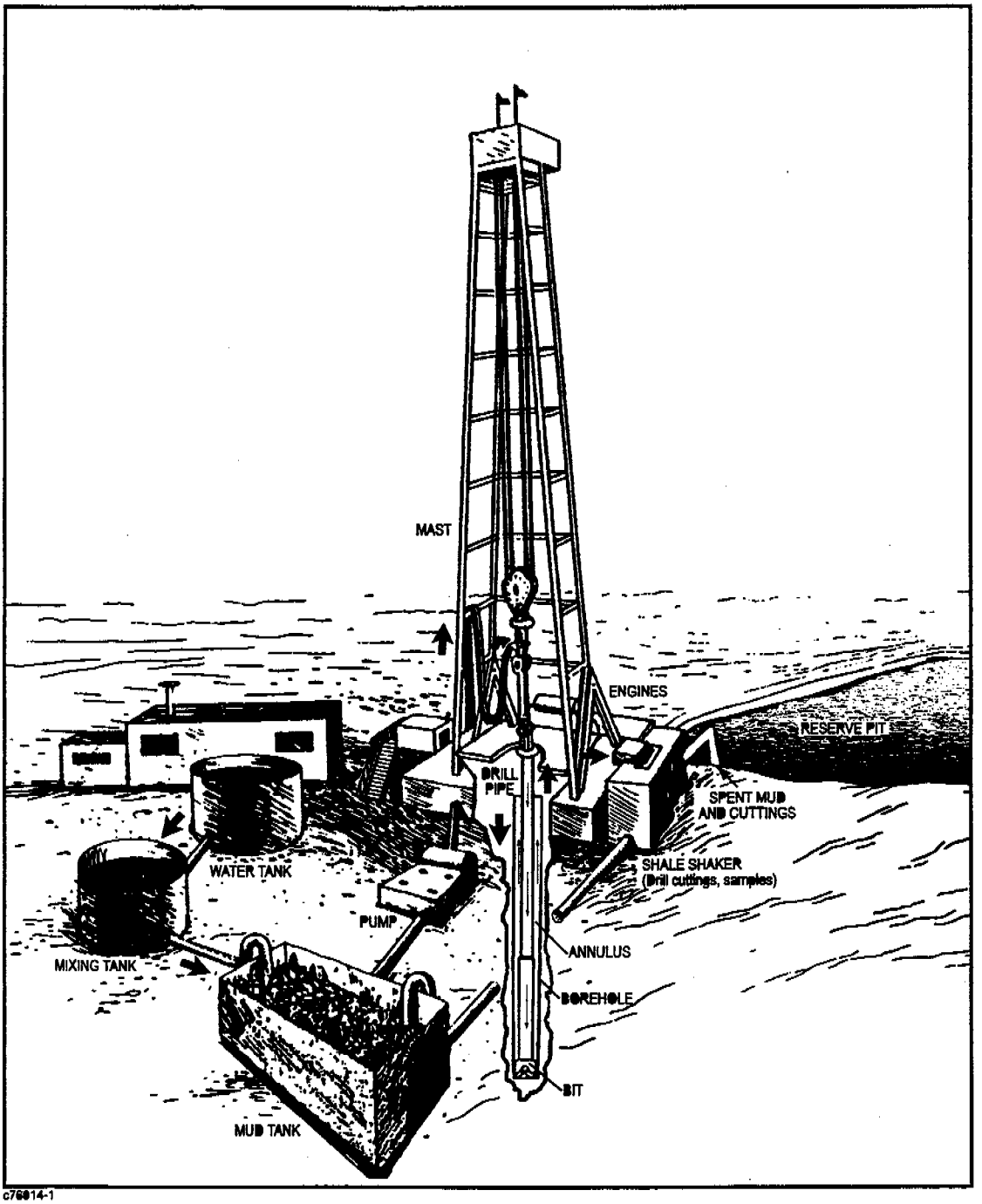
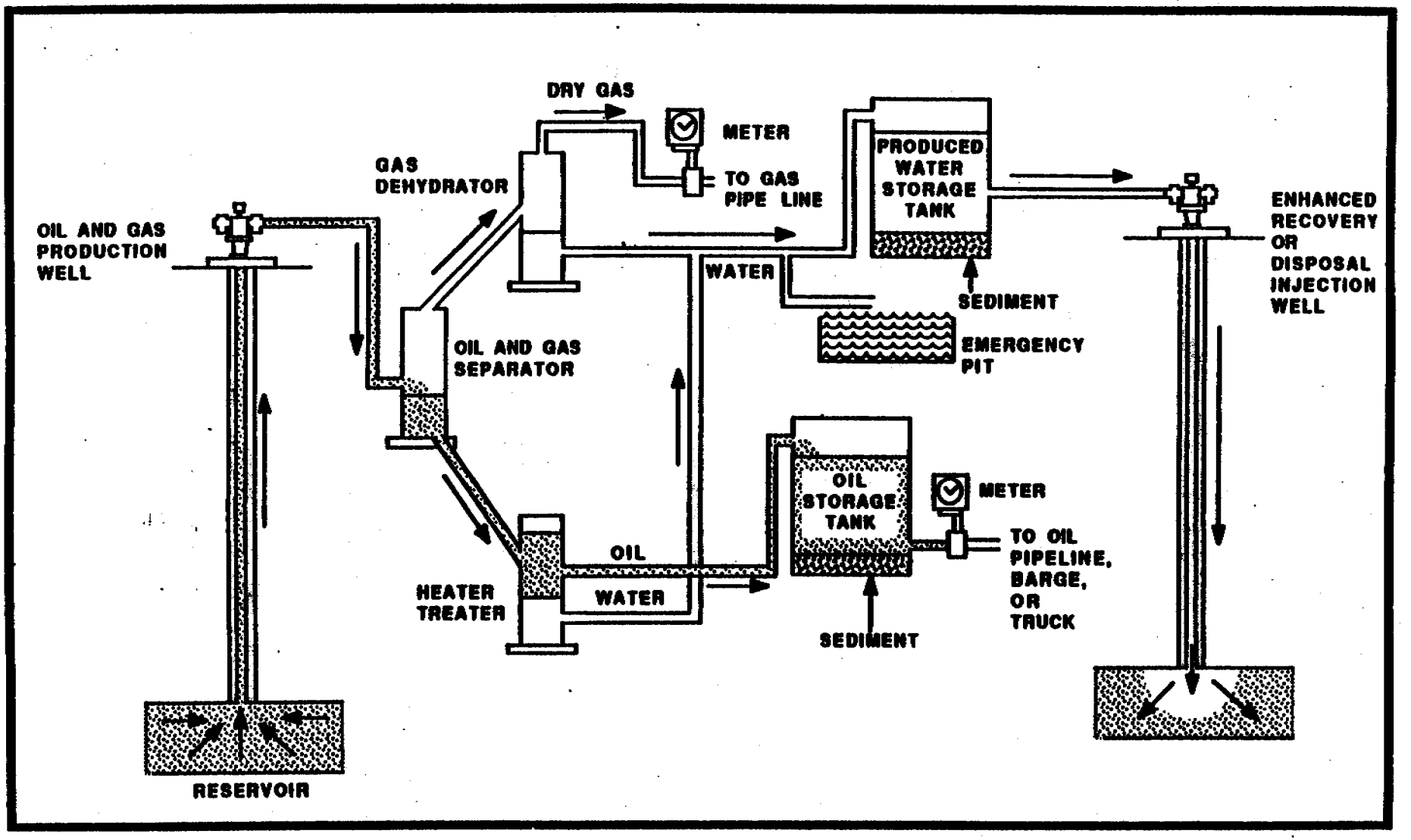


Figure 1.5-2
Typical Production Operations



During the life of an oil and gas production field, maintenance work will be performed on the various facilities on a routine basis. As the field matures it will be necessary to carry out remedial work on the wells and surface equipment to maintain an efficient operation. This may include replacing the subsurface pumps in the wells, recompleting the reservoir, and repairing pump jacks and processing equipment. Remedial work may be required to clean up a well that loses production because of contaminants in the oil, which clog up the downhole equipment. Wells may also have to be reworked to repair broken or malfunctioning downhole equipment (casing and pumps). Workover fluids are used to maintain the reservoir pressure during the workover process. Like completion fluids, these are likely to be contaminated with oil and are usually processed to remove the oil and injected into a disposal well. Surface equipment must be maintained in good working order and repaired when failures occur. Repairs and remedial work on oil and gas field equipment are similar to maintenance around any factory or commercial operation. Heavy lifting equipment and repair tools (to weld, bend and cut) are commonplace.

As oil and gas fields are depleted, wells are plugged and abandoned and the production equipment is removed and salvaged for sale or reuse. A well is plugged and abandoned by removing the downhole production equipment (pumps, packers and sometimes the casing) and plugging the well with cement across the production zones, the fresh water zones and other minerals zones (coal). The surface casing is cut off below the ground level and (sometimes) a monument is erected to mark the location of the underground casing top. If a well pad had been unstructed (of concrete, wood or metal) it is usually removed and the land surface restored to its original contour and wildlife activity.

1.6. REFERENCES

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2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. OVERVIEW

One of the major purposes of an EIS/EIR is to define and analyze reasonable alternatives to the Proposed Action, and the environmental impacts to be expected from each. DOE has identified two similar actions: a Proposed Action, the sale of all rights, title and interest in NPR-1; and a recommended action, the transfer of NPR-2 to BLM for management under their existing Federal lands authority, including the possible leasing of additional mineral rights, except for certain surface rights in Ford City, which would be sold. As described in Chapter 1, Congress has directed DOE to sell NPR-1. DOE has recommended to Congress that it enact legislation to transfer NPR-2 to DOI. DOE has selected the Proposed Action as its Preferred Alternative.

This section describes these two similar actions as well as the reasonable alternatives to those actions. In addition, it briefly compares the various environmental impacts of all the options as well as the cumulative impacts of the actions in conjunction with other oil and gas development in the area. Tables 2.1-1 and 2.1-2 provide a summary of the factors that led to the development of the analytical framework used in this section and throughout the SEIS/PEIR to determine the alternatives to be examined and the environmental impacts of greatest concern. Appendices A, B, and C describe in more detail the operations, facility and expected development of the two oil fields.

Although the two actions share similar objectives, geographic proximity, and timing, they are addressed as separate actions in this SEIS/PEIR. Even though the two actions involve roughly the same time frame, they would be implemented separately according to different timetables. Congress has already authorized the sale of all rights, title and interest in NPR-1 and established a deadline of February 10, 1998 for completion of the process. The transfer of NPR-2 to BLM is a DOE recommendation to Congress for enactment of legislation authorizing the transfer. This recommendation can only be considered a "possible" action until Congress enacts the necessary legislation. However, both actions are analyzed in this SEIS/PEIR due to the potential for cumulative impacts if both were implemented. Congress would then have the benefit of this analysis in deciding whether and which divestiture action to authorize for NPR-2.

2.1.1. NPR-1 Overview

In addition to the proposed sale of the Federal government's interests in NPR-1 in accordance with P.L. 104-106, DOE has identified two reasonable alternatives to be analyzed in the SEIS/PEIR. The two reasonable alternatives to the proposed action are: No Action (continued DOE ownership and operation of NPR-1); and withdrawal of the Department of Energy from direct petroleum production activities at NPR-1 but continued Federal ownership (requiring new legislation). While DOE can decide which alternative to implement at the end of the SEIS/PEIR process (or request new legislation, if appropriate), it cannot be certain of the type of ownership, operation, or development that would occur under the Proposed Action or alternatives. The scoping process identified a number of possible outcomes. However, it was determined that the environmental impacts of the various alternatives are driven by the manner in which NPR-1 is developed, which involves only two basic possibilities—government operation (with Chevron under the current unit agreement) or commercial operation. By predicting the impacts from either of these development cases, it is possible to reasonably predict the consequences of DOE's divestiture of NPR-1, because any divestiture strategy is likely to lead to either one of the cases, or a combination of the two. Therefore, to characterize the environmental impacts that may be associated with the alternatives, DOE has created development cases to provide the basis for the impact analysis in this SEIS/PEIR from the sale of NPR-1.

Table 2.1-1
General Assumptions Concerning NPR-1 Impact Analysis

SALE OF NPR-1
• The *primary nature* of the developmental activities at NPR-1 are not expected to change for the foreseeable future under any of the alternatives considered • NPR-1 would remain primarily a producing oil field • The environmental impacts of either the Proposed Action or alternatives are driven by how the field is developed and there are only two basic possibilities: – Development and Operation Under Government fiscal Structure – Commercial Development and Operation under Private Sector Fiscal Structure • The *affected environment* would not change under government or commercial development- - the affected environment includes: – Endangered Species – Cultural Resources – Air Quality – Water Use – Spill Hazards • The significant changes that may occur include: – the *timing and pace* of the development and its impacts (commercial development would be more rapid and more intense) – the *loss of the affirmative Federal obligation* to mitigate the environmental consequences of its actions over minimum statutory requirements, particularly in the protection of endangered species • Even a change in timing and pace of development would not cause significant impacts in many areas of environmental concern because most of the facilities necessary to support future operations already have been constructed. However, some areas could potentially be significantly impacted, such as endangered species, as shown in Section 2.4 • In addition, the way in which NPR-1 is sold (i.e. whether it is sold to only one or more than one entity) would not alter the potential for most environmental impacts, with endangered species and biodiversity being significant exceptions

Table 2.1-2
General Assumptions Concerning NPR-2 Impacts Analysis

TRANSFER OF NPR-2
• Development activities at NPR-2 over the next 15 years would not change significantly regardless of whether or not the field is transferred or sold – Most of the land (90 percent) is already leased, with development decisions already being made by private companies – The field is nearing the end of its useful life with 99 percent of the recoverable crude oil having already been produced – The surface rights recommended for sale are part of a residential area • However, if the remaining surface rights are sold as well as the minerals rights, the land could be converted to agricultural use with some limited residential development (after oil and gas production ends in 2013 or beyond), resulting in environmental impacts different from the transfer recommended by DOE

The development cases considered are:

- The Reference Case (the Proposed Action from the 1993 SEIS),
- The Government Development Case, and
- The Commercial Development Case.

The 1993 SEIS analyzed the impacts of the proposed action of continuing operation of NPR-1 based on the currently unchanged philosophy of operating the 14 reservoirs at the "Maximum Efficient Rate" (MER) as mandated by the authorizing legislation, the NPR Production Act.[1] The Reference Case projects this 1993 analysis into the future and forms a baseline against which to compare the consequences of the Proposed Action and alternatives. The Reference Case consists of a single production projection for each year through the year 2034 from the NPR's Fiscal Year 1995 Long Range Plan (LRP) plus an aggregate production projection for the remaining life of the field.

The extent to which NPR-1 would be developed under either Federal or private ownership over the next 40-plus years cannot be predicted precisely. Numerous factors would impact operations at Elk Hills, including oil and gas prices, the development of oil and gas field technology, increased understanding of the nature of the reservoirs, availability of funds for capital investment, and management operating philosophy. Just as these variables are difficult to predict, so too are future activities. Under these circumstances, development cases based on a single yearly production estimate are of limited value in estimating the differences in environmental impacts between selling and not selling NPR-1. This is particularly true when the magnitude of difference is small. Therefore, to reasonably predict the consequences of future government or commercial development of NPR-1, DOE has developed a range of future oil and gas development activities with an upper and lower bound for the Government and Commercial Development Cases. These cases provide the basis for estimating the potential environmental impacts. This analytical approach conservatively estimates the impact of all possible development outcomes up to the upper bound of the range for each of the cases.

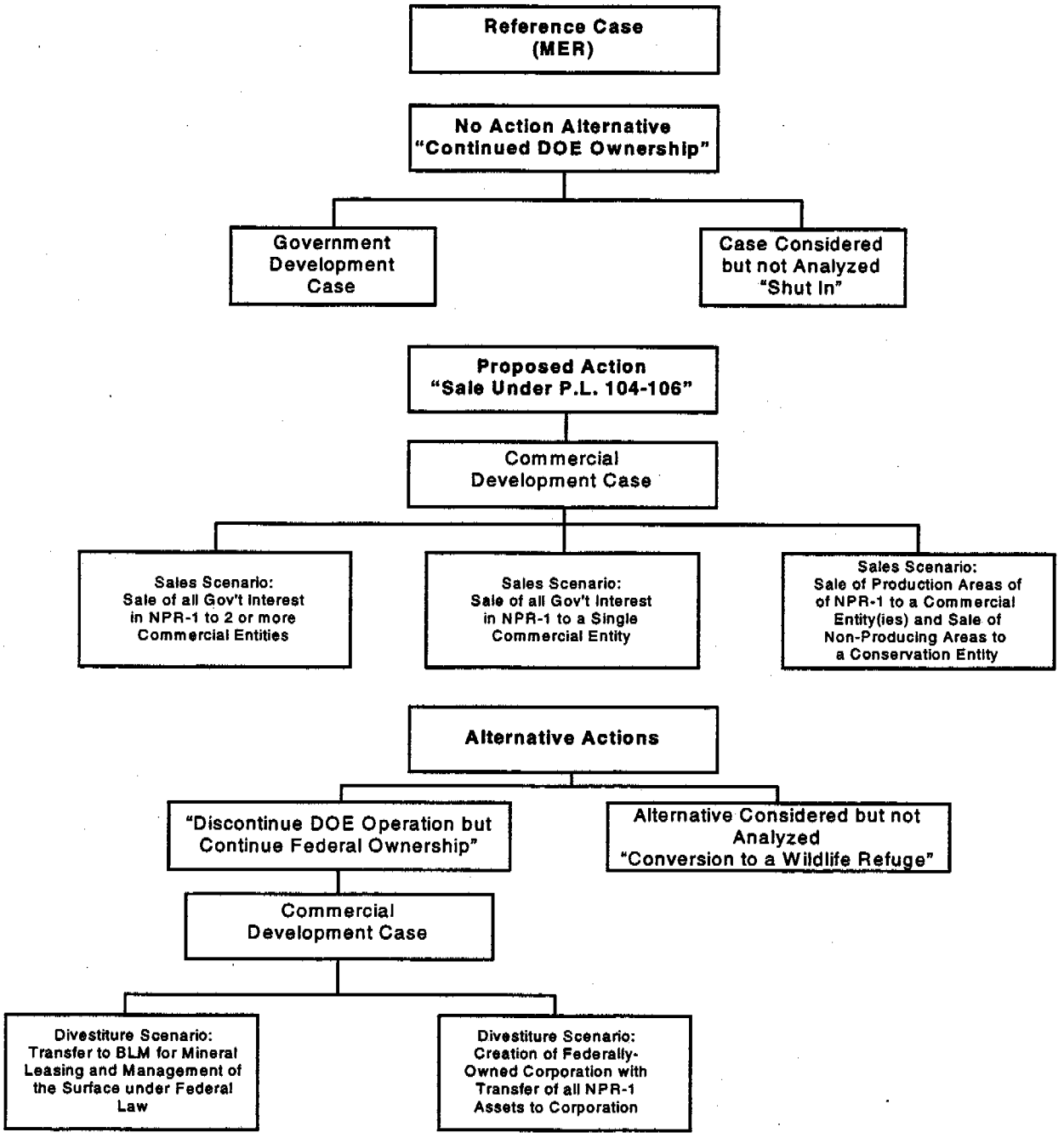
The Government Development Case would occur under the No Action alternative. The Commercial Development Case is expected to occur under both the Proposed Action and the alternative action (private development but with continued government ownership) because both actions involve commercial operation of NPR-1 (see Figure 2.1-1). However, some differences in impacts could be expected because of differences in timing and pace of development, and because continued government ownership would carry with it affirmative obligations to mitigate impacts that private ownership would not impose (see Table 2.1-1).

This section discusses similarities and differences between the Reference Case, the Government Development Case, and the Commercial Development Case. The primary differences between the three cases are driven by five main factors:

- The constraints placed upon current development by the NPR Production Act;
- The availability of funding for government development of the NPR;

[1] The no-action alternative was to continue production by operating and maintaining existing wells, but no further development. The other alternative examined was the proposed action but excluding an enhanced recovery project and two gas-related projects.

Figure 2.1-1
Matrix of NPR-1 Alternative Actions,
Development Cases and Sales Scenarios



- The cost of capital for the initial outlay by a private buyer that would cause the buyer to accelerate development in order to minimize the recoupment period for the investment;
- The future price of oil which would affect the decision to invest in more development and enhanced recovery techniques; and
- An assumption that in responding to competitive market pressures, a private company would be able to more cost effectively apply enhanced recovery techniques that require a substantial capital investment.

These differences in assumptions result in the differences in future production estimates for the three cases. Depending on assumptions made, government and commercial development could be very similar. Figure 2.1-2 illustrates actual past NPR-1 total hydrocarbon production by year and the projected annual production for the three cases (in thousand barrels of oil equivalents). The figure shows that the upper bound of the Government Development Case and the lower bound of the Commercial case overlap. The Reference Case also falls within the bounds of the Government Development Case. This section explains how the cases were developed taking these assumptions into account. The development of the cases is explained more fully in Appendix B. In addition, this section includes a discussion of a number of possible divestiture "scenarios" identified in the scoping process that could lead to the "commercial development case" under either the Proposed Action or the Alternative to the Proposed Action. The impact analysis presented in Chapter 4 and the summary of impacts in Section 2.5 show the limited variations in impacts which could occur among the various scenarios for the Proposed Action or the Alternative to the Proposed Action.

The Proposed Action for Kern County that triggers CEQA involves processing an amendment to the Kern County General Plan. Approval by DOGGR of future well activities by a private owner might also trigger the application of CEQA.

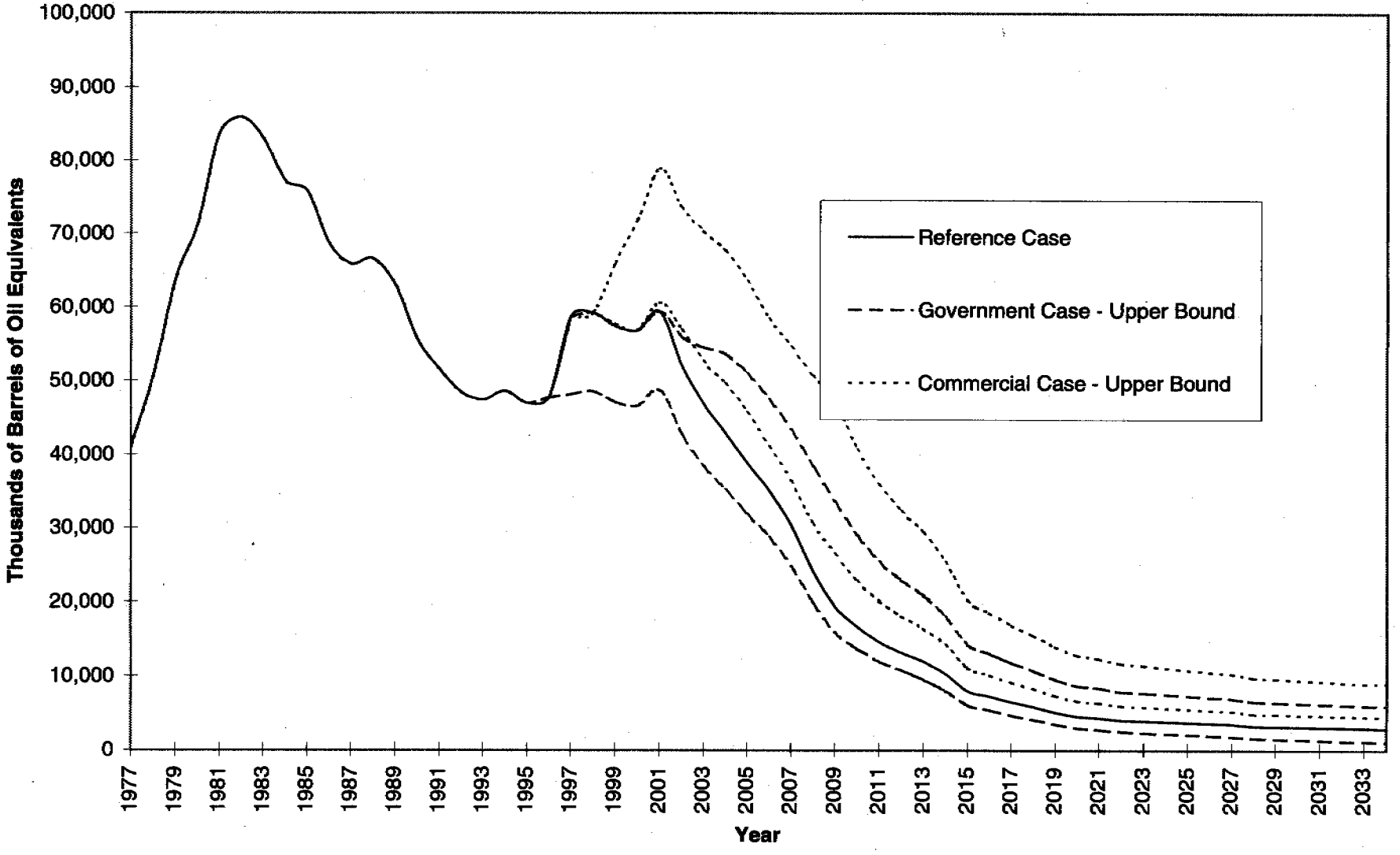
2.1.2. NPR-2 Overview

Section 3416 of P.L. 104-106 required that DOE conduct a study of options for maximizing the value of naval petroleum reserves other than NPR-1 and report to Congress. The law provided that the study include four possible options for maximizing the value of the reserves. DOE identified a fifth option for maximizing the value of NPR-2—the sale of the remaining mineral rights at NPR-2, subject to the existing leases, with transfer of the remainder of the government's interest to the BLM for management under the Federal Land Policy and Management Act (43 U.S.C. §1701 *et seq.*). From these five options, in addition to the Recommended Action, DOE has identified two alternatives to be analyzed in the SEIS/PEIR.

These are: No Action (continued DOE ownership and operation of NPR-2); and the sale of all government interest in NPR-2 subject to the existing leases. Each of the alternatives represents an option that Congress may choose to authorize. Figure 2.1-3 graphically displays the action and alternatives.

In addition to the differences in schedules and manner of sale for NPR-1 and NPR-2, there are three important differences that affect the analysis of the environmental consequences of two actions. First, unlike NPR-1, DOE has no day-to-day operational control over the production of oil and gas at NPR-2. Most of the mineral rights have been leased to seven private companies, which have responsibility for operating the reserve subject to DOGGR approval of well related activities. DOE does retain control of surface rights, subject to the needs of the companies developing the oil field. DOE also retains a royalty interest of approximately 14 percent or less depending on the reservoir.

Figure 2.1-2
NPR-1 Historical Production And Case Projections

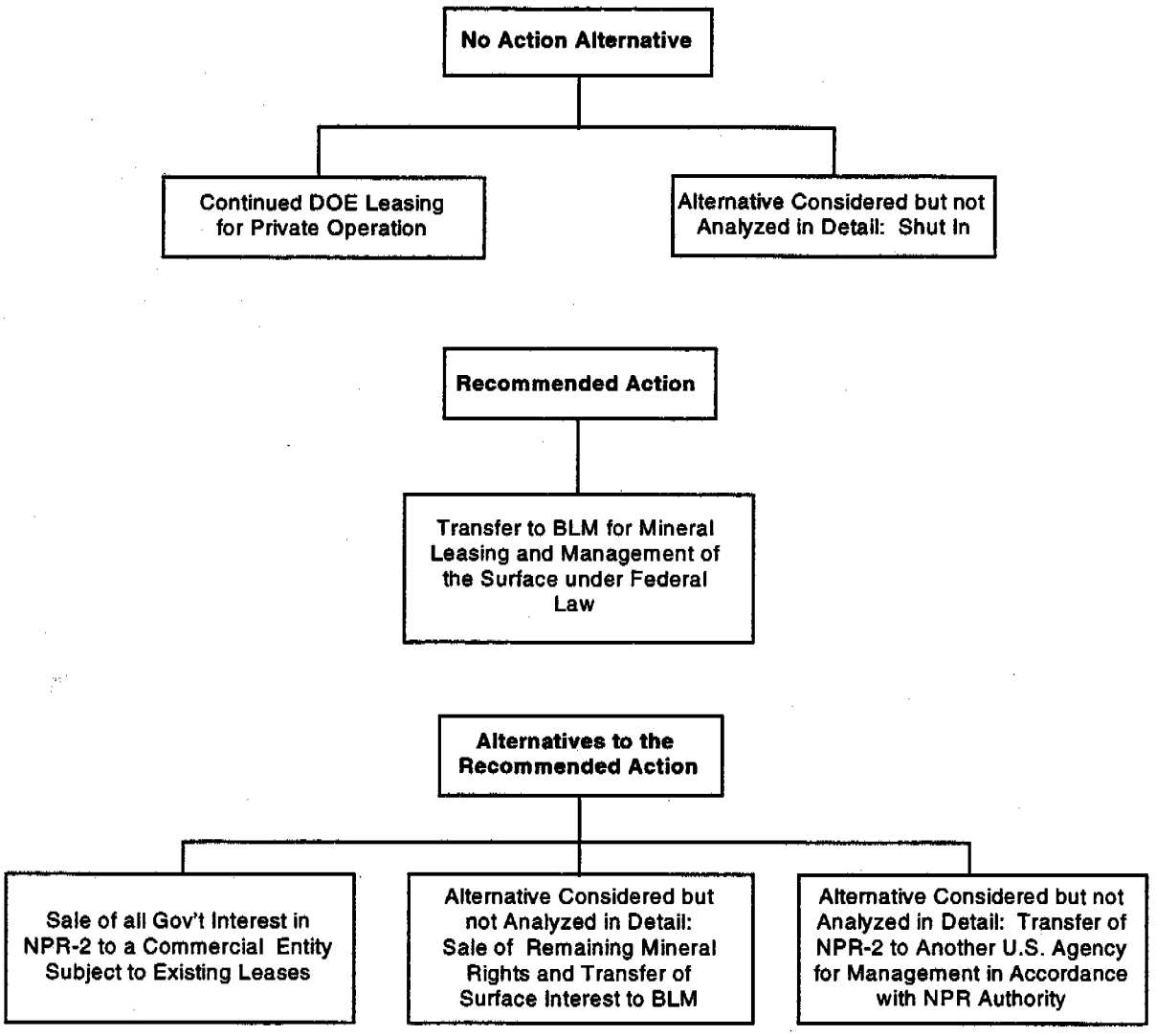


Second, NPR-2 is near the end of its useful life as an oil field, with only about 1 percent of its recoverable oil and gas remaining. Third, unlike NPR-1, where DOE owns approximately 78 percent of the acreage, the agency only controls 35 percent of NPR-2 acreage, the remainder of which is under private control. Since DOE can only sell its remaining royalty interest, this represents less than 5 percent of NPR-2 production.

Because development of NPR-2 is already in the control of private industry, there would be no significant change in the operation of the reserve under any of the alternatives. Therefore, separate development cases have not been prepared for the Recommended Action and alternatives. Further, because of the current leased status of the government's mineral interest, alternative sales scenarios are not practical under the Recommended Action and alternatives and would not result in any meaningful changes in environmental impact for those scenarios.

Transfer of NPR-2 to BLM would not require an amendment to Kern County's General Plan and would not trigger CEQA. However, the sale of the surface rights in Ford City and the alternative of sale of all of the Federal government's remaining interest in NPR-2 would trigger CEQA. As the sale of these lots or NPR-2 has not yet been authorized by Congress, the possible action is not yet sufficiently advanced to trigger the application of CEQA. This conclusion is consistent with the preparation of a program EIR under CEQA, which contemplates additional analysis as a program proceeds and actions are identified. When an action is proposed that is sufficiently defined to permit analysis under CEQA, additional appropriate CEQA analysis, documentation and decision-making will occur.

Figure 2.1-3
Matrix of NPR-2 Alternative Actions



2.2. NPR-1 PROPOSED ACTION AND ALTERNATIVES

The Proposed Action is the sale of the Federal government's interests in NPR-1 in accordance with the National Defense Authorization Act for Fiscal Year 1996 (P.L. 104-106). Title 34 of the Act establishes a procedure and schedule for the sale of NPR-1. Under the procedures established by the Act, DOE hired a number of industry experts to assist in the sale:

- An investment banker to prepare a draft contract of sale and independently administer, consistent with commercial practices, the sale of NPR-1;
- An independent petroleum engineer to assist in making a final determination of equity in NPR-1 between DOE and CUSA;
- An independent petroleum engineer to prepare a reserves report (estimating the remaining recoverable oil and gas) consistent with commercial practices; and
- Five independent experts in the field of valuation of oil and gas fields to assist in the determination of the minimum acceptable price for NPR-1.

DOE has devised a sales strategy, consistent with the act, that seeks expressions of interest in buying all or part of NPR-1 from private industry; selects qualified buyers; provides those buyers access to the technical, geological and financial information necessary to prepare the bids; and solicits bids. The investment banker then negotiates with the highest bidders and obtain final bids. DOE, in consultation with the Office of Management and Budget (OMB), must determine the net present value of the anticipated revenue stream if NPR-1 were not sold, adjusted for anticipated tax revenues if NPR-1 were sold. This information is to be provided to the five independent appraisers who are tasked with preparing their assessments of the value of NPR-1. After receiving the assessments, DOE and OMB would determine the minimum acceptable price for sale of NPR-1. If bids totaling that amount are not received, the sales process would be terminated. If the bid(s) exceed that amount, DOE forwards to Congress a written notice of the conditions of the sale and an assessment of whether it is in the best interest of the U.S. to proceed. After 31 days, DOE may enter into a contract to sell NPR-1. The Act provides that the contracts for sale are to be executed no later than February 10, 1998, two years after the date of enactment of the Act. However, the Act also provides that the sale may be suspended if DOE and OMB determine that a course of action other than immediate sale is in the best interest of the U.S.

The Proposed Action for Kern County that triggers CEQA involves processing an amendment to the Kern County General Plan Use, Open Space and Conservation Element from a "State or Federal Land" designation to a "Mineral or Petroleum" designation for NPR-1. The Mineral and Petroleum designation is intended for areas that contain producing or potentially productive oil and gas production areas. Permitted uses are those activities associated with resource extraction. The existing zoning for property within NPR-1 is either Limited Agricultural or Exclusive Agriculture, both subject to Chapter 19.98 (Oil and Gas Production) of the Kern County Zoning Ordinance specifying performance standards for oil and gas production.

Future state action to be taken under this programmatic EIR consists of ongoing permitting and approval of well activity on NPR-1 by DOGGR. The well activities are regulated by DOGGR under authority of the California Public Resources Code and Chapter 4 of Title 14 of the California Code of Regulations. The new private owner of NPR-1 (as well as any NPR-2 lessees) would be required to comply fully with all of these requirements. These requirements include environmental compliance, financial responsibility, well activity approval, well closure approval, and proper conservation activities of the natural resource.

Under the California Public Resources Code when an operator wishes to drill, redrill, deepen, or alter the casing of a well, the operator must file a bond with DOGGR. An individual well or blanket operator bond can be filled. Individual bonds range from $10,000 (for wells shallower than 5,000 feet) to $50,000 (for commercial Class II injection wells). Blanket bonds are $100,000 for onshore wells and $250,000 for offshore wells. Bonds can be terminated or canceled when the wells have produced or used for injection for a continuous six-month period, the wells have been properly plugged and abandoned, or another bond has been substituted.

Written approval by DOGGR is needed before commencing drilling, reworking, or injection, operations on any well. Approval can be denied if an operator is in noncompliance. Variances can be granted if an operator can demonstrate the necessity for the variance and safety and damage prevention are not otherwise compromised. Onsite temporary pits associated with the well activity may also be addressed in the permitting of the well activity. There are technical standards which must be met for the permitted activities including well spacing requirements, oil spill contingency plan requirements, well casing requirements, blowout prevention requirements, drilling fluid disposal requirements, produced water disposal requirements, and maintenance requirements. In addition each operator is required to maintain accurate records of all permitted well activities.

When an operator wishes to abandon a well, DOGGR must be provided with pertinent information and give written permission. The information provided has to include a closure plan. A well is deemed properly plugged and abandoned when DOGGR has been provided evidence that any oil and gas bearing geologic zones and underground sources of drinking water have been sealed, surface waters have been protected and all regulatory requirements have been met. DOGGR can order the reabandonment of a previously abandoned well when the future construction of any structure over or near the well could result in a hazard. DOGGR can also, upon a request of a city or county, after an opportunity for the operator to comment, order an idle well with no future utility to be plugged and abandoned. DOGGR maintains a Hazardous and Idle-Deserted Well Abandonment Program for the plugging of wells where the responsible party cannot be located.

The future commercial operation of NPR-1 is expected to involve from 7,400 to 7,900 separate approvals from DOGGR (a single new well might involve an initial permit, 2 to 3 reworkings and the final abandonment). This permitting activity would involved ongoing DOGGR oversight of the commercialized NPR-1 over the remaining life of the project. DOGGR would be responsible for assuring that the permitting of activities on a commercially operated NPR-1 is consistent with CEQA's requirements. This would include assuring the implementation by the new operator with any mitigating measures included in this SEIS/PEIR. The DOGGR's discretionary Permit to Conduct Well Operations could include conditions used for environmental mitigation required in the NEPA/CEQA process. In carrying out its authorities, DOGGR is advised by the Conservation Committee of California Oil and Gas Producers (CCCOGP), a unique, industry supported, tax exempt organization that was created in 1929 and that pursuant to state statute has administered a voluntary hydrocarbon resource conservation program for DOGGR since 1995. The organization works through a technically qualified, industry-appointed Engineering Board supplemented by a small staff. Its charter is to monitor operations, calculate maximum efficient recovery (MER) rates, and assemble and evaluate production and reservoir data from onshore, state tidelands, and Outer Continental Shelf (OCS) areas.

The two alternatives to the Proposed Action are No Action (continued DOE ownership and operation of NPR-1), and withdrawal of the Department of Energy from direct petroleum production activities at NPR-1 but continued Federal ownership (requiring new legislation). The following discussion lays out the Proposed Action and alternatives in more detail. The Reference Case is discussed first in order to explain the baseline of current activities against which the results of the Proposed Action and the alternatives should be measured.

2.2.1. The Reference Case

Past activities at NPR-1 and continued future production under current plans forms the Reference Case against which the environmental impacts of the Proposed Action and alternatives are measured. The 1993 SEIS analyzed the impacts of the continued operation of NPR-1 in compliance with the requirement of the Naval Petroleum Reserves Production Act to produce NPR-1 at the "maximum efficient rate" (MER). This discussion is summarized from that SEIS, updated for events that occurred since then. Continued development of NPR-1 at the MER was the basis for the Proposed Action in that SEIS. That Proposed Action, updated for events and changes in planning that have occurred since the 1993 SEIS, now forms the basis for the Reference Case. The Reference Case consists of two major elements: 1) oil and gas exploration, development and production; and 2) facilities and related operations.

To understand oil and gas development and production, it should be noted that most oil and gas wells do not flow freely but require an artificial system to force (technically described as "lift") the oil and gas to the surface.[2] The method of artificial lifting is dependent on several variables, including: the depth of well, the characteristics of the sand, the gas-to-oil ratio, the viscosity of the oil, and cost provisions.[3] Lifting methods and machinery are categorized as either surface or subsurface lifts. Examples of lifting methods include: free flow, standard beam rig, hydraulic pumping, submersible electric pumping, and gas lift. These methods constitute primary recovery (the initial production of oil and gas from a well or field). During the primary recovery phase of operation, approximately 25 percent of the oil and gas can be recovered.[4] Recovery of oil and gas depends on the ability of petroleum fluids to flow through the geologic formation to the well. This flow is dependent on the porosity (the relative volume of the pore spaces between mineral grains as compared to the total rock volume) and permeability (a measure of the resistance offered by rock to the movement of fluids through it) of the formation. The recovery of oil and gas is most efficient when a steady rate of flow (depletion) is maintained. Gas reinjection is frequently used to maintain initial production rates in which gas produced is reinjected into the formation to increase reservoir pressure and lift hydrocarbons. At NPR-1, a majority of the gas produced is used for reservoir pressure maintenance and gas lift.

When primary recovery methods have been exhausted, enhanced recovery techniques are used to replace or enhance the natural reservoir drive with an artificial or induced drive. Several methods of enhanced recovery are used. For the waterflooding technique, a well or series of wells is drilled on the perimeter of the reservoir and water is injected under pressure. Hydrocarbons remaining in the formation are forced out by the "sweep" of the water moving through the formation. Steamflood is similar to waterflood except it is used where waterflood techniques are unsuccessful.

The principal exploration, development and production elements of the Reference Case include: (1) the continuation of current oil and natural gas production at NPR-1, (2) implementation of additional activities to enhance recovery and efficiency, such as infill drilling, well remediation, artificial lift, gas-lift, gas injection and water injection; and (3) various other development projects required to maintain MER.

The concept of MER is the underlying principle for the current oil and gas exploration, development and production plans at NPR-1. The Naval Petroleum Reserves Production Act of 1976 defines MER as "the maximum sustainable daily oil and gas rate from a reservoir which will permit

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[2] "Modern Petroleum, A Basic Primer of the Industry." Bill D. Berger and Kenneth Anderson. The Petroleum Publishing Company. Tulsa, OK. 1978.

[3] Ibid.

[4] Ibid.

economic development and depletion of that reservoir without detriment to the ultimate recovery" (emphasis added).[5] DOE has interpreted this to mean that MER reservoir determinations are to be made and updated on a regular basis taking into account the "unique characteristics of each reservoir," and "sound engineering practices designed to maximize both economic return and ultimate recovery" (DOE 1985b). In other words, MER is dependent on an evolving understanding of reservoir characteristics, sound engineering practices as these change with technological advancements, the economic return of competing development strategies as economic conditions fluctuate over time, and the impact of competing strategies on ultimate recovery.

These characterizations result in MER determinations that are in a constant state of change, and this has broad implications in planning future activities and establishing the Proposed Action, which is the subject of this document. From these determinations of MER, the NPR staff prepare long-range and annual plans for the exploration, development and production of oil and gas at NPR-1. The 1995 Long Range Plan and the 1997 Annual Operating Plan establish projections for exploration and development, which form the estimated future projections of the Reference Case.[6] These plans also provide the basis for analyzing the other development cases.

To understand how the various estimates for oil and gas development and production were developed for each of the cases requires some background on how oil and gas reserves are classified. The basic categories used by industry and the 1995 LRP includes the following:

- **Proved Developed Reserves** - development and production of petroleum with greater than 90 percent probability; the location of the petroleum is well defined and is being produced.
- **Proved Undeveloped Reserves** - reserves with a 90 percent or more probability of production that require capital for development.
- **Risked Unproved Probable Reserves** - no well tests to define the extent of the oil reserve, but seismic testing, geologic testing, and comparisons to similar oil fields indicate the probability of oil with a risk factor of 50 percent.
- **Unrisked Unproved Probable Reserves** - unproved probable reserves; a risk factor has not been assigned.
- **Unproved Possible Reserves** - no well tests to define the extent of the reserves but seismic tests indicate strong similarity to producing fields; reserves considered to have 10 percent or less certainty level; no production, revenue, expense or capital stream have been developed.

The 1995 LRP addresses each of these categories of reserves at NPR-1. The development and production of the first three categories make up the Reference Case through the year 2034; development of the possible reserves (reduced by a risk factor) are assumed to occur after that date consistent with the LRP. The analysis of that case and the unproved possible reserves forms the basis for future exploration, development and production projections of the Government Development Case and the Commercial Development Case.

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[5] It is expected that the CCCOGP would reach a similar conclusion.

[6] The LRP describes four development scenarios: a "Proved Developed Case," a "Proved Case," a "Proved + Probable Case" and an "Expected Development Case." The "Expected Development Case," also called the "Total Development Case," assumes the implementation of all ordinary oil-field hydrocarbon recovery techniques as needed to enhance recovery and operational efficiency in accordance with MER requirements. This case corresponds to the Proposed Action in the 1993 SEIS (called the "Full Development Case" in the 1993 SEIS and the FY 1988-1995 Long Range Plan on which the SEIS was based), updated for the actual development which has occurred since that date and any changes in reservoir development plans.

Table 2.2-1 shows the total projected oil, gas, natural gas liquids and water production for the Reference Case (as well as the Government Development Case and Commercial Development Case) through the year 2034 and for the life of the field. Figure 2.1-2 graphically illustrates yearly production in barrel of oil equivalents through the year 2034 compared to the estimated range under the Government Development Case. Table 2.2-2 shows the projected new well drilling for all of the cases, and Table 2.2-3 the projected well remedial work. All of these figures are important to the quantitative analysis of the environmental impacts of the Proposed Action and alternatives. Yearly estimates and further discussion of exploration, development and production activities for all of the cases as well as how these number were calculated can be found in Appendix B.

The Reference Case projections fall within the lower and upper bound of the Government Development Case projections; this is illustrated by Figure 2.1-2. Availability of funding is the most important factor in determining the level of future government development. Without funding to pursue exploration and enhanced oil recovery opportunities, future government development of NPR-1 is likely to fall below the Reference Case projections.

The facilities and support operations at NPR-1 form the second major element of the Reference Case. Key facilities include:

- Active, shut in or abandoned wells (a typical NPR-1 well pad is shown in Figure 2.2-1);
- Collection, injection and distribution systems for oil, gas, natural gas liquids and water (potable, fire, waste and waterflood source waters);
- Gas processing facilities;
- Storage tanks process equipment and loading facilities;
- Gas-injection compression plants;
- Gas-lift compressor plants;
- A cogeneration plant and electric power distribution systems;
- Wastewater collection, storage, treatment and injection facilities;
- Environmental protection and mitigation facilities and projects;
- Myriad support facilities and infrastructure, including office buildings, communication systems, roads, and vehicle fleets; and
- Third party activities necessary to operate pipelines, power lines and substations as well as unrelated third party activities such as seismic testing programs.

These facilities and operations are described more fully in Appendix A and are part of the Reference Case. As these facilities were developed to support previous NPR-1 activities, which peaked in the early 1980's and are not projected to return to that level under any of the cases (except where noted), these facilities and operations would remain the same under either the Government Development Case or the Commercial Development Case.

Table 2.2-1
NPR-1 Summary of Production Projections for All Development Cases

	Total 1997-2034[a]	2035 - ?	Total 1997 - ?
Reference Case			
Oil (MMB)	352	104	455
Gas (BCF)	1,869	96	1,965
NGL (MMGal)	2,928	177	3,105
Water (MMB)	885	303	1,188
Total Hydrocarbon Production (MMBOE)	733	124	856
Government Case - Lower Bound[b]			
Oil (MMB)	274	0	274
Gas (BCF)	1,515	0	1,515
NGL (MMGal)	2,332	0	2,332
Water (MMB)	684	0	684
Total Hydrocarbon Production (MMBOE)	582	0	582
Government Case - Upper Bound			
Oil (MMB)	530	119	649
Gas (BCF)	2,055	94	2,149
NGL (MMGal)	3,295	151	3,447
Water (MMB)	1,250	281	1,531
Total Hydrocarbon Production (MMBOE)	950	139	1,089
Commercial Case - Lower Bound			
Oil (MMB)	448	60	507
Gas (BCF)	1,966	47	2,013
NGL (MMGal)	3,118	75	3,193
Water (MMB)	1,182	158	1,339
Total Hydrocarbon Production (MMBOE)	849	69	918
Commercial Case - Upper Bound			
Oil (MMB)	753	179	932
Gas (BCF)	2,269	141	2,410
NGL (MMGal)	4,116	257	4,372
Water (MMB)	1,093	716	2,809
Total Hydrocarbon Production (MMBOE)	1,225	208	1,433

[a] Yearly production estimates through the year 2034 can be found in Appendix D.
[b] The lower bound assumes insufficient investment to recover any oil or gas beyond 2034.

Table 2.2-2
NPR-1 New Well Drilling and Affected Acreage[1] for All Development Cases

CASE	Wells	Affected Acreage
Reference	446	981
Government - Lower Bound	252	554
Commercial - Lower Bound	452	994
Government - Upper Bound	490	1078
Commercial - Upper Bound	628	1382

[1] Assumes 1.0 acres of "permanent" (long-term) disturbance for the well pad, .2 acres for access and 1.0 acres of temporary disturbance.

Table 2.2-3
NPR-1 Well Remedial Activities and Affected Acreage[1] for All Development Cases

	Stimulations:		Recompletions and Conversions:		Artificial Lift Installations:		Total Remedial Activities:	
CASE	No.	Acreage	No.	Acreage	No.	Acreage	No.	Acreage
Reference	3,	3, 237	1,441	1,441	75	75	4,753	4,753
Gov.-Lower Bound	237	1,509	859	859	66	66	2,434	2,434
Com.-Lower Bound	1,509	3,254	1,471	1,471	85	85	4,810	4,810
Gov.-Upper Bound	3,254	3,332	1,471	1,471	137	137	4,940	4,940
Com.-Upper Bound	3,332 3,401	3,401	1,516	1,516	196	196	5,113	5,113

[1] Assumes 1 acre of temporary disturbance per remedial activity.

2.2.2. NPR-1 No Action Alternative

2.2.2.1. NPR-1 No Action Alternative: Continued DOE Ownership and Operation

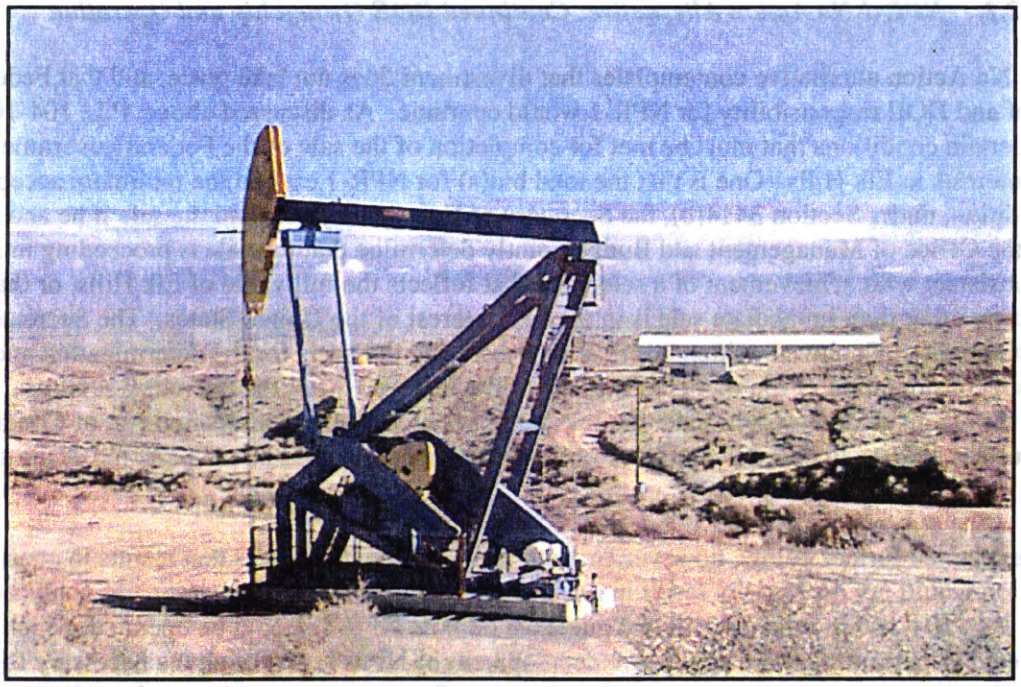
The No Action alternative contemplates that divestment does not take place, and that Federal ownership of and DOE responsibility for NPR-1 would continue. As discussed above, P.L. 104-106 establishes certain conditions that must be met for completion of the sale of the Federal government's ownership interests in Elk Hills. One is that the total bid(s) for NPR-1 exceed the minimum acceptable price. In addition, under Section 3414(b), the Secretary of Energy may suspend the sale if he and the Director of the Office of Management and Budget jointly determine that the sale is proceeding in a manner inconsistent with achievement of a sale price that reflects the full value of Elk Hills, or that a course of action other than immediate sale is in the best interest of the United States. The Secretary of Energy must submit to Congress written notification describing the basis for the determination and requesting a reconsideration of the merits of the sale of the reserve. After the Secretary submits notification for reconsideration of the sale, the sale cannot proceed, unless a separate Act of Congress authorizes further action. In either event, the No Action alternative would be the outcome of the sales process.

As explained further below, however, an outcome of the sales process that results in continued DOE operation would not necessarily result in a return to the previous development plans analyzed in the 1993 SEIS. P.L. 104-106 provided additional guidance on how NPR-1 should be operated, which as been interpreted as permitting more aggressive development of NPR-1, assuming the necessary funding is obtained. For this reason, the Government Development Case was prepared to analyze the range of possible future production levels from continued DOE operation of NPR-1.

2.2.2.2. Government Development Case

As discussed earlier, numerous factors impact the amount of production at NPR-1, including oil and gas prices, development of oil and gas field technology, increased understanding of the nature of the reservoirs, availability of funds for capital investment, and management operating philosophy. Just as these variables are difficult to predict, so too are future activities. To reasonably predict the consequences of future government development, DOE analyzed a range of outcomes for each case. However, these ranges were developed to conservatively estimate the environmental impacts of the alternatives and should be viewed as estimating all possible development outcomes up to the upper bound of the ranges for each case.

Figure 2.2-1
Typical NPR-1 Well Pad with Pump Jack



The **lower bound** of the Government Development Case was calculated from the Reference Case adjusted for actual 1995 and 1996 production, which has been lower than the 1995 LRP Plan projections. Estimated production by product type and total barrel of oil equivalent, through 2034 and for the remainder of the field's productive life, are shown in Table 2.2-1.

The **upper bound** of the Government Development Case is significantly above the Reference Case. This is due to DOE's interpretation of P.L. 104-106 as removing certain constraining factors in the MER philosophy established by the Naval Petroleum Reserves Production Act. Section 3412(h) of P.L. 104-106 requires that, until the sale of Elk Hills is completed, DOE "continue to produce the reserve at the maximum daily oil or gas rate from a reservoir, which will permit maximum economic development of the reservoir consistent with sound oil field engineering practices in accordance with section 3 of the unit plan contract." The unit plan contract is the agreement between DOE and CUSA under which NPR-1 is operated.

DOE has interpreted this legislation as removing the restriction in the MER definition of the Naval Petroleum Reserves Production Act that limits production to a sustainable rate that permits economic development and depletion "without detriment to ultimate recovery." This permits accelerated government development that maximizes the economic value to the government consistent with sound engineering practices and sustainable production even if the ultimate recovery of hydrocarbons is reduced. An example of this might be a decision to produce more gas rather than reinjecting it.

However, although P.L. 104-106 permits production from the NPR-1 reservoirs at a "maximum economic development rate," it also reduces the funds available to the NPR to pursue development opportunities. For the purposes of NEPA analysis, the SEIS/PEIR assumes that sufficient funds would be appropriated to achieve accelerated government development of NPR-1; otherwise development is likely to be closer to the lower bound of the Government Development Case.

The development and production of the **upper bound** of the Government Development Case were developed from the Reference Case (or the 1995 LRP "Total Development Case") plus:

- The most promising of the possible reserve projects in the LRP with a risk factor applied to the reserves based on the probability of success.
- The remainder of the possible reserve projects in the LRP with a higher risk factor applied.

In developing the upper bound of the Government Development Case it was also assumed that the activities in addition to the Reference Case would not occur as rapidly as commercial development due to current fiscal constraints. Thus production from new development is assumed to occur later in the Government Development Case compared to the Commercial Development Case.

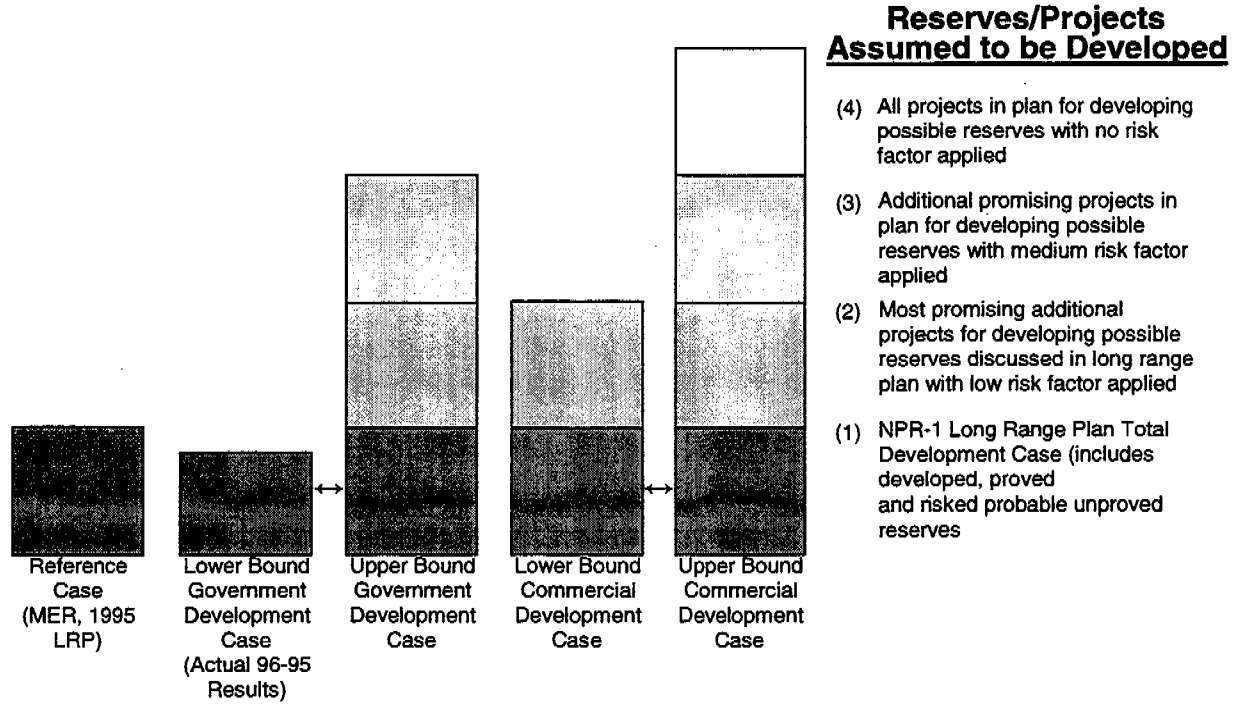
The reserves included in the Reference Case and those used in calculating the upper and lower bounds of both the Government Development Case and the Commercial Development Case are shown graphically in Figure 2.2-2. The projected production for the upper and lower bounds is shown in Table 2.2-1. The Government Development Case is illustrated graphically by Figure 2.1-2. New well drilling and well remediations are shown in Tables 2.2-2 and 2.2-3, respectively. The Government Development Case, including yearly production estimates through the year 2034, is explained in further detail in Appendix B.

2.2.2.3. NPR-1 No Action Alternative Considered But Not Analyzed in Detail: Shut-In

This case would involve the shut-in of NPR-1 at the end of the current three-year Presidential production authorization, which extends through April 5, 2000. NPR-1 would return to its shut-in

reserve status except production necessary for testing and reservoir maintenance. Surface facilities and wells would be maintained to assure readiness for national defense needs. This case would involve the least environmental impact of any of the possible cases. Because an affirmative action by the President is a prerequisite to continued production after April 5, 2000, this alternative is possible from a legislative standpoint. However, this case was not analyzed in detail because it is not a reasonable alternative means of achieving the P.L. 104-106 objective of maximizing the economic value of NPR-1 to the government. Further, the initial statutory production authorization has been extended six times, by Presidents of both parties, most recently in 1997. It is unlikely that NPR-1 would be shut-in even if it is not sold as required by P.L. 104-106

Figure 2.2-2
Potential Scope of Development Plans



2.2.3. NPR-1 Proposed Action

2.2.3.1. NPR-1 Proposed Action: Sale of All Government Interest as Directed by P.L. 104-106

P.L. 104-106 directed the initiation of a process to sell all of the Federal government's interests in NPR-1. Sale of NPR-1 is therefore the Proposed Action for the SEIS/PEIR. DOE has selected the Proposed Action as its Preferred Alternative. As it is not possible to predict how a commercial owner or owners would develop NPR-1, for the purposes of characterizing the potential environmental impacts, the Commercial Development Case includes a range of production activities reflecting possible future operations by private industry.

Like the Reference Case, the Proposed Action would involve: (1) drilling new wells; (2) withdrawal of oil, gas, and water from new and existing production wells; (3) injection of gas, and water into new, converted, or existing injection wells as needed to maintain production; and (4) selling, delivering, and otherwise distributing oil, NGLs and gas not needed for injection. What would change is the timing and pace of activities. Development of the probable and possible reserves would be accelerated under commercial development as the private owner seeks to recoup the cost of its investment in NPR-1 in the shortest time possible subject to ongoing DOGGR oversight of well related activities. Development of the proved, producing reserves would continue under the principle of MER.

2.2.3.2. The Commercial Development Case

Commercial development of NPR-1 would likely include one or more of a combination of the following actions, where economically justifiable:

- Eventual phase-out of gas injection, and the disposition of gas previously reinjected.
- Accelerated depletion of the shallow oil zone.
- More extensive development of the siliceous shales.
- Pattern waterflood of the Stevens sand reservoirs.
- Application of enhanced oil recovery processes.

These developmental activities are more likely to occur under commercial ownership than under the Government Development Case. DOE has not actively pursued these activities under Federal ownership because their viability was still being assessed, and because Federal budget constraints have resulted in insufficient resources for their full-scale implementation.

Like the Government Development Case, the estimated future production of the Commercial Development Case is provided as a range of possible outcomes with an upper and lower bound.

The **lower bound** of the Commercial Development Case includes:

- The Reference Case, adjusted for actual 1995 and 1996 production (that is, the lower bound of the Government Development Case); plus
- The most promising projects identified in the 1995 Long Range Plan for the development of NPR-1's "possible reserves," with a risk factor being applied.

The **upper bound** of the Commercial Development Case includes:

- The Reference Case; plus
- All the projects under consideration by the government for the development of NPR-1's "possible reserves."

The projected production for the upper and lower bounds is shown in Table 2.2-1. The Commercial Development Case is illustrated graphically, along with historical production, in Figure 2.1-2. New well drilling and well remediations are shown in Tables 2.2-2 and 2.2-3, respectively. The Commercial Development Case, including yearly production estimates, is also discussed in further detail in Appendix B.

2.2.3.3. Sale Scenarios Resulting in the Commercial Development Case

Given that the sales process for NPR-1 could generate different types of ownership and operating offers, DOE developed three representative sale scenarios. These are: (1) sale of all government interest in NPR-1 to two or more separate commercial entities; (2) sale of all government interest in NPR-1 to a single commercial entity; or (3) sale of production areas of NPR-1 to one or more commercial entities and sale of non-producing areas to a conservation entity. On October 8, 1996, DOE announced that its sales strategy would be to market NPR-1 in segments rather than as a single asset to maximize the value of the reserve. However, depending on the NEPA process and how the bidding proceeds, any of the three sales scenarios could still occur. These three scenarios are described further below.

All of these sales scenarios are expected to lead to future production activities that would fall within the upper and lower bound of the Commercial Development Case. These sales scenarios would not result in sufficiently different environmental impacts to justify their analysis as separate alternatives. The similarity of the environmental impacts is discussed in Section 2.5. However, the discussion on impacts also indicates where a particular scenario might result in a different environmental impact for the Commercial Development Case.

Under each of these sales scenarios, there are also optional choices for addressing endangered species issues, which the new owner may choose to pursue. P.L. 104-106 allows DOE to transfer an otherwise nontransferable Section 7 endangered species incidental take permit to the purchaser or purchasers of NPR-1 if the Secretary of Energy determines that transfer of the permit is necessary to expedite the sale of the reserve in a manner that maximizes the value of the sale to the U.S. (Section 3413(d)). P.L. 104-106 requires that the "transferred permit shall cover the identical activities, and shall be subject to the same terms and conditions, as apply to the permit at the time of the transfer." Under Section 7 of the Endangered Species Act, Federal agencies are required to implement programs for the conservation of endangered or threatened species. Private entities are normally subject to Section 10 of the Endangered Species Act, which does not require the same level of mitigation measures. The Secretary has determined that the incidental take permit should be transferred to the purchaser. However, the SEIS/PEIR analyzes both the impacts of transferring the Section 7 permit and the impacts of a private owner obtaining a Section 10 permit, so that the mitigation effects of transferring the permit can be clearly demonstrated (see also the discussion of mitigation in Section 2.5). The three sale scenarios to be addressed within the Commercial Development Case for the Proposed Action are described below.

Scenario 1: Sale of All Government Interest in NPR-1 in Two or More Segments to Commercial Entities (each having one or more owners) Subject to a Single Unit Operating Agreement

In this scenario, DOE would sell all Federal ownership interest in Elk Hills in multiple segments to multiple private industry entities under multiple sales contracts. The largest segment would include an "operating working interest," in which the buyer would become the field operator; there would also be one or more smaller non-working interests sold (in which the buyer would own the oil and gas produced but had no input to operation decisions). DOE would no longer have authority or responsibility for the management of Elk Hills and all development and production decisions would be vested solely with the private sector owners—a possible outcome sought by the legislation. This strategy was announced by DOE on October 8, 1996 and explained in public meetings held in Houston, Texas and Bakersfield, California on October 5 and October 16, respectively. The strategy was developed from three guiding principles: 1) maximizing the value of NPR-1; 2) allowing all qualified bidders to compete on an equitable basis; and 3) not precluding smaller bidders from the process. This scenario addresses the issue of access to diluent oil at NPR-1 (diluent is a lighter grade crude oil used to facilitate the transportation of heavier crude oil), a socio-economic and energy impact, which was raised during the public scoping process.

It should be noted that the sales process cannot require the future owners of NPR-1 to operate under a single unit operating agreement. The NPR-1 currently operates under a unit agreement, but that agreement contains terms and conditions that, while reasonable in light of the NPR-1 historical background and the fact that one of the parties is the government, do not make sense between two private parties. As part of the sales process, however, DOE has developed a new draft unit agreement in conjunction with CUSA which it believes the new owners and CUSA are likely to enter into prior to the final transfer of NPR-1. The draft Unit Agreement contains the following key terms and provisions:

- **Unitization:** Provides that all the oil and gas interests of the participants in the agreement are unitized so that operations may be conducted as if the unit area consisted of a single interest. Provides that the parties would own all production of oil and gas from the unit and all equipment and materials and be responsible for all costs and liabilities according to their respective ownership percentages as set forth in the unit agreement.
- **Operator:** Establishes the qualifications for the unit operator and the process for designation as operator. The operator would be required to have the appropriate structure and experience to serve as operator, minimum assets of $200 million and the capability to deal with environmental compliance responsibly and promptly. The operator would also be required to have a good safety and environmental compliance record, and the Agreement provides for the removal of the operator upon resignation or for good cause.
- **Drilling and Development:** Provides for the drilling of new wells and the reworking, sidetracking, deepening, recompleting or plugging back of existing wells. Also establishes procedures for the parties to elect to participate in each well activity and to share costs and any resulting production.
- **Expenditures and Liabilities:** Provides for the payment by each of the parties for their share of the unit's expenses and establishes the respective liabilities of the parties.
- **Transfer of Ownership Interest:** Establishes the procedures that the parties must comply with before the transfer of any of the parties' interests in the unit.
- **Term of the Agreement:** Provides that the agreement remains in effect as long as any well in the unit area is capable of producing oil or gas in payable quantities

- **Compliance with Laws and Regulations** Provides that the agreement is subject to all applicable Federal, state and local laws, ordinances, rules, regulations and orders.
- **Other Terms and Conditions:** Provides a variety of other terms and conditions addressing dispute resolution, improved oil recovery programs, force majeure, Federal tax issues, claims and lawsuits, title examination and notices.

Although the draft agreement calls for a unit operator with a good environmental record, the remaining terms of the agreement would not have a significant effect on the environmental affects of future operations at NPR-1. The more significant environmental issue lies not with the terms of the agreement, but whether one exists. In the absence of an agreement, additional infrastructure might have to be built by the new owners, with additional impacts to the environment. For the reasons discussed below, it is believed that a new unit agreement, generally similar to DOE's draft, would be entered into by the new owners and CUSA without further government action.

Scenario 2: Sale of All Government Interest in NPR-1 to Single Commercial Entity(having one or more owners)

In this scenario, DOE would sell all Federal ownership interest in Elk Hills under a single contract, which could occur if a single bidder offered a price that exceeded the highest bids for all the individual segments. Like Scenario 1, DOE would no longer have authority or responsibility for the management of Elk Hills; and all development and production decisions would be vested solely with a single private sector entity having one or more owners. From a facilities development aspect, this scenario is similar to Scenario 1 in that there is a single operator.

Scenario 3: Sale of Production Areas of NPR-1 to One or More Commercial Entities With a Single Unit Operating Agreement and Sale of Non-Producing Areas to Conservation Entity.

Under this alternative, a portion of NPR-1 would be sold to one or more commercial entities for continued production. A conservation area on NPR-1 would be sold to a conservation entity (a private non-profit organization or a Federal or state conservation agency) that would manage the tract of land as a wildlife habitat to support endangered species and other biological resources. The conservation entity would restrict or exclude oil and gas exploration and production activities on this portion of NPR-1. This alternative would allow a conservation agency or nonprofit organization to implement conservation and species recovery measures and to conduct research, thereby relieving the private industry entities of these responsibilities on the conservation area. The portion of NPR-1 sold to private industry would be subject to either Section 7 or Section 10 of the Endangered Species Act, as discussed above, as well as the California Endangered Species Act, Section 2081.

Scenario Considered But Not Analyzed In Detail: Sale to One or More Commercial Entities without a Unit Operating Agreement

This scenario is not analyzed because it is not a likely outcome of the sales process. The scenario arises from an organizational alternative proposed by Chevron during the comment process, in which NPR-1 would be sold to two or more separate entities, perhaps as many as 14 different owners (one for each reservoir at NPR-1) or even more. The approach would enhance competition for the smaller parts of NPR-1 because more companies would be able to afford to purchase the smaller pieces, resolving some concerns of small California heavy crude producers who rely on NPR-1 production for diluent. The problem is that, with multiple operators at the field, each operating their portion

independently, additional infrastructure would be required for a given level of production. This would result in greater environmental impacts and a lower sales price to the government, as each buyer would factor into their bid the additional infrastructure that would have to be built. A similar plan would involve the current strategy, reflected in Scenario 1 above, in which the successful bidders do not enter into a unit agreement, for whatever reason, but develop their properties separately instead. Either approach would probably result in greater environmental impacts than the other three commercial scenarios.

This scenario is not a reasonably likely outcome for several reasons. First, NPR-1 has already been developed pursuant to a unit agreement. Further, standard industry practice is to operate oil fields having multiple owners under a single unit operating agreement to achieve operational efficiency. Therefore, the likely outcome of a sale to multiple owners would be the establishment of a unit operating agreement. And because of the additional infrastructure costs and its unorthodox organizational approach, it is likely that structuring the sale in this fashion would cause lower bids, frustrating the Congressional objective and possibly even resulting in no sale. The sales process permits the high bidders sufficient latitude to work out any concerns over the draft unit agreement before submitting their final offers and so it is likely that a reasonably similar agreement would be entered into by the new owners. The diluent and competition issues can be addressed by dividing NPR-1 production into smaller pieces, but subject to a single unit operating agreement, as outlined in DOE's proposed sales strategy. This is characterized by Scenario 1 of the Proposed Action alternative, achieving the same objective but with a lower environmental impact.

2.2.4. NPR-1 Alternative to the Proposed Action

The scoping process identified a number of proposed alternatives to the complete sale of all government interest in NPR-1. All of these alternatives are outside of the sale authority of P.L. 104-106 and, as such, their implementation would require additional legislation. Most of these alternatives have been combined into a single alternative supplemented by scenarios (like the Proposed Action discussion) because regardless of the ownership or operating scenario, all require new legislation and, from the standpoint of future production and development, all are expected to result in the Commercial Development Case or minor variations thereof.

This section also addresses a second alternative raised during the scoping process, the conversion of NPR-1 to a conservation preserve. The reasons why this alternative was considered but not analyzed in detail are explained below.

2.2.4.1. NPR-1 Alternative to the Proposed Action: Divestiture Involving Retention of Some Government Ownership With Commercial Petroleum Production (Requires Additional Legislation)

Under this alternative, the Federal government would enact and implement legislation to take some other action to divest NPR-1 in order to maximize its value to the government. However, under these alternatives there would remain some (perhaps minimal) element of government control that would not otherwise occur under the Proposed Action. The greater the governmental control, the lesser the expected environmental impacts. That control notwithstanding, as the objective is to maximize the value of NPR-1, it is expected that development would occur at a level of intensity similar to private ownership. Therefore this alternative is characterized primarily by the Government Development Case. As the case is fully described under the Proposed Action, that discussion is not repeated here. Instead, the discussion focuses on the possible alternative scenarios and explains any differences from the Commercial Development Case.

2.2.4.2. Divestiture Scenarios Resulting in Commercial Development Case

From the perspective of environmental impacts, the following scenarios analyzed in the SEIS/PEIR do not involve sufficiently different environmental outcomes to justify consideration as separate alternatives. Although each of the following scenarios would be expected to result in the Commercial Development Case similar to the Proposed Action, some variations in expected impacts would occur depending on the scenario as explained below.

Scenario 1: Transfer of NPR-1 to BLM for Lease of Mineral Rights with BLM Management of Surface Property

Under this scenario, the Secretary of Energy would recommend to Congress that legislation be enacted to authorize the government to retain ownership of NPR-1 while transferring NPR-1 to BLM for leasing of the mineral rights under the Mineral Leasing Act and management of the surface under the Federal Land Policy and Management Act. This alternative would be similar to the Proposed Action for NPR-2, and is the way the Federal government manages most of its oil and gas resources on Federal lands. Commercial development under this scenario can be characterized as the Commercial Case except that biological land use and socio-economic issues would be characterized by the Government Development Case. As ownership of the property is retained by the Federal government, this scenario would require compliance with Section 7 of the Endangered Species Act.

Scenario 2: Creation of Federally-Owned Corporation With Transfer of All NPR-1 Assets to the Corporation

Under this scenario, the Secretary of Energy would recommend that Congress enact legislation to establish a government-owned corporation and authorize the transfer of NPR-1 assets to the corporation. Federally chartered corporations are established by an act of Congress, and in the past have encompassed a broad range of organizational structures. Under this scenario, it is assumed that the corporation would be responsible for generating its own capital and operating funds and would not require annual appropriations from Congress. The profits generated by the corporation would be deposited in the U.S. Treasury. DOE expects that this corporation would develop the petroleum reserve in a manner similar to the Proposed Action. Development under this scenario can be characterized as the Commercial Case except that land use and socio-economic issues would be characterized by the Government Development Case.

Scenario Considered But Not Analyzed In Detail: Creation of Federally-Chartered, Publicly-Traded Corporation With Transfer of All NPR-1 Assets to the Corporation

This scenario is not analyzed because it would not result in sufficiently different impacts to the environment compared to the alternatives and scenarios to be considered to justify separate analysis in this EIS/EIR. Under this scenario, an act of Congress would transfer NPR-1 assets to a corporation. The corporation would issue stock to the public (the proceeds of which to be deposited in the U.S. Treasury), and would not require annual appropriations from Congress. The profits generated by the corporation would be distributed to stockholders. Unless otherwise restricted by authorizing legislation, DOE expects that the new corporation under this scenario would operate in a manner similar to the new private owners under the Proposed Action; development under this scenario can be characterized as the Commercial Development Case. Since the impacts are expected to be identical, no value would accrue from analyzing this scenario separately.

Scenario Considered But Not Analyzed In Detail: Divestiture of Mineral Rights and Oil Production Facilities with Government Retention of Surface Property Rights

This scenario was raised as an alternative to a complete divestiture by the Department of the Interior, Fish and Wildlife Service, in the 1995 Biological Opinion for NPR-1. Under this scenario, the Secretary of Energy would recommend to Congress that legislation be enacted to authorize the government to divest the sub-surface mineral rights to NPR-1 (and related production facilities) but retain ownership of the surface. The scenario assumes that a private mineral rights owner(s) would extract petroleum at a rate similar to the Commercial Development Case described in the Proposed Action, but the manner in which the surface of NPR-1 is managed would be subject to some Federal government approval and oversight. This alternative would require compliance with the higher standards of Section 7 applicable to Federal agencies under the Endangered Species Act. Commercial development under this scenario can be characterized as the Commercial Case except that biological, land use and socio-economic issues would be characterized as falling somewhere between the Government Development Case and the Commercial Development Case.

BLM manages over 100,000 acres in its Valley Management Area, in which it controls only the surface rights. Since the government does not have ownership of the mineral rights, BLM experience has shown that it has less control over how the oil field is operated than if the mineral rights were leased (Scenario 1). BLM's lease terms permit the Federal government to control the siting of oil and gas facilities so that impacts to sensitive habitat can be avoided. With a sale of the mineral rights, there would be no such controls unless the terms of the sale contained sufficient terms and conditions to permit government control similar to a lease of the mineral rights. For the purposes of developing this scenario as distinct from Scenario 1, it was assumed that no such conditions would be included in the terms of the sale. The result could be more environmental impacts than if the government were to lease the field. Since Scenario 1 provides a more environmentally acceptable means of accomplishing the same objective, this alternative was not analyzed in detail.

2.2.4.3. NPR-1 Alternative Considered But Not Analyzed in Detail: Conservation Preserve

Another alternative identified in the scoping process was to shut-in oil and gas production completely on NPR-1 and to convert the entire property into a conservation preserve. This alternative is distinct from the no-action shut-in alternative, which would only involve a temporary cessation of production in accordance with the NPR Production Act, but with the facilities "mothballed" for restart at a later time (such as an energy or national security emergency). The arguments raised against mothballing as a reasonable alternative--that it would not meet the objective of providing maximum revenues to the Federal government--would apply with equal if not greater force to the complete conversion to a conservation preserve and are not repeated here. Further, it is DOE's and BLM's experience, confirmed by the 1995 NPR-1 Biological Opinion of the Fish and Wildlife Service, that oil and gas development is not inconsistent with the objectives of the Endangered Species Act. Therefore, the highest and best use of NPR-1, consistent with the Congressionally mandated objective of maximizing its value to the Federal government is as a working oil and gas field, with appropriate safeguards as required by law. It should also be noted that the existing Section 7 permit requires the set aside of 7,000 acres for no oil and gas development. As noted above, this SEIS/PEIR analyzes the sale of NPR-1-with the transfer of that Section 7 permit and its requirement for the establishment of the 7,000 acre preserve as well as the consequences of not transferring the permit.

2.3. NPR-2 Recommended Action and Alternatives

DOE has identified a Recommended Action and two alternative actions for NPR-2. The Recommended Action is the transfer of NPR-2 to BLM for management in accordance with the Federal Land Policy and Management Act (43 U.S.C. §1701 *et seq.*), and possible additional leasing under the Mineral Leasing Act, except for 16.7 acres of surface rights in Ford City, California, which are recommended for sale. DOE recommended this action in its report to Congress on maximizing the value of the reserves other than NPR-1 required by P.L. 104-106. In that report, DOE noted that NPR-2 is a significant habitat for a number of endangered or threatened animal and plant species and continued government ownership would provide for the rigorous protection of endangered species on the property. Implementation of the Recommended Action requires new legislation as would all of the alternatives, except for the No Action Alternative.

The alternatives to the Recommended Action are: No Action (continued DOE ownership and operation of NPR-2); and sale of all right, title and interest in NPR-2 subject to the existing leases. The following discussion lays out the Recommended Action and alternatives in more detail. The No Action alternative is discussed first to explain the baseline of current activities against which the results of the action and other alternatives should be measured.

Under the analysis of the divestiture of NPR-2, the recommended action and alternative were not further refined into multiple cases based on different levels of activities because NPR-2 already is being operated by private industry under long-term leases, and is coming to the end of its productive life. However, although the level of oil field operation is not expected to vary significantly, the alternatives could have very different environmental impacts. These are summarized in section 2.4.

2.3.1. NPR-2 No Action Alternative

The No Action Alternative provides for the continued production and development of known reserves at NPR-2 under DOE's administration by the current private operator mineral lessees. The nature of the private production activities would be very similar to NPR-1 but at a much lower level of activity because the field is near the end of its useful life. However, DOE's responsibilities at NPR-2 are very different from NPR-1. This alternative is one of the options for maximizing the value of the NPRs which P.L. 104-106 required to be included in DOE's Report to Congress.

Activities include drilling and installing approximately 75 new reservoir wells. Remedial well workovers would continue to be performed to restore and/or increase oil production in older wells. To maintain production at NPR-2, wells may be recompleted or redrilled and/or enhanced recovery techniques such as waterflooding or injection of chemicals may be implemented when hydrocarbon production from wells is approaching economic limits. Currently, there are 208 active wells, 34 tank settings, and six oil/water sumps on DOE lands within NPR-2.

Support facilities for hydrocarbon development at NPR-2 include facilities at the well site, such as oil and gas meters; gauging facilities; utility lines; tank settings, pipelines, pumps and sumps; roads; buildings; transport pipelines; storage and equipment yards; oil/water/gas dehydration/lease automatic custody transfer (LACT) units; compressors; and tanks. Dehydration/LACT facilities include a production tank, a settling tank, a shipping tank, monitoring and metering equipment, and a pump. Maintenance and repair of petroleum support facilities would be required to maintain operation of tank settings and dehydration/LACT facilities.

Facilities and equipment that become unnecessary may be secured for later reactivation (stored or mothballed), abandoned, disassembled and/or salvaged. Typical storing or mothballing techniques

include: shutting in wells; emptying storage tanks, pipelines, and equipment of all products; refilling pipelines and storage tanks with water containing either a corrosion inhibitor or a vapor corrosion inhibitor; and fencing buildings and facilities to provide isolation. Facilities or equipment that become unnecessary or inoperable would be abandoned, disassembled, or salvaged. The affected land may be reclaimed.

Third party activities similar to those permitted on NPR-1 would also continue to be authorized by DOE. Table 2.3-1 provides expected future production.

2.3.1.1. NPR-2 No Action Alternative Considered But Not Analyzed in Detail: Shut-In

This alternative would involve the shut-in of NPR-2 at the end of the current three-year Presidential production authorization, which extends through April 5, 2000. This alternative was not an option required to be examined by P.L. 104-106. Under this option, NPR-2 would return to its shut-in reserve status except production necessary for testing and reservoir maintenance. Surface facilities and wells would be maintained to assure readiness for national defense needs. This case would involve the least environmental impacts of any of the possible cases. Because an affirmative action by the President is a prerequisite to continued production after April 5, 2000, this alternative is possible from a legislative authority standpoint. However, this case is not analyzed in detail because it is not a reasonable alternative. The initial statutory production authorization has been extended six times, by Presidents of both parties. It is unlikely that NPR-2 would be shut-in even if none of the possible alternatives were to be adopted.

An option that would, for all practical purposes, be identical to shut-in would be the termination of all petroleum-related leases, shutting down existing operations, and closing existing facilities. Under this alternative, DOE would maintain administrative responsibility and U.S. government ownership of the property. Third-party agreements, permits, and other contractual agreements would continue as defined under the No Action Alternative. Closures and potential cleanup actions would be those required by Federal, state, and local standards and regulations. This alternative for NPR-2 is currently considered highly speculative in the absence of both congressional action to terminate leases entered into with private oil companies and knowledge of the plausibility of the Federal government's ability to terminate existing leases. Therefore, this alternative is not considered further in this SEIS/PEIR as a reasonable alternative.

Table 2.3-1
NPR-2 Future Production From 1997

	Lower Bound Total (1997-2013)	Upper Bound Total (1997-2024)
Oil (MB)	3,100	5,200
Gas (BCF)	14	25
NGL (MGal)	11,000	19,000
Total Hydrocarbon Production (MBOE)	5,780	9,960

2.3.2. NPR-2 Recommended Action

2.3.2.1. NPR-2 Recommended Action: Transfer of NPR-2 to BLM

This action is the transfer of the DOE's interests in NPR-2 to BLM for management in accordance with current BLM policy and the Federal Land Policy and Management Act (43 U.S.C. §1701 *et seq.*), and possible leasing of currently unleased acreage under the Mineral Leasing Act (30 U.S.C. §181 *et seq*), with the exception of the Ford City surface rights to be sold. This was recommended to Congress in the report on maximizing the value of the reserves other than NPR-1 required by P.L. 104-106. This is very similar to the no-action alternative, with BLM as the government entity instead of DOE. Control of production and development would remain with the current lease holders, and activities are expected to remain the same. DOE would no longer have any administrative responsibility for NPR-2. The Department of Interior's Minerals Management Service would collect royalties from NPR-2 production, as it does for all leases managed by BLM. If a determination were made to lease the remaining acreage, BLM would manage the leasing process.

Approximately seventeen acres of government NPR-2 land is located in a residential area of Ford City (see Figure 2.3-1). The action would include the sale of these surface rights. The surrounding residential area was disposed of in the 1980s. The remaining surface rights would be managed by BLM under their existing Federal land management programs. BLM would be responsible for assuring that the lessees comply with the existing leases, and managing the surface area of NPR-2, including ongoing third party activities.

BLM would manage NPR-2 in accordance with its management plans for other Federal oil and gas properties in the San Joaquin valley. On May 5, 1997, BLM approved its Resource Management Plan for the Caliente Resource Area and the Plans's EIS. The Caliente Resource Area encompasses a geographic area including 13.8 million acres of land in central California. The Plan guides management of the approximately 590,000 acres of public land (currently excluding NPR-1 and NPR-2) and an additional 450,000 acres of Federal reserved mineral estates within the geographic area. The Plan divides the Resource Area into three management areas.

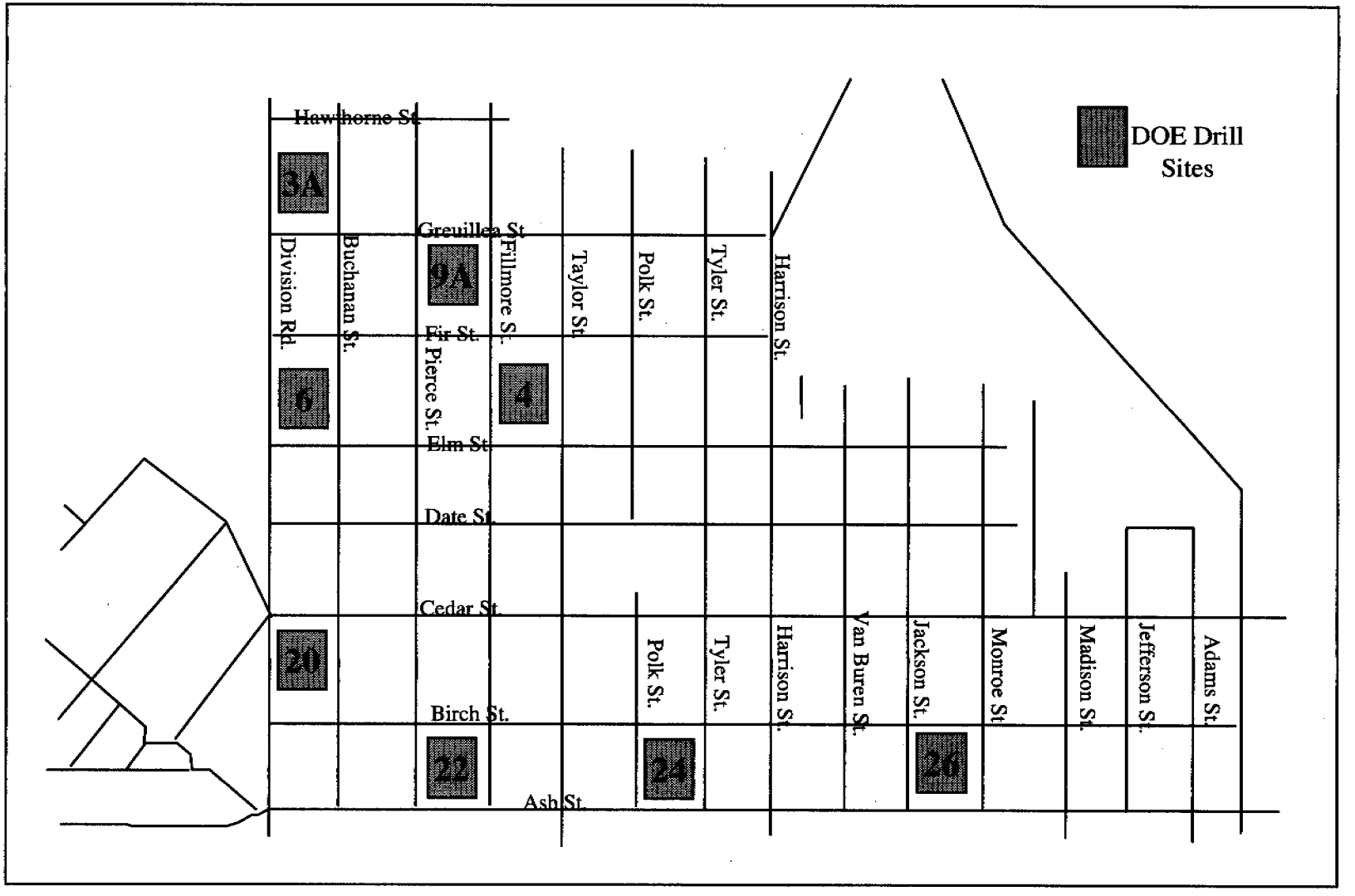
Under the Plan, the lands would be managed to achieve the following Resource Area management objectives:

- Provide healthy, sustainable, biologically diverse ecosystems contributing goods, services and other social and cultural needs for local communities, the region, and the nation; and
- Meet the Plan's minimum standards of ecosystem health.

The lands would also be managed to achieve the following management area objectives:

- Provide a leadership role in developing and implementing regional conservation strategies. Dedicate or reposition public lands to meet San Joaquin Valley conservation goals.
- Integrate management objectives with and assist local county governments, private organizations, and state agencies in the development and implementation of local management plans (e.g., Habitat Conservation Plans, mitigation banks, county general plans, and air and water quality plans).

Figure 2.3-1
Ford City NPR-2 Acreage to Be Sold



- Collaborate with the oil and gas and livestock industries in meeting mutually beneficial management objectives.

The Plan includes programs for the management of 938,000 acres of fluid mineral estates, with 140,400 acres currently leased for oil and gas exploration and development. Of the unleased acreage, approximately 605,000 would be offered for leasing under Plan, some of which being subject to surface use restrictions.

This Recommended Action would require Congressional authorization.

2.3.3. NPR-2 Alternatives to the Recommended Action

2.3.3.1. NPR-2 Alternative Action: Sale of all Government Interest in NPR-2 to a Commercial Entity Subject to the Existing Leases

In addition to the Recommended Action and No Action alternative, DOE, in the Report to Congress under P.L. 104-106, was also required to examine three other options for maximizing the value of the other NPRs. One of those options has been included as a possible alternative to the Recommended Action to be analyzed in the SEIS/PEIR. This would consist of the sale of all government interest in NPR-2 to a commercial entity subject to the existing leases.

This alternative is identical to the Proposed Action for sale of NPR-1, except that it would be subject to existing leases. Again, this alternative would require Congressional authorization. Such authorization would include similar safeguards as those included for the sale of NPR-1 to assure that it is conducted in a fair manner and the government receives full value. The most significant difference is that the Federal government would no longer control how the land would be used in addition to the existing leases. As NPR-2 is nearing the end of its productive life and is closer to the city of Taft, non-oilfield development is a possible future event, particularly on lands with no recoverable oil and gas, with significant impacts to the NPR-2 environment.

2.3.3.2. NPR-2 Alternative Considered But Not Analyzed in Detail: Sale of Remaining Mineral Rights Subject to Current Leases and Transfer of Remaining Interest to BLM for Management of the Surface Interest in Accordance with Federal Law

This alternative is not analyzed because, like the similar alternative scenario for NPR-1, it would not result in sufficiently different impacts to the environment compared to the other alternatives to justify separate analysis in this EIS/EIR. In this possible alternative, BLM would continue to manage the leases on NPR-2 as DOE currently does. BLM would manage the surface facilities in a manner consistent with its existing Federal land management programs, as described under the Recommended Action. However, the remaining mineral rights (subject to those leases) would be sold outright before the transfer by DOE. Like the purchasers of the smaller non-operating interests in Sales Scenario 1 of the proposed NPR-1 action, the buyers of the remaining mineral rights would not control how future development of reserves would occur unless the buyer were the same as the existing lessee of a given tract of land. Like the Recommended Action, this alternative would require Congressional authorization.

BLM experience with the management of this type of estate is that it has less control over how the oil field is operated than if the mineral rights are leased, which is the Recommended Action. The result could be more environmental impacts than if the government leases the field, unless the terms of the sale contain sufficient terms and conditions to permit government control similar to a lease of the mineral rights. The management of the field would be further complicated if the buyer of the remaining mineral rights was different from the existing lessee.

Development under this alternative can be characterized as the Sale Alternative discussed above, except that biological, land use and socio-economic issues would be characterized as falling somewhere between the complete sale and both the No Action alternative and the Recommended Action. Since the impacts are expected to fall within the range of impacts of other alternatives, no value would accrue from analyzing this alternative separately.

2.3.3.3. NPR-2 Alternative Considered But Not Analyzed in Detail: Transfer of NPR-2 to Another U.S. Agency for Management in Accordance with NPR Authority

P.L. 104-106 also required that DOE examine a fourth alternative. In preparing its report to Congress, DOE did not identify any agency that would provide any measurable management or environmental benefits when compared to continued operation by the DOE or transfer to BLM; therefore, this alternative is not analyzed in detail. Since the impacts are expected to be similar to the No Action alternative or the Recommended Action.

2.4. CUMULATIVE PROJECTS

Based on NEPA and CEQA requirements, the SEIS/PEIR analyzes the cumulative impacts of the Proposed Action in conjunction with other past, present, and reasonably foreseeable future projects of a similar scope and nature. CEQ NEPA regulations define cumulative impacts as:

> [T]he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"[7]

The CEQA guidelines define cumulative impacts as:

> [T]wo or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probably future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."[8]

2.4.1. Basis for Cumulative Projects

There are two possible approaches to the selection of the projects to be included in the cumulative impact analysis for this SEIS/PEIR. The first would be to include other Federal, state and private oil and gas activities in a very broad region, the second would be to include all Federal, state and private oil and gas activities in a more local region. The cumulative projects were limited to oil and gas projects because these are the only ongoing development activities in the vicinity of Elk Hills. This area of Kern County lacks the infrastructure to support large-scale development. Currently the Kern County General Plan does not include any provision for such development and no amendments to permit such development are expected to be adopted in the foreseeable future. However, where appropriate, such as in the air resources section, the cumulative impact includes a broader region and non-oil and gas-related activities.

BLM recently completed an environmental impact statement as part of the development of its Resource Management Plan for the Caliente Resource Area (BLM, 1996), which is divided into three management segments: the Coast Management Area; the Valley Management Area; and the South Sierra Management Area. NPR-1 and NPR-2 are located with BLM's Valley Management Area. The BLM EIS includes an analysis of the environmental impacts of the BLM leasing program for approximately 367,000 acres in the Valley Management Area (which excludes the 77,590 acres of NPR-1 & NPR-2). For comparative purposes, that EIS estimates that 150 to 260 new wells would be drilled annually on Federal lands compared to the highest projected well drilling activities under this DSEIS/PEIR of 89 new wells to be drilled on NPR-1 and NPR-2. As the analysis in that EIS is recent, DOE has determined to incorporate the analysis by reference rather than to re-analyze Federal oil and gas activities in the region. That EIS concluded that, in general, the trend for environmental impacts from oil and gas activities on Federal lands was slightly positive due to decreasing levels of activities as the fields were depleted and future adoption of more stringent environmental standards. However, there would be

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[7] 40 CFR 1508.7
[8] 14 CCR 15335

unknown impacts to Federally listed and special status plant species from activities on occupied and potential habitat. These conclusions, it is important to note, are based on BLM management practices that reflect the Federal obligation to affirmatively protect the environment, which private companies do not have.

The second approach, which is to include a more localized area, is used in this SEIS/PEIR. This approach was adopted because first, the BLM EIS already has analyzed the broader region, and second, there are Kern County Planning and permitting and habitat conservation issues that can be more effectively analyzed from a more local perspective. The oil and gas fields included in the cumulative projects were selected from the Kern County oil fields that are sufficiently near NPR-1 and NPR-2 to share a similar environment. Figure 2.4-1 shows the cumulative impact analysis area examined in this study.

In conducting the cumulative analysis, a more detailed examination of NPR-2 is undertaken than for the other cumulative projects. The cumulative analysis includes not only the NPR-1 Proposed Action and alternatives with the cumulative projects, but also includes the Recommended Action and alternatives for NPR-2. These alternatives are reasonably foreseeable within the meaning of that term as used by the NEPA and CEQA regulations. Alternative development scenarios for the other cumulative projects can not be as readily determined and therefore detailed future development scenarios for the other cumulative projects have not been developed.

2.4.2. Cumulative Oil and Gas Projects

Each cumulative project is described below (including NPR-1 and NPR-2 for comparative purposes) and analyzed later for each of the environmental topics addressed for the Proposed Action. Figure 2.4-1 provides the proposed boundaries of the cumulative impact analysis area and the general location of the cumulative projects. Table 2.4-1 provides a summary of wells for the cumulative projects. Table 2.4-2 provides a summary of production for the years 1990 to 1995 for the cumulative projects and Kern County. The Draft SEIS/PEIR includes the following cumulative projects in the cumulative impacts analysis:

- Elk Hills–Naval Petroleum Reserve Number 1
- Buena Vista - Naval Petroleum Reserve Number 2
- Asphalto Oil Field
- Portion of Midway–Sunset Oil Field
- McKittrick Oil Field
- Railroad Gap Oil Field
- North Coles Levee Oil Field
- South Coles Levee Oil Field
- Portion of Paloma Oil Field
- Portion of Yowlumne Oil Field
- Cymric Oil Field

The Elk Hills Oil Field (NPR-1) covers 47,400 acres in the Northern Central section of Kern County, California. As of 1997, the field has an expected life of more than 50 years. Total 1995 figures for oil reserves were 331 MMB; gas reserves totaled 962 BCF, of that 352 MMB and 1,869 BCF were government lease reserves. In 1995 there were 2,504 active wells in the field. Production in that same year at Elk Hills was 24 MMB of oil and condensate and 123 BCF of gas. Although Elk Hills is the fourth largest oil field in California, from 1994 to 1995 it ranked third among the top ten oil fields with the largest production decreases.

Figure 2.4-1
Cumulative Impact Analysis Area

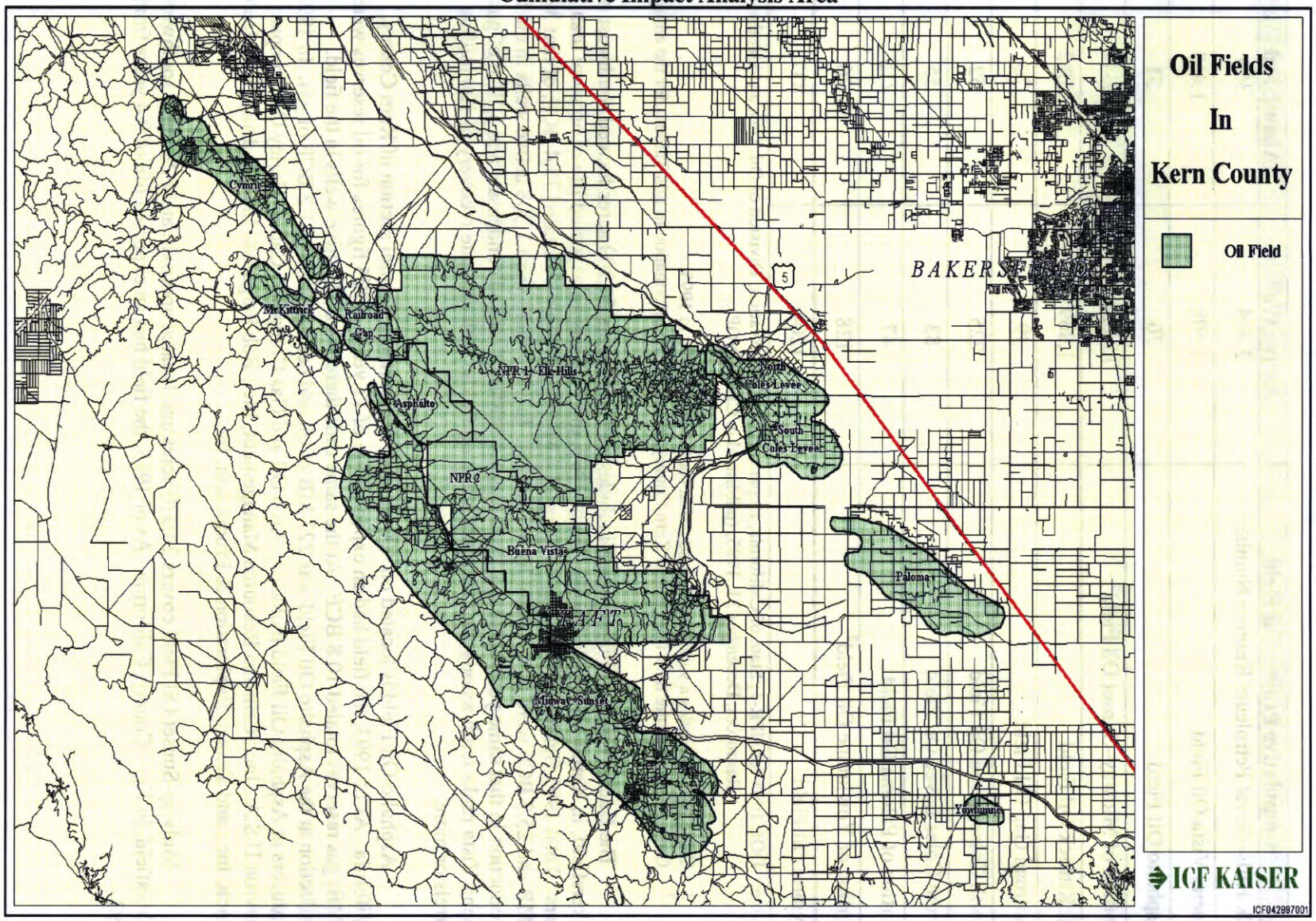


Table 2.4-1
Summary Of Wells For Cumulative Projects[1]

Cumulative Project Oil Field	Active Wells	Abandoned Wells
Elk Hills–Naval Petroleum Reserve Number 1	2,504	360
Buena Vista Oil Field	1,508	1,464
Asphalto Oil Field	76	51
Portion of Midway–Sunset Oil Field[2]	15,127	6,347
McKittrick Oil Field	1,869	1,082
Railroad Gap Oil Field	39	70
North Coles Levee Oil Field	225	52
South Coles Levee Oil Field	83	55
Portion of Paloma Oil Field[2]	47	215
Portion of Yowlumne Oil Field[2]	128	26
Cymric Oil Field	1204	837

Source: DOE 1995 for NPR-1; State of California, Department of Conservation, Division of Oil, Gas, and Geothermal Resources, December 31, 1995, (published in CEQA NOP).

[1] Table 2.4-2 provides a summary of production for the years 1990 to 1995.
[2] Only a portion of the field falls within Kern County; however, the information in this Table is for the entire field.

The Buena Vista Oil Field (which includes NPR-2) covers 54,200 acres located southwest of Bakersfield, in Kern County, California. As of 1997, the field has an expected life of no more than 20 years. Total 1995 figures for oil reserves were 20.4 MMB; gas reserves totaled 73.4 BCF, of that 3-5 MMB and 25.3 BCF were government lease reserves. In 1995 there were 1,508 active wells in the field. Production in that same year, at Buena Vista was 1.1 MMB of oil and condensate and 5 BCF of gas. Buena Vista ranks tenth among the California giant oil fields, with ultimate recovery of 100 million barrels or more.

Asphalto Oil Field is located on 400 acres in the Northern Central section of Kern County, California. As of 1993, the field had an expected life of 13 years. 1995 figures for oil reserves were 2.3 MMB; gas reserves totaled 10.8 BCF. At the same time there were 76 active wells in the field. Production at the Asphalto Oil Field was 223 MB of oil and condensate and 1.2 BCF of gas. In 1993, the producers at Asphalto Oil Field included: Arco Oil and Gas Company; Cather-Herley Oil Company; Chevron U.S.A., Inc.; Crimson Resource Management, Inc.; Bob Ferguson, Independent; Pine Meadows Ranch, Inc.; and Texaco Exploration & Production, Inc.

Midway-Sunset Oil Field covers 24,370 acres and located approximately 28 miles southwest of Bakersfield, in Kern County, California. As of 1993, the field had an expected life of 9.4 years from 1993.

Table 2.4-2
Summary Of Production For 1990 To 1995 For Cumulative Projects And Kern County

	Annual Oil Production (Barrels/Day)						Peak Oil Production		Cumulative Production	Estimated Producible Oil Reserves
Cumulative Project	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**(Bbls/Day)**		**(1,000 Bbls)**	**(1000 Bbls)**
NPR-1[1]	79,070	72,480	68,430	64,810	65,690	61,820	173,070	(1981)	1,077,173	367,100
Buena Vista (NPR-2)	4,360	4,250	4,400	4,040	3,400	3,010	52,750	(1925)	657,389	19,900
Asphalto Field	474	482	470	698	641	611	N/A	N/A	35,338	2,387
Midway–Sunset Field[2]	161,840	168,090	167,220	166,920	163,950	163,700	168,090	(1991)	2,298,474	454,100
McKittrick Field	4,370	4,050	3,310	3,150	3,180	4,630	31,300	(1966)	276,714	7,100
Railroad Gap Field	121	81	66	65	59	51	4,030	(1965)	10,445	420
North Coles Levee Field	1,040	927	751	687	676	621	17,080	(1919)	162,445	2,000
South Coles Levee Field	712	608	616	540	499	424	7,130	(1947)	58,006	2,000
Paloma Field	281	365	203	168	163	139	16,670	(1949)	61,070	920
Yowlumne Field[2]	12,750	10,310	8,560	6,160	4,830	4,220	24,340	(1978)	103,650	13,700
Cymric Field	24,670	28,460	29,260	26,780	26,270	27,300	29,260	(1992)	268,653	94,200
Total of Cumulative Projects	289,688	290,103	283,286	274,018	269,358	266,526	N/A	N/A	5,009,357	963,827
Total: Kern County Fields	628,900	633,600	608,300	588,100	578,100	569,600	700,400	(1985)	9,662,355	1,986,000

Source: State of California, Department of Conservation, Division of Oil, Gas, and Geothermal Resources, December 31, 1995.

[1] Annual production, not fiscal year production.
[2] Only a portion of the field falls within Kern County; however, the information in this Table is for the entire field.

1995 figures for oil reserves were 454 MMB; gas reserves totaled 26.9 BCF. At the same time there were 15,127 active wells in the field. Production at the Midway-Sunset Oil Field was 59.6 MB of oil and condensate and 1.7 BCF of gas. Producers at Midway-Sunset include BLM lessees and more than 50 private companies and independents. The field was ranked, in 1995, as the second largest oil field in California.

McKittrick Oil Field is 1,579 acres and is located in the Northern Central section of Kern County, California. As of 1993, the field had an expected life of 8.2 years. 1995 figures for oil reserves were 8.2 MMB; gas reserves totaled 11.7 BCF. At the same time, there were 1,869 active wells in the field. Production at the McKittrick field was 1.7 MB of oil and condensate and 1.2 BCF of gas. Producers at McKittrick include BLM lessees and more than 13 private companies and independents. It was ranked, in 1995, as the nineteenth largest oil field in California and the fifth largest production increases from 1994 to 1995.

Railroad Gap Oil Field is 456 acres and is located in the Northern Central section of Kern County, California. As of 1993, the field had an expected life of 17 years. The 1995 figures for oil reserves were 334 MB; gas reserves totaled 4 BCF. At the same time, there were 39 active wells in the field. Production at the Railroad Gap Oil field was 19.1 MB of oil and condensate and 254 MMCF of gas. As of 1993, Chevron, U.S.A., Inc. was the sole owner of the Railroad Gap field.

North Coles Levee Oil Field comprises 3,700 acres in the Northern Central section of Kern County, California. As of 1993, the field had an expected life of 9 years. As of 1995, figures for oil reserves were 2 MMB; gas reserves totaled 2.5 BCF. At the same time, there were 225 active wells in the field. Production at the North Coles Levee Oil Field was 226 MB of oil and condensate and 165 MMCF of gas. As of 1993, Arco Oil and Gas Company was the sole owner of the North Coles Levee Oil Field. The field was ranked, in 1995, as the thirty-third largest oil field in California.

South Coles Levee Oil Field covers 3,340 acres in the Northern Central section of Kern County, California. As of 1993, the field had an expected life of 13 years. The 1995 figures for oil reserves were 2.1 MMB; gas reserves totaled 122.8 BCF. At the same time, there were 83 active wells in the field. Production at the South Coles Levee Oil Field was 153 MB of oil and condensate and 5.7 BCF of gas. In 1993, producers at the South Coles Levee field included: Arco Oil and Gas Company; and Marathon Oil Company.

Paloma Oil Field is 5,760 acres located 17 miles southwest of Bakersfield, in Kern County, California. As of 1993, the field had an expected life of 15 years. The 1995 figures for oil reserves were 923 MB; gas reserves totaled 6.9 BCF. At the same time, there were 47 active wells in the field. Production at the Paloma Oil Field was 51 MB of oil and condensate and 6.9 BCF of gas. In 1993, producers at the Paloma field included: Central Pacific Resources; Lloyd Management Corporation; Santa Fe Energy Resources, Inc.; Shell Western E&P Inc.; and Vintage Petroleum, Inc.

Yowlumne Oil field covers 3,100 acres located 20 miles southwest of Bakersfield. As of 1993, the field had an expected life of 7.5 years. 1995 figures for oil reserves were 13.5 MMB; gas reserves totaled 5.6 BCF. At the same time, there were 128 active wells in the field. Production at the Yowlumne field was 1.5 MMB of oil and condensate and 862 MMCF of gas. In 1993, Texaco Exploration & Production Inc. was the sole owner of the field.

The Cymric Oil Field is comprised of 6,020 acres in the Northern Central section of Kern County, California. 1995 figures for oil reserves were 94 MMB; gas reserves totaled 3.6 BCF. At the same time, there were 1,204 active wells in the field; and production at the Cymric field was 10 MMB of oil and condensate and 751 MMCF of gas. Producers at Cymric include BLM lessees and more than 25 private companies and independents. It was ranked, in 1995, as the twenty-first largest oil field in California and the sixth largest production increase from 1994 to 1995.

2.5. COMPARISON OF ENVIRONMENTAL IMPACTS

This section compares the environmental impacts of the proposed action and alternatives and also summarizes the impacts of the cumulative projects including the NPR-1 proposed action and alternatives along with the possible alternatives for divestiture of NPR-2. Key conclusions and comparisons are listed in Tables 2.5-1 and 2.5-2 (these tables are presented at the end of this section).

As summarized earlier, NPR-1 is expected to remain exclusively an oil field for the next half century. The environmental impacts will be affected by how the field is developed. There are only two basic possibilities: continued government development or commercial development. The difference between these two possibilities will be driven by three factors: the cost of government operations versus the cost of private sector operations; the constraints on access to capital needed for development by the government budget process; and the cost of capital to industry which will incentivize the buyer to accelerate development in order to more quickly recover the NPR-1 acquisition costs. These in turn affect how much oil and gas will be economically recoverable from NPR-1, along with a number of other factors, such as oil and gas prices, technology development and operating strategies. The amount of oil and gas produced in turn affects the impacts on the environment.

The affected environment will not change under either development approach. Further, the fact that most of the facilities have already been constructed to support previously higher levels of development will mean that, although cumulatively significant, the additional changes are not significant compared to the Reference Case. For example, it is projected that under the maximum possible commercial development, an additional 231 acres will be permanently disturbed, representing less than 10% of acreage disturbed under the Reference Case. In addition, the production of oil and gas will not be that different between the two cases. The projected oil and gas production under the upper bound of the Government Development Case overlaps with the lower bound of the Commercial Development Case. The difference in total production under the two cases is expected to be less than 20%. Where the two alternatives are so closely similar, it is difficult to predict differences in impacts.

It should also be noted that it is unlikely that the manner in which divestiture occurs would have a significant affect on the environmental impacts, so long as a single operating interest is maintained. Again, primarily what matters is whether NPR-1 continues to be developed by the government or by the private sector.

What will change is the timing and pace of the development (commercial development will occur sooner and will be more intense) and the loss of the affirmative Federal obligation to mitigate the environmental consequences of its actions. For the most part, the environmental impacts from these differences can be mitigated to a less than significant level, even with loss of the Federal obligation to affirmatively protect the environment. The following discussion highlights the most critical impacts.

The most significant impacts from future development of NPR-1 involve biological resources. NPR-1 serves as important habitat for a several threatened and endangered species including: the San Joaquin kit fox, the blunt nose leopard lizard, the giant kangaroo rat, the Tipton kangaroo rat, the antelope squirrel and Hoover's woolly-star. Oil and gas development on NPR-1 will continue to result in the destruction of habitat for these species and the destruction or injury to individual members. Private development, being more intense, will increase the mortality and injury rate. Further, the levels of protection required of private industry with respect to endangered species is lower than that required of the Federal government. More important, however, is what occurs after NPR-1 is no longer a producing field. If NPR-1 remained in the hands of the government, either under the no action alternative or under the alternative action, it would most likely be preserved as habitat at the end of oil and gas production. If

sold however, there is no way to predict what type of development might eventually occur. Even conversion to agriculture would have significant impacts on the species.

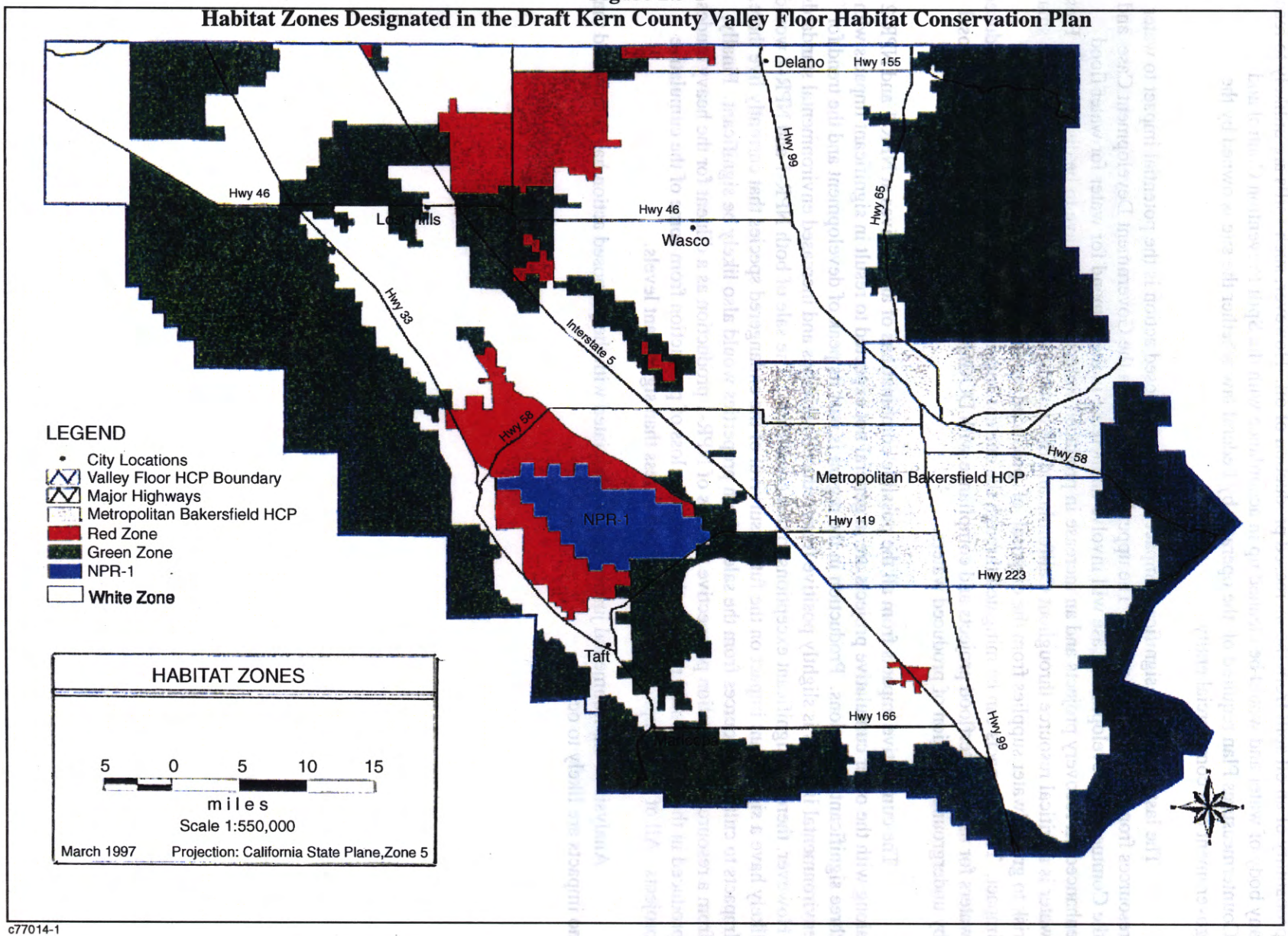
Despite the significance of these impacts, reasonably available mitigation measures could reduce them to a less than significant level. Substantial mitigation would occur in the near term under the proposed action through the transfer of DOE's incidental take permit to the purchaser(s). The terms and conditions of the permit, including the mitigation commitments DOE made in the 1995 Biological Opinion, would ensure that the purchaser(s) would operate NPR-1 in the same manner as DOE. However, these mitigations would be static in that they would not reflect a Federal agency's continuing affirmative obligation to conserve and restore threatened and endangered species. Additional mitigation beyond the transfer of the terms and conditions of the 1995 Biological Opinion could be applied to mitigate the significant affects of losing this affirmative obligation. These additional mitigation measures could be included in a California Department of Fish and Game (CDFG) permit for NPR-1. Alternatively, the new owner could participate in a regional Habitat Conservation Plan jointly permitted by CDFG and the U.S. Fish and Wildlife Service (FWS). One example of a regional HCP is the Kern County Valley Floor Habitat Conservation Plan (VFHCP) currently in development. The VFHCP is a cooperative effort among Federal, state and local agencies as well as private industry to conserve the region's endangered species and their habitat while allowing for continued economic growth. The plan calls for protection against future development of 90% of the remaining natural habitat (known as Red Zones) covered by the plan (see Figure 2.5-1). By including NPR-1 in a regional plan, its lands would ultimately be reserved for habitat, and the plan's take avoidance measures would assure that the new owners would continue to implement procedures to reduce mortality and injury during oil and gas development. Selection of which approach to take would be up to any new owner, however. Chapter 4 details sufficient mitigation measures which, if adopted by the appropriate approving agency (either CDFG and, if appropriate, FWS), would mitigate the impacts of the proposed action to less than significant in accordance with CEQA.

The second most significant potential impact from the proposed action is the potential impact to cultural resources. Development at NPR-1 has the potential to disturb archaeological sites that might be eligible for the National Register. Work is currently underway, in consultation with the State Historic Preservation Officer, to complete the identification of the site's cultural resources. Until this work is complete, the potential impacts can not be determined. Upon completion of the current studies, DOE will enter into a Memorandum of Agreement with the State Historic Preservation Officer as to the extent of the impacts and what mitigation, if any, needs to occur. This will be completed before the record of decision is prepared under this SEIS/PEIR. There will be greater potential for significant impacts and less possibility of mitigation if the proposed action is adopted; if the government retains NPR-1 under either the no-action alternative or the alternative action, then the impacts will be mitigated to less than significant levels. Mitigation measures designed to preserve biological habitat might also reduce the potential for disturbance of pre-historic archeological sites, although some prehistoric and many historic sites could be destroyed in returning the land to its pre-development condition.

The third most significant potential impact from the proposed action is the possibility under the upper bound of the Commercial Development Case to exceed ambient air standards on site (but no significant impacts off-site) for nitrous oxides, sulfur dioxides and particulate matter. It should be noted that these non-attainment estimates were determined using standard air models that typically are overly conservative in estimating air emissions. Air emissions sources are permitted by the San Joaquin Valley Unified Air Pollution Control District and any non-attainment would require mitigation to comply with the standards under either government development or commercial development. Any impacts would thus be mitigated to less than significant levels.

Figure 2.5-1

Habitat Zones Designated in the Draft Kern County Valley Floor Habitat Conservation Plan



c77014-1

The fourth most significant impact from the proposed action would be the slightly increased probability of an oil spill from the increased production of oil. However, such spills are unlikely to reach any body of water and would be cleaned up in accordance with the Spill Prevention Control and Countermeasures Plan required of the operator by Federal law whether the site is owned by the government or a commercial entity.

The last potentially significant impact from the proposed action is the potential impact to water resources from the proposed action. The upper bounds of both the Government Development Case and the Commercial Development Case will involve an increase in the demand for water for water flood enhanced oil recovery projects and an increase in produced waters that will have to be disposed of. Fresh water is a critical resource throughout California and the demand for additional water as well as the small risk to groundwater supplies from the disposal of produced waters represent a significant potential impact. These impacts can be mitigated through the current ongoing program at NPR-1 to treat produced waters for use in waterflood projects and compliance with DOGGR mandated standards in the disposal by underground injection of produced waters.

The cumulative impacts from all the possible combinations of alternatives at NPR-1 and NPR-2 along with the other cumulative projects are in general not expected to result in significant impacts with three significant exceptions. Production in the region is past its peak of development and the trend for environmental impacts is slightly positive from reduced activities and increased environmental standards. However, there are significant exceptions to this conclusion. The sale of both NPR-1 and NPR-2 would likely have a significant impact on the future survival of the endangered species that currently live there. Impacts to cultural resources from the sale of both properties would also likely be significant. Finally, from a resource conservation perspective the loss of NPR-1 production as a diluent for the heavy crudes produced in the region could result in the premature loss of production from some of the cumulative projects. All of these impacts can be mitigated to less than significant levels.

Analysis of environmental justice issues associated with the proposed action has determined that no impacts are likely to occur.

TABLE 2.5-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

	Reference Case	No Action Alternative	Proposed Action:
		Government Development Case	Sales Scenario: Sale of all Gov't Interest in NPR-1 to 2 or more Commercial Entities
Geology and Soils			
Fault rupture and seismicity	◍ Less than significant impact for structures built according to Uniform Building Code	◍ Same as Reference Case	◍ Same as Reference Case
Erosion	◍ Increased erosion due to additional temporary disturbance of 1065 acres over 30 years. Erosion-control and site-rehabilitation activities will reduce impact to levels below significance	◍ Increased erosion due to additional temporary disturbance of 602-1171 acres over 30 years. Impacts mitigated to below significance	◍ Disturbed area higher than Reference Case 1080-1500 acres. Impacts mitigated to below significance. Potential impacts in non-producing areas depend on future commercial activities.
Subsidence	◍ Potential risk of subsidence due to hydrocarbon production will continue at same levels. Monitoring and prompt response will reduce impacts to levels below significance	◍ Same as Reference Case	◍ Same as Reference Case
Hazardous Materials and Waste Management	◍ Industry practices and regulations will reduce potential levels to below significance	◍ Same as Reference Case	◍ Same as Reference Case for oil and gas development activities. May differ for new commercial activities in non-producing areas
Air Resources	Previous EIS impacts estimated using different methodology, cannot compare impacts	◍ Emissions increases expected with increased production levels through 2001, emission limited by air quality permits (SJVUAPCD/EPA) - no off-site NAAQS violations	◍ Same as No Action Alternative
Water Resources			
Change in surface runoff and flooding potential	○ No impact due to very small increase in impervious areas	○ Same as Reference Case	○ Same as Reference Case for oil and gas development activities. May differ for new commercial activities in non-producing areas
Decrease of surface water quality	⊕ Less than significant impact due to small quantity of runoff and waste management practices	⊕ Same as Reference Case	⊕ Same as Reference Case
Impacts on ground-water quantity	⊕ Continuous decrease of annual volume of water needed for injection program. Available water expected to cover needs	⊕ Continuous decrease of annual volume of water needed for injection program after 1999 peak of 51.2 MMB (upper bound). Available water expected to cover needs	⊕ Decrease of annual volume of water needed for injection after 2004 peak of 93.6 MMB (upper bound). Available water expected to cover needs of hydrocarbon activities. More water may be needed if commercial activities arise in non-producing areas.
Impacts on ground-water quality due to well drilling and pipeline construction	⊕ Less than significant impact due to industry practices and State well drilling regulations	⊕ Same as Reference Case	⊕ Same as Reference Case
Impacts to ground-water quality off-site due to injection of produced water	◍ Annual injection of less than 51.3 MMB expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures.	◍ Annual injection of less than 73.1 MMB (upperbound) expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures	◍ Annual injection of less than 120 MMB (upperbound) expected to cause less than significant impacts off-site. Groundwater monitoring in place needed to detect any potential migration and determine mitigation measures
Impacts to wetlands	○ No jurisdictional wetlands have been identified on NPR-1.	○ Same as Reference Case	○ Same as Reference Case
Flooding Potential and impacts to floodplains	○ No significant differences are expected in the amount and rate of surface runoff or existing topography. Adequate management of the floodplain is expected to continue.	○ Same as Reference Case	○ Same as Reference Case
Biological Resources			
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	◍ 400 acres disturbed out of 800 acres allowed in BO	◍ 263 acres less than maximum in the BO and 355 acres greater than BP maximum	◍ 263 - 684 acres beyond BO maximum

Legend
○ No Impact
⊕ Less Than Significant Impact
◍ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE 2.5-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

Commercial Development Case		Alternative Actions	
Sales Scenario: Sale of all Gov't Interest in NPR-1 to a Single Commercial Entity	**Sales Scenario: Sale of Production Areas of NPR-1 to a Commercial Entity(ies) and Sale of Non-Producing Areas to a Conservation Entity**	**Sales Scenario: Transfer to BLM for Mineral Leasing and Management of the Surface under Federal Law**	**Sales Scenario: Creation of Federally-Owned Corporation with Transfer of all NPR-1 Assets to Corporation**
◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as first Sales Scenario	◎ Disturbed area higher than Reference Case 1080-1500 acres. Impacts mitigated to below significance. No impacts in non-producing areas.	◎ Same as Sales Scenario 3 of Proposed Action	◎ Same as Sales Scenario 3 of Proposed Action
◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as first Sales Scenario	◎ Same as Reference Case	◎ Same as Reference Case	◎ Same as Reference Case
◎ Same as No Action Alternative	◎ Same as No Action Alternative	◎ Emissions increases expected with increased production levels through 2001, emission limited by air quality permits (SJVUAPCD/EPA); increases in mobile emissions (higher # employees)	◎ Same as previous column
○ Same as first Sales Scenario	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊕ Same as first Sales Scenario	⊕ Same as first Sales Scenario in producing areas. No significant additional water needs expected in non-producing areas.	⊕ Same as Sales Scenario 3 of Proposed Action	⊕ Same as Sales Scenario 3 of Proposed Action
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
◎ Same as first Sales Scenario	◎ Same as first Sales Scenario	◎ Same as first Sales Scenario	◎ Same as first Sales Scenario
○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case	○ Same as Reference Case
◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum	◎ 263 - 684 acres beyond B0 maximum

TABLE 2.5-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

	Reference Case	No Action Alternative	Proposed Action:
		Government Development Case	Sales Scenario: Sale of all Gov't Interest in NPR-1 to 2 or more Commercial Entities
Loss of affirmative federal obligations to protect, conserve, and help recover T&E species and their habitats	N/A Federal agency would be responsible for NPR	N/A Federal agency would be responsible for NPR	◍ ESA does not require private entities to conduct these activities
Loss of protection of T&E plants from habitat loss, damage, or destruction	N/A	N/A	◍ ESA does not require private entities to conduct these activities
Costs for acquisition, protection and management by a conservation entity	N/A	N/A	N/A
Unfunded protection and management of DOE established conservation	N/A	N/A	◍ New owners would need to bear the costs of maintaining the conservation area
Reduced potential for recovery of listed species and increased potential for listing additional species	○ No Impact	○ No Impact	◍ Additional acreage disturbed and potential loss of affirmative government role to conserve and restore species
Mortality, injury, displacement	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Loss or destruction of dens and burrows	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Local Hoover's woolly-star population lost and seed bank diminished	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities	◍ Occurs with development of wells and other oil and gas facilities
Cultural Resources			
Destruction or damage to significant paleontological localities	⊕ Expected production will not destroy the only two known significant localities	⊕ Same as Reference Case	⊕ Same as Reference Case
Destruction or damage to significant or important archaeological sites	○ No impacts under current DOE procedures	○ Same as Reference Case	◍ No impact to significant historic archeological sites or buildings. Potential for impacts to five or more significant prehistoric sites.
Destruction or damage to places of traditional or cultural importance	◍ Impacts uncertain but not expected to be significant	◍ Same as Reference Case	◍ Same as Reference Case
Land Use	⊕ No change in on-site land use; insignificant land disturbance; negligible indirect impacts on land uses adjacent to site	⊕ Same as Reference Case	⊕ Same as Reference Case
Noise	⊕ Because of distance between equipment and residences, change in noise levels would not be noticeable	⊕ Same as Reference Case	◍ Initial 10 years of upper-bound production with equipment closer to residences might require noise mitigation
Socioeconomics			
Fiscal Impacts	○ No Impact	○ No Impact	○ No Impact
Employment	○ No Impact	○ No Impact	○ No Impact
Risk Assessment	○ Increased risks associated with aging equipment and facilities offset by declining production levels and associated site activities	⊕ Slightly higher incidence of spills due to increased production levels but adequate containment and response measures in place to limit impact. Also, lack of vulnerable receptors, i.e., surface water.	⊕ Elevated production and activity levels result in greater risk in terms of spills and accidents, however, adequate contingency measures and lack of vulnerable receptors limit impact to less than significant levels.
Energy Conservation	⊕ Less than Significant Impact	⊕ Potential for minor increase in energy consumption	⊕ Same as No Action Alternative
Environmental Justice	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

Legend
○ No Impact
⊕ Less Than Significant Impact
◍ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE 2.5-1
Summary and Comparison of Impacts From the Reference Case, No Action, the Proposed Action and the Alternatives

Commercial Development Case		Alternative Actions	
Sales Scenario: Sale of all Gov't Interest in NPR-1 to a Single Commercial Entity	**Sales Scenario: Sale of Production Areas of NPR-1 to a Commercial Entity(ies) and Sale of Non-Producing Areas to a Conservation Entity**	**Sales Scenario: Transfer to BLM for Mineral Leasing and Management of the Surface under Federal Law**	**Sales Scenario: Creation of Federally-Owned Corporation with Transfer of all NPR-1 Assets to Corporation**
⊛ ESA does not require private entities to conduct these activities	⊕ A conservation entity would conduct these activities on the non-producing areas	N/A Federal agency would be responsible for NPR	N/A Federal agency would be responsible for NPR
⊛ ESA does not require private entities to conduct these activities	⊕ A conservation entity would conduct these activities on the non-producing areas	N/A	N/A
N/A	⊕ Conservation entity would have to bear these costs unless funding came from elsewhere	N/A	N/A
⊛ New owners would need to bear the costs of maintaining the conservation area	⊕ Conservation entity would have to bear these costs unless funding came from elsewhere	N/A	N/A
⊛ Additional acreage disturbed and potential loss of affirmative government role to conserve and restore species	⊕ The impacts would only occur on the producing portion of the field	N/A	N/A
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊛ Occurs with development of wells and other oil and gas facilities	⊕ The impacts would only occur on the producing portion of the field	⊛ Occurs with development of wells and other oil and gas facilities	⊛ Occurs with development of wells and other oil and gas facilities
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊛ Same as previous column	⊛ Same as previous column	○ Same as Reference Case	○ Same as Reference Case
⊛ Same as Reference Case	⊛ Same as Reference Case	⊕ Presumes that BLM will apply its Native American Consultation procedures to NPR-1	⊛ Same as Reference Case
⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case	⊕ Same as Reference Case
⊛ Same as previous column	⊛ Same as previous column	⊕ Same as Reference Case	⊕ Same as Reference Case
○ No Impact	○ No Impact	○ No Impact	○ No Impact
○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Same as previous column	⊕ Same as previous column	⊕ Same as previous column	⊕ Same as previous column
⊕ Same as No Action Alternative	⊕ Same as No Action Alternative	⊕ Same as No Action Alternative	⊕ Same as No Action Alternative
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

TABLE 2.5-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

ENVIRONMENTAL CONSEQUENCE	Cumulative Projects, NPR-1 Reference Case & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Government Development & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Sale & NPR-2 Transfer
Geology and Soils			
Fault rupture and seismicity	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Erosion	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Subsidence	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Hazardous Materials and Waste Management	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Air Resources	Previous EIS impacts estimated using different methodology, cannot compare impacts	◎ Emissions increases expected with increased production levels through 2001, however basin-wide emissions decreasing for most regional pollutants (ozone, particulates)	◎ Same as NPR-1 Government Development and NPR-2 No Action (previous column)
Water Resources			
Change in surface runoff and flooding potential	○ No Impact	○ No Impact	○ No Impact
Decrease of surface water quality	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts on ground-water quantity	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts on ground-water quality due to well drilling and pipeline construction	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts to ground-water quality off-site due to injection of produced water	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
Impacts to wetlands			
Flooding potential and impact to floodplains			
Biological Resources			
Plant and Animal Communities			
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
Loss of plant communities due to exploration and maintenance	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
Mortality, injury, displacement of animals	⊕ Mitigated to less than significant	⊕ Less than significant	⊕ Less than significant
T&E Species			
Loss of Federal obligation to protect, conserve, and help recover T&E species and their habitats	N/A because Federal Government continue to own NPR-1&2	N/A	◎ Potentially significant but can be mitigated to less than significant
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Loss of protection of T&E plants from damage or destruction	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Mortality, injury and displacement of T&E species	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
Change in regional biological baseline with reduced recovery potential for T&E species	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
Potential for increased limits on other projects in region	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant

[1] It is unlikely that any action would be taken on NPR-2 if, as a result of the statutory process, no action is taken on NPR-1. Therefore those combinations are not considered in this chart or this document.

Legend
○ No Impact
⊕ Less Than Significant Impact
◎ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE 2.5-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

Cumulative Projects, NPR-1 Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Sale & NPR-2 Sale	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Transfer	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Sale
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Emissions increases expected with increased production levels through 2001, however basin-wide emissions decreasing for most regional pollutants (ozone, particulates); Increased particulate impacts	◎ Same as NPR-1 Government Development and NPR-2 No Action	◎ Same as NPR-1 Government Development and NPR-2 No Action
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
⊕ Less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Less than significant	⊕ Less than significant	⊕ Less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant
⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant
⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant

TABLE 2.5-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

ENVIRONMENTAL CONSEQUENCE	Cumulative Projects, NPR-1 Reference Case & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Government Development & NPR-2 No Action [1]	Cumulative Projects, NPR-1 Sale & NPR-2 Transfer
Potential for increased financial needs for conservation area acquisition/management	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
Species of Concern			
Impacts on species of concern (plant and animal species)	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
Total Impacts (past and future)	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
Growth Inducing Impacts	○ No Impact	○ No Impact	○ No Impact
Cultural Resources			
Destruction or damage to significant paleontological localities	⊕ Assumes NEPA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	⊕ Same as previous column
Destruction or damage to significant or important archaeological sites	○ No Impact	○ No Impact	◎ No impact to significant historic archeological sites or buildings. Potential for impacts to five or more significant prehistoric sites.
Destruction or damage to places of traditional or cultural importance	◎ Impacts uncertain but not expected to be significant	⊕ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	◎ Same as previous column
Land Use	○ Primary land use remains petroleum production with no cumulative indirect effects on adjacent land use	○ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	○ Same as previous column
Noise	○ Noise impacts of cumulative projects not additive to specific receptors	○ Same as NPR-1 Reference Case and NPR-2 No Action (previous column)	○ Same as previous column
Socioeconomics			
Fiscal Impacts	○ No Impact	○ No Impact	○ No Impact
Employment	○ No Impact	○ No Impact	○ No Impact
Risk Assessment	○ No Impact	⊕ Spills and accidents are discrete events. Negative impacts from such events are quickly corrected. Cumulative impacts from spills highly unlikely as there are no common water courses. Groundwater impacts pose minimal risk to health or environment	⊕ See text under previous column for explanation
Energy Conservation	⊕ Less than Significant Impact	⊕ Potential for minor increase in energy consumption	◎ Potential impact on heavy crude production from loss of NPR-1 crude as diluent/mitigated by split sale of NPR-1
Environmental Justice	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

[1] It is unlikely that any action would be taken on NPR-2 if, as a result of the statutory process, no action is taken on NPR-1. Therefore those combinations are not considered in this chart or this document.

Legend
○ No Impact
⊕ Less Than Significant Impact
◎ Potentially Significant Unless Mitigation Incorporated
● Significant Impact

TABLE 2.5-2
Comparison of Cumulative Impacts From Cumulative Projects and Alternatives

Cumulative Projects, NPR-1 Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Sale & NPR-2 Sale	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Transfer	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 No Action	Cumulative Projects, NPR-1 Alternative Sale & NPR-2 Sale
◎ Potentially significant but can be mitigated to less than significant	◎ Potentially significant but can be mitigated to less than significant	N/A	N/A	◎ Potentially significant but can be mitigated to less than significant
◎ Potentially significant	◎ Potentially significant	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
◎ Potentially significant	● Significant Impact	⊕ Mitigated to less than significant	⊕ Mitigated to less than significant	◎ Potentially significant
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ Same as previous column	⊕ Assumes CEQA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action	⊕ Assumes CEQA compliance protects NPR-2 resources, if any	⊕ Same as NPR-1 Reference Case and NPR-2 No Action
◎ Same as previous column	◎ Same as previous column	○ Same as Reference Case	○ Same as Reference Case	◎ Impacts unknown until consultation with SHPO completed
◎ Same as previous column	◎ Same as previous column	◎ Same as previous column	◎ Same as previous column	◎ Same as previous column
○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column
○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column	○ Same as previous column
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
○ No Impact	○ No Impact	○ No Impact	○ No Impact	○ No Impact
⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation	⊕ See text under previous column for explanation
◎ Same as previous column	◎ Same as previous column	⊕ Potential for minor increase in energy consumption	⊕ Potential for minor increase in energy consumption	⊕ Potential for minor increase in energy consumption
⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact	⊕ Less than Significant Impact

2.6. REFERENCES

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3. DESCRIPTION OF EXISTING ENVIRONMENT

The following section provides an overview on the geology and soils associated with the NPR site. Section 3.1.1 and Appendix G provide an overview of the applicable regulations affecting this site. The geology of the region is defined in Section 3.1.2. Section 3.1.3 outlines both the history and potential of seismic activity at NPR-1 and NPR-2. Land subsidence issues are reviewed in Section 3.1.4. Section 3.1.5 details both NPR-1 and NPR-2's geologic resources. Section 3.1.6 depicts NPR-1 and NPR-2's soil makeup. Section 3.1.7 provides the reader with a list of references for additional information.

3.1. GEOLOGY AND SOILS

3.1.1. Applicable Regulations

The California Uniform Building Code defines the area where NPR-1 is located as a seismic Zone 4 area (highest potential in a scale from 0 to 4), and outlines requirements for new construction and renovation. The drilling and operation of wells are regulated under the California Laws for Conservation of Petroleum and Gas, which are promulgated as CCR Title 14 and are administered by the California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR). The Kern County Code of Building Regulations would also apply to any new construction or renovation at NPR-1.

There are several operational procedures at NPR-1 relating to soil protection and erosion minimization, such as DOE Policy and Procedures 1880-002, "Conservation of Topsoil: General" and 1880-003, "Topsoil Conservation: Above-Ground Pipeline/Pipeline Rights-of-way and Associated Service Roads."

While NPR-1 remains under Federal ownership, the provisions of the Archeological Resources Protection Act of 1979 and the Native American Graves Protection and Repatriation Act of 1990 apply to investigations of archaeological material recovered from NPR-1 lands.

3.1.2. Geology

DOE SEIS (1993) presents a detailed description of geology and soils of the NPRC region (Section 3.1 and Appendix C). At the regional level, the San Joaquin Valley is a large, northwest-trending trough between the Sierra Nevada on the east and the Coast Range mountains on the west. The Valley is filled with thick sediments eroded from the mountains on both sides (Maher et al. 1975).

NPR-1 is located about 25 miles southwest of the city of Bakersfield, near the southwestern edge of the San Joaquin Valley in Kern County, California. NPR-1 encompasses the Elk Hills, a foothill spur that extends from the Temblor Range southeastward. Elk Hills, which is about 16 miles long and 6 miles wide, reaches a maximum height of 1,551 feet, (about 1,000-1,200 feet above the floor of the San Joaquin Valley). (For a detailed map of physiographic features of the area see DOE SEIS (1993a) or Maher et al. (1975)).

In the NPR-1 area, the Tertiary and Quaternary deposits underlying Elk Hills and nearby areas are up to 24,000 feet thick. The Tulare formation lies at the surface of Elk Hills and consists of alternating beds of gravel, sand, silt and clay (most noticeably the Amnicola, Tulare and Corcoran clay units), deposited under non-marine conditions. The Tulare formation consists of both saturated and unsaturated intervals. The upper units of the formation are mostly unsaturated, while the lower units are saturated with both water and oil (DOE EA 1994). The rock types of the Tulare formation have received

different names from various researchers (see Milliken (1992) for a summary of different stratigraphic nomenclatures of the Tulare formation). Woodring et al. (1932) and Maher et al. (1975) provide good background information on the Tulare formation. Milliken (1992, 1993) studied the geology of the south and northeast flank areas of NPR-1. One important conclusion of these studies was that the relationship between the Tulare formation and surficial units is far more complex than simple Tulare/alluvium contacts depicted by earlier researchers.

The Tulare formation has been folded into a large compound anticline with about 400 feet of closure. It consists of two subsidiary anticlines, commonly referred to as the 29R and the 31S structures. The 29R, oriented in a southeasterly direction, is tightly folded, asymmetrical and faulted. The 31S structure, oriented in an eastward direction, is cut by numerous normal faults, four of which reach the surface in the northeast flank of the structure. The other faults in the shallow out-bearing beds do not have topographic expression (Maher et al. 1975). Woodring et al. (1932) describe smaller "earthquake cracks" along and parallel to the extreme north flank. Their trend is approximately perpendicular to the surface faults. Most noticeable among these cracks or small faults is the Tupman fault, a fracture cutting post-Tulare fan deposits with strike-slip and vertical displacement in the northeast flank of NPR-1 (see Milliken (1993) for a more detailed description and a map).

NPR-2 is located in the southwest-central San Joaquin Valley near the city of Taft. NPR-2 includes the entire Buena Vista Hills area and parts of Midway Valley and Buena Vista Valley. The Temblor Range borders the southwest boundary of NPR-2, and Elk Hills defines the northeastern boundary. Elevation is highest in the southeastern portion of NPR-2 at 1,288 feet (DOE EA 1994). The geologic structures in the NPR-2 area are not very different from those previously described in NPR-1. Quaternary alluvial deposits are the uppermost formation, with a thickness that ranges from zero (at the base of the Temblor Range to the west and the base of the Buena Vista Hills to the east) to over 800 feet along the valley floors (DOE EA 1994).

3.1.3. Seismicity

From 1852 through 1993, southern California experienced 19 major earthquakes with estimated Richter scale magnitudes ranging from 5.9 to 8.0. The largest recorded earthquake in the region occurred in 1952 with an estimated Richter scale magnitude of 7.7. Because southern California is a seismically active region, many earthquakes have occurred in the Kern County area since 1993. However, only a few have had a magnitude greater than five on the Richter scale. The most notable of these earthquakes includes the Wheeler Ridge earthquake (5.2 magnitude) and the Ridgecrest earthquake (5.4 magnitude). The Wheeler Ridge earthquake occurred on May 27, 1993, 15 miles southwest of Bakersfield; although noticed over a wide area of southern and central California, it caused little damage. The Ridgecrest earthquake, which occurred on August 17, 1995, was 11 miles north of Ridgecrest and also caused little structural damage.

Though Elk Hills is in a seismically active region, no historically active faults have been identified by the State Geologist or the California Division of Mines and Geology (CDMG) at NPR-1 (DOE SEIS 1993). As described in the previous section, some minor faults are observed in NPR-1. The most important active fault near NPR-1 is the San Andreas fault (located 12 miles west of Elk Hills beyond the Temblor Range), which is an important fault in the formation of the southern Coast Ranges and adjacent structures on the west side of the San Joaquin Valley (Maher et al. 1975). Other major formations near NPR-1 are the White Wolf fault (25 miles southeast from NPR-1) and the Pond Posso fault (22 miles northeast from NPR-1).

Three potentially active thrust faults have been identified in the southern portion of NPR-2, approximately 0.5 to 1.0 miles northwest of Ford City (DOE EA 1994). Two of the three faults have

been accurately located and trend northeast to southwest. The third fault is inferred to trend northeast/southwest (DOE EA 1994) and is likely either an active fault near Ford City, identified by the state of California, or the active Buena Vista Thrust fault, situated five miles south of NPR-1 (DOE EA 1994). Displacement along each fault caused by creep or possible creep has been identified (DOE EA 1994 from CDMG, 1976). Fault creep was first reported in 1933 after causing the collapse of several oil well casings (DOE EA 1994).

CDMG has designated two special study zones within the boundaries of NPR-2 encompassing the three faults discussed above (Figure 3.1 from DOE EA 1994). The California Special Study Zones are potentially active Holocene fault areas (within the past 11,000 years) that have been well-defined through field studies and geologic analysis. Special Study Zone guidelines require the identification of subsurface geologic features indicating active faulting and displacement prior to construction on a proposed building site located within a Special Study Zone (DOE EA 1994). This requirement applies to the construction of structures that would be occupied 2,000 hours annually (DOE EA 1994).

3.1.4. Subsidence

Land subsidence is known to occur throughout the San Joaquin Valley. The four types of subsidence known to occur in the San Joaquin Valley are listed below:

1. Reduction of underground water level and consequent compaction of the aquifer, usually as a result of pumping a confined aquifer;
2. Hydrocompaction of soils above the water table, usually as a result of surface irrigation and weak soil structure;
3. Reduction of underground fluid level and consequent compaction, usually as a result of oil and gas production; and
4. Deep-seated tectonic settlement, usually associated with earthquake activity (DOE EA 1994 from Kern County, 1974).

Most subsidence in the San Joaquin Valley is the result of pumping water from an underlying confined aquifer system. This hydrocompaction-type subsidence from surface irrigation has occurred in the valley south and southwest of Bakersfield, but is not known to have occurred at NPR-1 or NPR-2 (DOE EA 1985, 1993a, 1994).

Land surface subsidence has not been reported at NPR-1 (DOE EA 1985, 1993a). Since 1993 there have been no reports discussing subsidence at NPR-1. However, occurrences of localized sliding at two compressor sites (4G and 33S) have been observed and corrected (BPOI 1996). The Kern Water Bank project installed a subsidence monitoring system, in 1994, including 28 surface benchmarks and one extensometer (Kern County Water Agency 1994).

Oil field subsidence, the third most common type of subsidence in the San Joaquin Valley, is known to occur in a few small, localized areas south and west of Bakersfield (DOE EA 1994 from Kern County, 1974), including portions of NPR-2. The potential for oil field subsidence depends, among other factors, on the self-support and degree of compaction of the oil production zone. In NPR-1, the Stevens and Carneros zones have favorable resistance and the rocks are fairly well consolidated. The Shallow Oil and the Dry Gas Zones offer less support. (See DOE SEIS 1993a Section 3.1.2.3, and Appendix A for a discussion of oil- and gas-producing zones of NPR-1.)

Another type of subsidence that occurs within NPR-2 is not related to oil field operations, but rather to surface water and soil collapse as a result of overall weak soil structure (DOE EA 1994). This

type of subsidence has been documented in the Ford City area and encompasses approximately 23 acres (DOE EA 1994). The subsidence area is located within and adjacent to Ford City in the southeast quarter of Section 12C, T32S/R23E (DOE EA 1994 from BPOI, 1989). The most recent cave-in resulting from subsidence occurred in January 1988 (DOE EA 1994). The area is fenced to assure that members of the public do not have access. In addition, DOE/contractor personnel monitor it on a monthly basis in accordance with the environmental plan for NPR-2 (DOE EA 1994 from BPOI 1991). Current subsidence rates are generally very low. Kern County (1974) states that "subsidence has been less than one foot during the period of leveling control (DOE EA 1994). "Subsidence rates were likely to be much higher during periods of maximum production in the early 1900s. The field is nearing the end of its productive life with less than one percent of petroleum reserves remaining (DOE EA 1994). Currently, no active oil or gas wells exist in the subsidence area. Six abandoned wells in the subsidence area ceased operation prior to 1957 (DOE EA 1994 from BPOI, 1989). Current subsidence may be the result of compaction of reserves that were pumped in the past or the result of current pumping in the northeast quarter of the same section (DOE EA 1994).

3.1.5. Geologic Resources

Elk Hills is one of the largest domestic producing oil fields in the lower 48 states. It is also one of the nations' ten largest natural gas fields. In 1994 DOE conducted an audit to measure the resource base at NPR-1. The study estimated the total proved reserves at NPR-1 to be 366 MMB of oil and 1,200 Bcf of gas (DOE 1995). Table 3.1-1 presents the proved and unproved reserves of oil and gas at Elk Hills, according to DOE (1995) (These are total estimates, not recoverable estimates). The natural gas liquids extracted from the reserve include propane, butane, isobutane and natural gasoline.

Oil fields at NPR-2 are nearing the end of productive life (DOE EA 1994). In 1997, less than one percent of petroleum reserves at NPR-2 were estimated to be remaining, representing less than 5.2 MMB of oil (DOE EA 1994 from BPOI, 1991). DOGGR estimated remaining reserves to be 1.6 MMB of remaining oil and .24 Bcf of gas in the Buena Vista Front Area, and 18.8 MMB of oil and 73 Bcf of gas in the Buena Vista Hills Area (DOGGR 1996). These estimates are total remaining reserve estimates, not recoverable estimates.

Table 3.1-1
Elk Hills Reserve Estimates (DOE 1995)

Resource	Proved Reserves	Unproved Reserves
	NPR-1	NPR-1
Oil (million barrels)	366	676
Gas (billion cubic feet)	1,200	599

No mineral resources other than oil and gas have been commercially developed within Elk Hills. However, the coarser deposits of alluvium and the Tulare Formation could be used as a local source of sand and gravel (DOE EA 1985).

3.1.6. Soils

The soils of Elk Hills are composed of highly stratified deposits that vary greatly in their proportions of gravel, sand, silt, and clay. Some strata are gravelly sands, some are clayey, and some have a loamy texture with a mixture of sand, silt, and clay that is poorly sorted. A few areas have a soil layer that is chemically cemented hardpan (Regal 1997).

Many areas of Elk Hills contain loamy surface soils that are underlain by mottled clayey former lake deposits. Some of the subsurface layers contain gypsum crystals and other salts (e.g., sodium, chlorine, and boron) that commonly accumulate in arid regions. Salt concentrations usually are highest in fine-grained soils where the low permeability associated with these materials, low annual precipitation, and insufficient perennial surface water allow only minimal leaching to occur. In these high-saline areas, plant growth is reduced dramatically and shifts toward more salt-tolerant species.

There are several mechanisms for soil erosion, including aeolian (wind) and fluvial (rain, forming rills, gullies and channels). The mechanisms, effectiveness and extent vary in each event. Because the area is arid and sparsely vegetated, an increase in precipitation results in more soil erosion. Most of the landforms in this arid environment are fluvial in origin. When estimating the extent of soil erosion, the degree of disturbance by human activities can disrupt the accuracy of the results. Consequently, it is difficult to separate past from current erosional rates and natural from artificial erosional forces (DOE EA 1994).

A soil survey of NPR-1 was recently completed by the Soil Conservation Service (SCS Undated). Appendix C of DOE SEIS (1993a) provides additional information on soils at NPR-1. Most of the NPR-1 area is an anticline having been formed in uplifted stratified alluvium that slopes downward on both sides of a medial line. The northern slopes are cooler and moister than southern slopes, so the northern slopes generally have more vegetation than the southern slopes (SCS undated).

Before the area was uplifted, the surface layers were coarse to medium textured. In a large part of the area, several feet of the original surface strata have been lost through erosion, which in some areas has exposed coarse to fine textured strata with high salt content. Runoff from upslope areas has deposited salt in lower lying areas. Slow permeability of the soil layers and an insufficient supply of water indicates that these salts were not leached from the soil. Plant growth is reduced in areas that have excessive amounts of salts.

Twenty-six soil map units have been identified at NPR-1. The most common are Elk Hills sandy loam, 15 to 30 percent slopes (12 percent of the area), Torriorthents, thick Elk Hills complex, 15 to 30 percent slopes (11.8 percent of the area) and Torriorthents, thick-Torriorthents, thin Torriorthents, very thin eroded complex, 30 to 60 percent slopes (9.8 percent of the area). SCS (undated) and DOE SEIS (1993a, Appendix C) present detailed properties of these soils. In general most soils in NPR-1 have about 5 to 20 percent clay, and a permeability of about 2.0 to 6.0 inches/hour in the surface horizon; they are moderately susceptible to sheet and rill erosion, and have wind erosion potentials ranging from light to very slight (DOE SEIS 1993a).

Currently, Energy Advisory Services, Inc. is managing a habitat reclamation, erosion control and topsoil conservation program (UO-NPRC 1994). Under this program, catchment/sediment basins and sumps, vegetation filters, velocity dissipaters and other erosion control devices, drainage control and topsoil management measures are implemented. Forms have been designed for revegetation of sites needing reclamation.

The Soil Conservation Service completed an interim soil survey of NPR-2 (SCS Interim Report, undated). With NPR-1, most of the survey area is an anticline, formed in uplifted stratified alluvium that slopes downward on both sides of a medial line. Skyline Road is located at the approximate apex of the uplift. Some parts of Skyline Road are over 1,000 feet higher in elevation than the surrounding area. The uplifted area has been dissected by numerous drainage channels. Before the area was uplifted, the surface layers were coarse to medium textured. In a large part of the area, several feet of the original surface strata have been lost through erosion. In some of these areas, erosion has exposed coarse to fine

texture strata that have high salt content. A few areas have layers that are chemically cemented (SCS Interim Report, undated).

The fine-textured alluvium that underlies the surface strata was deposited in the area when it was part of a basin. In many of these, strata salts were deposited with the fine textured alluvium. Mottles, (blotches of different colors), occur in some layers, which indicate that they were once saturated with water. These basin deposits were later covered with coarser textured alluvium (SCS Interim Report, undated).

The salts that are present in the area were deposited in runoff from up slope areas. This runoff accumulated in the area when it was part of a basin, and the salts became concentrated as runoff water evaporated. These salts were not leached from the soil because of the slow permeability of the soil layers and an insufficient supply of water. The highest concentration of salts is in the finer textured strata (SCS Interim Report, undated).

Plant growth is reduced in areas that have excessive amounts of salts. Excessive amounts of sodium, chlorine and boron are toxic to plants. Some hillsides are poorly vegetated because erosion has exposed soil layers that have excessive amounts of salts. The northern slopes are cooler and moister than the southern slopes and, in many areas, northern slopes have a thicker layer of low salt soil at the surface (SCS Interim Report, undated). Consequently, the northern slopes generally have more vegetation than the southern slopes.

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3.2. HAZARDOUS MATERIALS AND WASTE MANAGEMENT

Activities associated with oil and gas production at NPR-1 and NPR-2 involve hazardous materials and generate several types of wastes, most of which are nonhazardous. This section focuses on hazardous materials and waste management activities or data since the preparation of the NPR-1 1993 Supplement to the 1979 Final Environmental Impact Statement (DOE SEIS 1993) and the NPR-2 draft Environmental Assessment (DOE EA 1994). Section 3.2.1 presents a brief overview of the regulations applicable to the generation, management and disposal of hazardous materials and wastes. Section 3.2.2 briefly characterizes waste generation at NPR-1 and NPR-2. NPR-1 has a number of on-site waste facilities (e.g., landfills, wastewater disposal areas, sumps) and other sites potentially contaminated with hazardous wastes (e.g., areas near waste storage areas). Section 3.2.3 and Appendix A present the updated status of these areas since the preparation of the DOE 1993 SEIS. Section 3.2.3 also identifies known waste facilities at NPR-2. Section 3.2.4 describes hazardous materials used or stored at NPR-1 and NPR-2. Section 3.2.5 lists the references used in this section.

3.2.1. Applicable Regulations

Hazardous materials and waste management at NPR-1 and NPR-2 are subject to Federal regulatory requirements under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Superfund Amendment Reauthorization Act (SARA) and the Toxic Substances Control Act (TSCA). NPR-1 and NPR-2 must also comply with California state laws governing hazardous substances and wastes. In addition, all facilities at NPR-1 and the DOE facilities on NPR-2 must follow certain DOE orders.

The majority of the waste generated at NPR-1 and NPR-2 is exempt from RCRA under the "petroleum" exclusion for petroleum exploration and production wastes (40 CFR 261.4). However, wastes not associated with exploration and production are subject to RCRA (e.g., small volumes of tank bottoms, spent solvents, paints, acids and lubricating oils) (DOE 1995). Nevertheless, under California law and the California Code of Regulations (CCR), oil-field wastes may be considered hazardous if contaminant levels exceed California hazardous waste criteria (DOE SEIS 1993).

NPR-1 and NPR-2 operations are conducted in accordance with CERCLA, as amended by SARA, under which activities to control or remove environmentally hazardous substances from inactive sites is managed (DOE SEIS 1993, DOE EA 1994).

SARA Title III requires statewide and local emergency planning and public "right to know" for the handling of extremely hazardous substances. NPR-1 is also subject to Toxic Release Inventory (TRI) reporting. TSCA regulates the management of potential PCB-contaminated liquids (such as waste oil, hydraulic fluids, heat transfer fluids and dielectric fluids) at NPR-1 and NPR-2, as well as PCB contaminated equipment (such as transformers, capacitors, and light ballasts) (DOE 1995).

State statutes are also applicable, and in some cases are more stringent than the Federal statutes. The California Health and Safety Code regulates hazardous wastes and hazardous materials and is administered by the Cal-EPA through the Kern County Department of Environmental Health Services (KCDEHS). Title 26 of the CCR contains state regulations for hazardous materials. A biennial report containing information on the volume of hazardous waste generated at NPR-1 and disposed at permitted disposal sites is submitted to the Cal-EPA every even numbered year (DOE 1995). An annual hazardous waste stream exceeding 12,000 kilograms occurring on NPR-1 or any of NPR-2 facilities would trigger compliance with the Hazardous Waste Reduction and Management Review Act of 1989 (SB14). The California State Safe Drinking Water and Toxic Enforcement Act (Proposition 65), requires NPR-1 to

post warning signs of the possibility of exposure to chemicals known to cause cancer or reproductive harm. Other applicable regulations are presented in DOE SEIS (1993).

As a DOE facility, NPR-1 follows the provisions of DOE Order 0440.1, which is the principal document defining environmental protection program requirements. DOE Order 0440.1 requires that NPR-1 establish waste-minimization programs to reduce the volume and toxicity of all wastes. This effort began at NPR-1 in 1987. Additional details on this program can be found in ATI (1997). NPR-2 private lessees, however, are not subject to DOE orders.

3.2.2. Waste Generation and Monitoring

The three largest waste streams at NPR-1 and NPR-2 are nonhazardous; these are produced water, spent drilling fluid, and solid wastes (DOE SEIS 1993). Hazardous wastes at NPR-1 and NPR-2 may include empty containers that contain residues of hazardous materials (e.g., spent acids, solvents, pesticides), oil production- or processing-related spills or contaminated media that are found to contain hazardous constituents, and tank-bottom sediments determined to be hazardous (DOE EA 1994; DOE SEIS 1993). In 1994, NPR-1 transported a total of 49,518 pounds of hazardous waste off-site for disposal or recycling at a permitted facility (DOE 1995). Of this amount, 43.7 percent (21,660 pounds) were attributed to tank cleaning activities. A total of 38 uniform hazardous waste manifests were used in 1994 to track wastes generated on NPR-1, and copies of these manifests were submitted to Cal-EPA (DOE 1995).

One of the largest wastestreams at NPR-2 (DOE EA 1994) is waste water from production. Information on annual hazardous waste generation for NPR-2 is difficult to obtain because hazardous waste management is the responsibility of the private lessees, and DOE does not monitor lessees' hazardous waste management records.

Waste monitoring on NPR-1 consists of tracking Federal and/or California hazardous wastes sent off NPR-1; sampling for PCBs in transformers; sampling soils and other wastes to determine if they are hazardous; and tracking NPR-1 oil spills, including corrective actions. NPR-2 waste monitoring activities are likely to be similar. In 1994, NPR-1 identified 13 chemicals that exceeded the threshold criteria for reporting under TRI regulations (40 CFR 372.25) (DOE 1995).

3.2.3. Updated Status of Waste Facilities

This section presents an overview of the current status of waste facilities at NPR-1 and NPR-2, as well as other sites included in remediation programs. Appendix A includes a detailed and comprehensive list of all NPR-1 waste facilities or contaminated areas and the contaminant(s) of concern and describes the updated status/recent activity at the facility/area.

NPR-1 contains several sites that were or are still contaminated with hazardous constituents. Closure activities have been completed on the 27R inactive hazardous waste trench unit, but DOE is awaiting approval of the post-closure plan by Cal-EPA (DOE 1995; ATI 1997). Four other contaminated sites were recommended for remediation and closure under CERCLA. Only one site (4G disposal area) has been remediated and closed; remediation and closure activities have not commenced at the three remaining contaminated sites (23S saltwater disposal sumps (1, 2, and 3), 1A-6M well pad with primary sump and overflow sump, and 27R truck washout station sumps) (ATI 1997). Since the closure of the 27R hazardous waste trench, all hazardous wastes at NPR-1 are transferred off site for disposal or recycling at a permitted facility. NPR-1 features four active hazardous waste transfer areas (2B storage area for transformers potentially containing PCBs, 27R and 35R hazardous waste storage areas, and 36S

accumulation pad for lead batteries), where hazardous wastes are stored prior to off-site disposal (DOE 1995; ATI 1997).[1]

NPR-1 has also closed a number of non-hazardous waste facilities. Clean-closure has been completed for four non-hazardous inactive waste landfills (35R, 26S east, 26S west and 36R), which are monitored quarterly and are awaiting final close-out approval by KCDEHS (ATI 1997). Clean-closure is completed or underway for sumps on six sites and 16 catch basins, closure reports have been submitted for these areas and DOE is awaiting final close-out approval by the California Regional Water Quality Control Board (CRWQCB) (ATI 1997; DOE 1995). An additional eight areas (e.g., sumps, catch basins) have been closed, and submission of closure reports to CRWQCB are pending. An additional 17 impoundments will be closed and reports submitted to CRWQCB in 1997 (ATI 1997). There are two active non-hazardous waste landfills at NPR-1 (27R and 10G).

Waste water generated on NPR-2 is disposed of both on and off site. Valley Waste Disposal Company, owned by a consortium of lessees, operates the waste water treatment facility on NPR-2. Table 3.2-1 presents waste facilities or other potentially contaminated areas at NPR-2, and describes the wastes managed or contaminants(s) of concern and the status or recent activity at the site. Hazardous wastes generated on NPR-2 subject to Federal and state waste management laws are transferred to permitted disposal facilities off site (DOE EA 1994).

Table 3.2-1
Waste Facility Status at NPR-2

Facility	Waste Managed or Contamination (if applicable)	Activity and Status	References
Section 26 Ford City Townsite burn dump area (DOE)	lead	Workplan for clean closure submitted to Kern Co. Environmental Health and Safety Department February 1997. Completed June 1997.	DOE 1997; BPOI 1997
Section 34B Broad Creek #3 evaporation/ percolation waste water treatment facility (Valley Waste Disposal Company)	none	Completed in 1994.	DOE 1997
Section 20 trash dump	general trash	Cleaned up and sold by ARCO to Vintage in 1997	Dave Bone (BPOI)
Section 30G wastewater sump (Phillips)	waste water	Currently inactive sump is undergoing site characterization and possible cleanup action for ultimate relinquishment back to DOE. Awaiting sample results to determine appropriate cleanup action.	DOE 1997
Section 22 soil discoloration	lead	Impacted soils will be excavated and disposed of with debris from 26 Ford City Townsite burn dump remediation.	BPOI 1997
8D gas plant (Texaco)	copper, chrome, and oily soil	Closure of gas plant is underway.	DOE 1997

[1] Any hazardous waste or wastes containing PCBs at these transfer areas would be disposed of at a properly permitted facility before transfer of NPR-1 to a new owner.

3.2.4. Updated Hazardous Materials Inventory

The 1993 SEIS provided annual chemical usage data based on a chemical inventory developed in 1988 (DOE SEIS 1993). More recently, an updated hazardous materials inventory was submitted to the Kern County Fire Department (BPOI 1996a). Table 3.2-2 lists the hazardous materials and annual amounts of chemicals stored on-site at NPR-1 based on the 1996 hazardous materials inventory. These chemicals can be released with wastes generated by normal operations at NPR-1, and occasionally by spills.

Table 3.2-2
Hazardous Materials Inventory at NPR-1 (BPOI 1996)

Material	Components	Annual Amount
B2 CHEMTOOL	Toluene (9 percent)	2,608 gallons
	Acetone (9 percent)	
	2-Butoxyethanol (9 percent)	
	Methyl Ethyl Ketone (9 percent)	
	Isopropanol (5 percent)	
	Methanol (5 percent)	
Chlorine	Chlorine Gas (100 percent)	10,800 cubic feet
Envir-sol Cleaner/Degreaser	d-Limonene	660 gallons
Tretolite CRW2011	Methanol (45 percent)	30,119 gallons
	Ammonium Bisulfite (10 percent)	
Tretolite CRW0132F	Methanol (45 percent)	12,118 gallons
	Ammonium Bisulfite (10 percent)	
Methanol	Methanol (100 percent)	249,285 gallons
Tretolite DM0761G	Heavy Aromatic Naphtha (60 percent)	8,252 gallons
	2-Ethyl-1-hexanol (30 percent)	
Tretolite SCW02451	Ammonium Chloride (10 percent)	3,509 gallons
Tretolite DMO4014K	Heavy Aromatic Naphtha (60 percent)	20,286 gallons
	2-Ethyl-1-hexanol (30 percent)	
Tretolite SCW0237H	Methanol (20 percent)	12,229 gallons
	Ammonium Chloride (7.5 percent)	
	Formaldehyde (0.5 percent)	
Triethylene Glycol	Triethylene Glycol (100 percent)	23,790 gallons
Tretolite PAOOO33L		3,675 gallons
Tretolite CGO118F	Heavy Aromatic Naphtha (60 percent)	13,056 gallons
	Isopropanol (10 percent)	
	Ethylene Glycol (5 percent	

Table 3.2-2
Hazardous Materials Inventory at NPR-1 (BPOI 1996) (continued)

Material	Components	Annual Amount
Tretolite DFO105J	Heavy Aliphatic Naphtha (60 percent)	787 gallons
Tretolite FLW1621	Heavy Aliphatic Naphtha (30 percent)	1,756 gallons
	Ethylene Glycol (5 percent)	
Tretolite XC105	Glutaraldehyde (50 percent)	15,172 gallons
Tretolite SCW3074	Ethylene Glycol	325 gallons
Anhydrous Ammonia	Ammonia (100 percent)	65,560 gallons
Isopropanol	Isopropanol (100 percent)	1,300 gallons
Tretolite HSW700L		35,888 gallons
Tretolite PAO118L	Heavy Aromatic Naphtha (60 percent)	4,538 gallons
Tretolite SCWO2376		769 gallons
Betz Corr-Shield 736		2,160 gallons
Ethylene Glycol	Ethylene Glycol (100 percent)	8,642 cubic feet
Propane	Propane (100 percent)	341,520,000 cubic feet
Diesel Fuel #2	Diesel Fuel #2 (100 percent)	17,038 gallons
Natural Gasoline	Natural Gas (100 percent)	52,500,000 cubic feet
n-Butane Mixture	n-Butane or Butane Mixture (100 percent)	34,000,000 cubic feet
Ethyl Mercaptan	Ethyl Mercaptan (99 percent)	800 gallons
Absorption Oil	Kerosene and Natural Oil Mixture	50,000 gallons
Betz Inhibitor 30K	Sodium Hydroxide, Solution	600 gallons
	(1-Hydroxyethylidene)bisphosphonic Acid	
	Zinc Oxide	
Argon Liquid		79,200 gallons
Helium Gas	Helium (100 percent)	50,118 cubic feet
Nitrous Oxide	Nitrous Oxide (100 percent)	700 cubic feet
Nitrogen Gas	Nitrogen (100 percent)	30,080 cubic feet
EP 680		550 gallons
Hydrogen Gas	Hydrogen (100 percent)	4,305 cubic feet
Acetylene Gas	Acetylene (100 percent)	29,435 cubic feet

Table 3.2-2
Hazardous Materials Inventory at NPR-1 (BPOI 1996) (continued)

Material	Components	Annual Amount
Betz Opti-Meen-80300		1,000 gallons
Betz Sulfite	Sodium Metabisulfite (25 percent)	1,100 gallons
Sodium Hydroxide 50 percent	Sodium Hydroxide (50 percent solution)	48,000 gallons
	Sodium Carbonate	
	Sodium Chloride	
Sulfuric Acid	Sulfuric Acid (93 percent)	24,000 gallons
Betz Ultrasperse AP200	Acrylic Acid	2,000 gallons
	Polyethylene Glycol	
	Allyl Ether Polypropylene Glycol	
Tretolite DMOOO46F	Alkylaryl Sulfonates (50 percent)	2,843 gallons
	Light Aromatic Naphtha (20 percent)	
	1,2-Diethylbenzene (20 percent)	
	Ethylhexanol (5 percent)	
	1,3,5-Trimethylbenzene (5 percent)	
API Modified Thread Compound	Lead	18,850 gallons
	Copper	
	Zinc	
	Graphite	
	Mineral Spirits	
Nitrous Oxide in Nitrogen	Nitrous Oxide	404 cubic feet
	Nitrogen	
Argon in Carbon Dioxide	Argon	7,940 cubic feet
	Carbon Dioxide	
Oxygen in Nitrogen	Oxygen	320 cubic feet
	Nitrogen	
Oxygen Gas	Oxygen (100 percent)	41,460 cubic feet
Isobutane	Isobutane (100 percent)	108,000,000 cubic feet
3M AFFF Fire Fighting Foam		330 gallons
Oil Sorb 22	Silica, Crystalline	13,100 gallons
CL-9860 Degreaser	Degreaser (100 percent)	715 gallons
Chevron 450 Thinner	Thinner (100 percent)	110 gallons
SSR Original Coolant	Non-hazardous	425 cubic feet
Portland Cement		5,400 gallons
Rock Salt		30,000 gallons
Redi-crete		119,160 gallons
Isopropyl Alcohol	Isopropyl Alcohol	
Compressed Gas - LO- NOX		1,800 cubic feet
Carbon Monoxide	Carbon Monoxide (100 percent)	1,824 cubic feet
Tretolite HSO600	Heavy Aromatic Naphtha	800 gallons
	Xylene, Mixed	
Aqua Surge Degreaser	Heavy Aromatic Naphtha	105 gallons

Table 3.2-2
Hazardous Materials Inventory at NPR-1 (BPOI 1996) (continued)

Material	Components	Annual Amount
Super Power Degreaser	Sulfonic Acids	160 gallons
	Sodium Hydroxide	
	Glycol Monobutyl Ether	
Lithium Grease		10 gallons
Propylene Glycol	1,2-Propylene Glycol (100 percent)	100gallons
Unleaded Gasoline		244,200 gallons
Waste Oil		550 gallons
Chemsearch Duo Power Hd	Sodium Tripolyphosphate	55 gallons
	Sodium Xylene Sulfonate	
	Doedecylbenzene	
Shell Donax TG-Plus IIE		110 gallons
Chemsearch ND-165 Cleaner	Sodium Metasilicate	55 gallons
	Sodium Xylene Sulfonate	
	Dodecylbenzene	
Various motor oils	Petroleum-based lubricating oil (100 percent)	122,663 gallons

A hazardous materials inventory for NPR-2 is not readily available because each lessee (rather than DOE) is responsible for storing and managing hazardous materials at its facilities according to applicable regulations. It is likely, however, that many of the hazardous materials used at NPR-1 are also used at NPR-2, but at a much lower magnitude.

3.2.5. References

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3.3. AIR RESOURCES

This section discusses the existing atmospheric conditions surrounding the NPR-1 and NPR-2 facilities, and the effect of oil and gas production at the two facilities on these baseline conditions. Section 3.3.1 presents the applicable Federal, state and local regulations used to regulate ambient air and atmospheric pollutants released from the facilities. Section 3.3.2 discusses the current baseline conditions of atmospheric pollutants and ambient air quality levels in the surrounding area. Section 3.3.3 and 3.3.4 discuss the atmospheric pollutants currently emitted from NPR-1 and NPR-2.

3.3.1. Applicable Regulations

Ambient Air Quality Standards. NPR-1 and NPR-2 are located in the southwestern corner of Kern County, the southernmost county in the San Joaquin Valley. The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) regulates sources of air pollution located in the central section of California running north/south from directly east of the San Francisco Bay area to the northeast of Santa Barbara.

Permits To Operate. NPR-1 consists of over 600 individual sources of air emissions. Each one of these emission sources is regulated by the SJVUAPCD and U.S. EPA through a Permit to Operate (PTO). NPR-1 annually submits an emission inventory, which includes air emissions for most of the permitted sources, as well a few other sources not covered by permits from the SJVUAPCD or the U.S. EPA (e.g., oil-spills, etc.). A total of 504 PTOs have been issued to NPR-1 to regulate these air emission sources (DOE 1997). The permits were issued to NPR-1 to comply with SJVUAPCD Rule No. 2010 (Permits Required). Rule 2010 requires "any person constructing altering, replacing or operating any source which emits, may emit, or may reduce emissions to obtain any Authority to Construct or a Permit to Operate."

There are a number of stationary emission sources that operate, via leases from DOE, on the NPR-2 site. These sources, which include compressor engines, electrical generators, boilers, heaters, flares, pump engines and miscellaneous field engines (DOE EA 1994), are operated under separate air permits by each of the lessees. Appendix D contains a list of these permits and the sources covered. The only permitted emission limits that apply to these sources are limits on sulfur compound emissions for the fixed roof tanks, and limits on particulate emissions for the Internal Combustion (IC) engines.[1]

Authorities to Construct. The SJVUAPCD also issues Authorities to Construct (ATC) under Rule 2010. These permit documents are required each time a facility constructs a new emission source. Although ATCs are valid for two years, NPR-1 and NPR-2 do not typically hold ATCs for extended periods of time. Upon installation of equipment covered by the ATC, a start-up inspection is conducted by SJVUAPCD and a PTO is issued. No ATC permits are anticipated to be pending at the time of the proposed sale (DOE 1997).

Prevention of Significant Deterioration Permits. For pollutants for which the area is considered to be in attainment or not classified, the U.S. EPA implements the Prevention of Significant Deterioration (PSD) program. NPR-1 currently holds one PSD permit (NSR 4-4-8/SJ 77-42), which was originally issued by U.S. EPA on February 22, 1982. This permit covers 34 IC engines and limits NO_x emissions. On April 7, 1989, this permit was modified to address the retrofitting of the original 34 engines with pre-combustion chamber or pre-stratified charge NO_x control technologies.

[1] Based on a review of Permits to Operate issued by the San Joaquin Valley Unified Air Pollution Control District.

Transfer of Permits and Certificates. The new owners would be required to submit an application to transfer the ownership of current permits (PTOs) and the appropriate filing fee at the completion of the sale. The transfer of PTOs is governed by SJVUAPCD Rule 2031 (Transfer of Permits) and Rule 3010 (Permit Fees). A letter notifying the SJVUAPCD of the pending change in ownership would be required to be submitted by DOE at least 30 days prior to completion of the sale. The permit application for the transfer of the PTOs to the new owners would have to be submitted to the SJVUAPCD by the new owners within 30 days of completion of the sale.

The PSD permit program, administered by the U.S. EPA, would also require transfer of permits with the sale of NPR-1. The transfer of the ownership requirements for the 1982 PSD permit NSR 4-4-8/SJ 77-42 is detailed in Section VI (Transfer of Ownership). The PSD permit requires that DOE notify the new owners of the existence of the PSD permit, including applicable permit conditions. A letter notifying the U.S. EPA of the pending change in ownership would be required to be submitted by DOE to the U.S. EPA, California Air Resources Board (CARB) and SJVUAPCD at least 30 days prior to completion of the sale.

Title V. Under Title V of the 1990 Clean Air Act Amendments, thousands of industrial sources and governmental facilities are required to apply for a comprehensive operating permit that addresses all the air emission sources at the site and lists all the applicable Clean Air Act regulations. Title V does not impose any new requirements or emission limits on sources, but may cause sources to incur additional costs associated with compliance demonstration requirements because Title V puts the burden of demonstration of compliance on the source's owners and operators. Although Title V is a Federal program, the program has been delegated by U.S. EPA and is being administered at the state and local level. The SJVUAPCD, which has jurisdiction over NPR-1 and NPR-2, operates its Title V program through Rule 2520 (Federally Mandated Operating Permits).

Two separate Title V applications have been prepared for NPR-1: (1) 35R Gas Plant Source; and (2) Western Light Oil Source. Multiple permits are normally used to keep independent operations separated and sheltered from each other's potential compliance issues. The 35R Gas Plant processes natural gas received from crude oil production wells. The natural gas is separated into natural gasoline, liquefied petroleum gas (propane and butane) and dry gas (primarily methane). The Western Light Oil Source consists of oil production equipment wells, oil production storage tanks, and other support equipment. The facility processes crude oil and natural gas from oil production wells. The oil pipelines transfer oil to refineries for processing; the natural gas is processed by the 35R Gas Process Plant.

The Title V permit applications that have been submitted to the District to date do not include alternative operating scenarios. These scenarios allow a facility flexibility and the ability to adjust to different operating conditions depending on market demands. With the addition of new equipment or the increase in production rates, such as a dehydrator that may be needed under the commercial case, the Title V permit will have to be "opened" to include the additional equipment. This will require public and U.S. EPA comment before the permit can be issued. The final Title V permit for NPR-1 is anticipated in December of 1997. Should the new owners be identified prior to the issuance of the Title V permit, DOE can identify the new owners as the permittee. Otherwise the new owners would be required to submit a new application for the transfer of the permit at the completion of the sale. The requirements for notification and application are the same for the Title V permit as for the Permits to Operate.

General Conformity. The Clean Air Act Amendments of 1990 (CAAA) require that Federal actions conform to state air quality plans (State Implementation Plans-SIPs) in order to meet the CAAA's air quality goals. The final General Conformity Rule stated that Federal activities must conform with the SIP and not (1) cause or contribute any violation of air quality standards, (2) increase the frequency or severity of existing violations, or (3) delay timely attainment of air quality standards or milestones.

The proposed action, the sale of the NPR-1 facilities to commercial operators, is a Federal action. However, it is exempt from General Conformity to the CAAA action is because the Federal agency can not control air quality impacts at the facility once ownership is relinquished. As stated in the Final Rule:

> "The Federal agencies would, in many cases, be unable to reduce emissions from sources that they cannot practicably control. This would result in the Federal action having to be prohibited because a positive conformity determination could not be made. The EPA believes that the Act does not intend to unreasonably restrict Federal actions so that they are generally prohibited in areas with air quality problems. Instead, the Federal agencies are required to control emissions in a reasonable manner and States must develop general air quality plans to achieve the NAAQS."

In contrast, one of the Proposed Alternatives to the Proposed Action—transfer of the property to another Federal Agency, such as BLM, for lease to commercial operators—is not exempt from General Conformity as a Federal Action. Future activities that could directly or indirectly cause emission increases above de minimis levels must be examined for applicability with the General Conformity rule. As proposed, projected activities under this alternative would cause increases in emissions due to the addition and operation of new equipment. This new equipment is needed to produce oil and gas at the higher commercial production rates. However, under existing SJVUAPCD and EPA permitting rules (see Section 3.3.3), all of this equipment is operated under New Source Review (NSR) and Prevention of Significant Deterioration (PSD) permitting rules. As stated in the General Conformity Rules below, these increased emissions are exempt from General Conformity since emission increases will be regulated by the SJVUAPCD, which has responsibility to develop the SIP:

> "Applicability--Exemptions and Presumptions of Conformity...Sources Subject to NSR or PSD. Actions subject to review under the NSR or PSD programs are exempt under the final rule. As explained in the NSR, such actions undergo procedures and criteria, including air quality analyses, equivalent to those required by the conformity rule. Thus, additional review under conformity is not necessary."

Applicable Air Regulations for Specific Sources. Several changes to SJVUAPCD rules will go into effect over the next several years, and DOE or the new owners would need to be aware of the impacts on facility operations. All engines rated at greater than 50 horsepower, for example, are required to be permitted by the SJVUAPCD. Under SJVUAPCD Rule 4701, emissions from IC engines will be limited in the future. By December 19, 1997, owners of these engines must submit an emission control plan to satisfy the emission limits specified in Section 5.1 of Rule 4701. In general, the larger IC engines did not meet the BARCT standard in 1995. However, with the implementation of appropriate control technology, they are expected to meet the SJVUAPCD limits required by 2001.[2] NPR-1 has electrified the remainder of the engines at the facility to comply with the December 31, 1995 deadline requiring NO_x, CO, and Reactive Organic Gases (ROG) emission limits. Note that the Title V application does not address the requirements imposed by this Rule since it was not Federally applicable at the time the Title V application was due. This Rule, however, is likely to become Federally applicable, and the facility may be required to open the Title V application or permit to include these requirements.

Emission Reduction Credits. The SJVUAPCD administers the storage or transfer of emission reduction credits (ERC) under Rule 2301 (Emission Reduction Banking). Banked ERCs refer to reduction of actual emissions from emission units recognized by the SJVUAPCD as being available for use as tradeoffs or offsets. Offsets are required when equipment or processes are modified or added and

[2] The Federal Facility Compliance Agreement was issued by U.S. EPA Region IX and required DOE to modify larger engines in order to reduce NO_x emissions.

emit significant levels of pollutants. To be eligible for certification as ERCs, emission reductions must be real (reduction or elimination of actual emissions), surplus, permanent, quantifiable and enforceable. NPR-1 currently holds ERC banking certifications for the following pollutants (DOE 1997):

- NO_x - 2,197.8 tons per year;
- CO - 8,534.5 tons per year; and
- VOC - 546.3 tons per year.

The SJVUAPCD has issued 19 ERC certificates to NPR-1. DOE may retain ownership of the ERCs or may transfer them to the new owner. If DOE retains ownership, the new owner may be required to obtain ERCs for any permit modifications with emissions increases. The new owner may obtain the ERCs from DOE or elsewhere. DOE may also transfer the ERCs as a part of the sale. If DOE transfers the ERCs to the new owner, the new owner would be required to submit an application to transfer ERC certificates at the completion of the sale. The transfer of ERCs is governed by SJVUAPCD Rule 2301 (Emission Reduction Credit Banking) and Rule 3060 (Emission Reduction Credit Banking Fee). DOE would have to submit a letter notifying the SJVUAPCD of the pending change in ownership at least 30 days prior to the completion of the sale. The ERC certificates would be reissued upon completion of application processing.

Emerging EPA Standard for $PM_{2.5}$. Particulate matter refers to small particles suspended in the air. The greatest health concerns are tiny particulates less than 10 microns in size (PM_{10}) that can be inhaled into the lungs. These are about 1/6th the size of a human hair. The EPA current health and welfare-based standards for PM_{10} were last revised by EPA in 1987. Since the standards were last revised, a large number of significant new studies have been published on the health effects of particular matter. Recent health studies have indicated that even more microscopic particles called $PM_{2.5}$ (particulate of less than 2.5 microns in size) can penetrate deeply into the lungs and damage lung tissue. They have a particularly negative health impact on more sensitive individuals (those with asthma, other respiratory diseases and heart disease). EPA revised the primary standards in July 1997 by adding a new annual $PM_{2.5}$ standard set at 15 microgram/m^3 and a new 24 hour $PM_{2.5}$ standard set at 65 microgram/m^3. EPA will work with states to deploy the $PM_{2.5}$ monitoring networks to determine (1) which areas meet or do not meet the new air quality standards (2) what are the major sources of $PM_{2.5}$ in various regions, and (3) what action is needed to clean up the air. States will have 3 years from the date of being designated nonattainment to develop pollution control plans and submit to EPA showing how they will meet the new standards. Areas will then have up to 10 years from their designation as nonattainment to attain $PM_{2.5}$ standards with the possibility of two 1-year extensions.

Particulate matter can be classified into two types:

- Primary Particulate - particles in the air that originate from direct emissions (road dust, dust storms, construction, wood smoke, motor vehicles and other combustion processes); and
- Secondary Particulate - formed in the atmosphere by condensation and chemical reaction of sulfur dioxide, nitrogen and hydrocarbons.

$PM_{2.5}$ is emitted by several sources in oil production facilities. The major source is fugitive dust from vehicles traveling on paved and unpaved roads. Road dust is responsible for emitting about 25 percent of $PM_{2.5}$ and 15 percent of PM_{10} (MRI 1997). Fugitive dust is also emitted during developmental and remedial drilling activities; about 15 percent of the PM_{10} emitted from this activity is classified as $PM_{2.5}$.

Sources of combustion are the major source of microscopic secondary particulate formation, including $PM_{2.5}$. Formation on secondary particulate is a complex process with several pathways and factors, including competing chemical reactions, temperature, the presence of smog, clouds and fog. In particulate formation, NO_x is changed from a gas into nitric acid by a chemical reaction. It then combines with ammonia, sea salt and other substances to form small particles. Combustion sources at oil production facilities include internal combustion engines (from stationary and mobile sources), boilers and flares.

3.3.2. Baseline Meteorology and Air Quality

A detailed discussion of climatic and meteorological conditions that occur around the NPR facility is included in Appendix D, Section D.1. Although frequent meteorological atmospheric inversions, which can lead to unhealthy air quality levels, occur in the central valley, severe air pollution episodes are infrequent in the winter due to the dispersion of pollutants by wind flows (see Figure D-2 in Appendix D). During the summer, however, the prevailing north-to-south winds carry ozone precursors (reactive organic gases (ROG) and nitrogen oxides (NO_x)) and particulate matter emissions to the southern region of the basin. Consequently, emissions from some of the larger cities in the basin, including Stockton and Fresno, are dispersed into Kern County. Consequently, ozone levels in the San Joaquin Valley Air Basin increase from north to south (CARB 1992).

Kern County is in nonattainment for ozone and fine dust (PM_{10}) (see Table 3.3-1). In addition, the City of Bakersfield is in nonattainment of the Federal standard for carbon monoxide (CO). An evaluation of the ambient air data collected by a network of air monitoring stations located throughout Kern County indicates attainment of the ambient air quality standards for CO, NO_x, sulfur oxides (SO_2), lead, sulfates, nitrates or air toxics in recent years. Ozone and PM_{10} concentrations, however, continue to reach unhealthy levels.

Historical analysis of the ambient monitoring data shows that general ozone air quality in the county has fluctuated over the last 15 years but has not significantly improved since 1980 (CARB 1992). Figure 3.3-1 presents the number of state and Federal ozone violations in Kern County since 1980 at monitoring stations near Bakersfield as well as the NPR facilities (Maricopa Station). Evaluation of the most recent data shows that the California standard of 0.09 ppm was exceeded at seven monitoring stations in Kern County in 1995. Table 3.3-2 presents the highest one-hour and annual mean ozone concentrations measured at each of the monitoring stations in 1995. The highest one-hour concentrations of 0.17 and 0.15 ppm were recorded at the Edison and Arvin monitoring stations, respectively. These values are approximately double the California standard for ozone.

Table 3.3-1
Kern County Attainment Status

Pollutant	Attainment Status	
	State Standard	*Federal Standard*
Ozone	Severe Nonattainment	Serious Nonattainment
Carbon Monoxide	Attainment	Attainment (except Bakersfield)
Sulfur Dioxide	Attainment	Attainment
Nitrogen Dioxide	Attainment	Attainment
Particulate Matter PM_{10}	Nonattainment	Serious Nonattainment
Lead	Attainment	Attainment
Sulfates	Unclassified	--
Hydrogen Sulfide	Unclassified	--
Vinyl Chloride	Unclassified	--

Figure 3.3-1
Annual Number of Ozone Violations in Kern County Since 1980

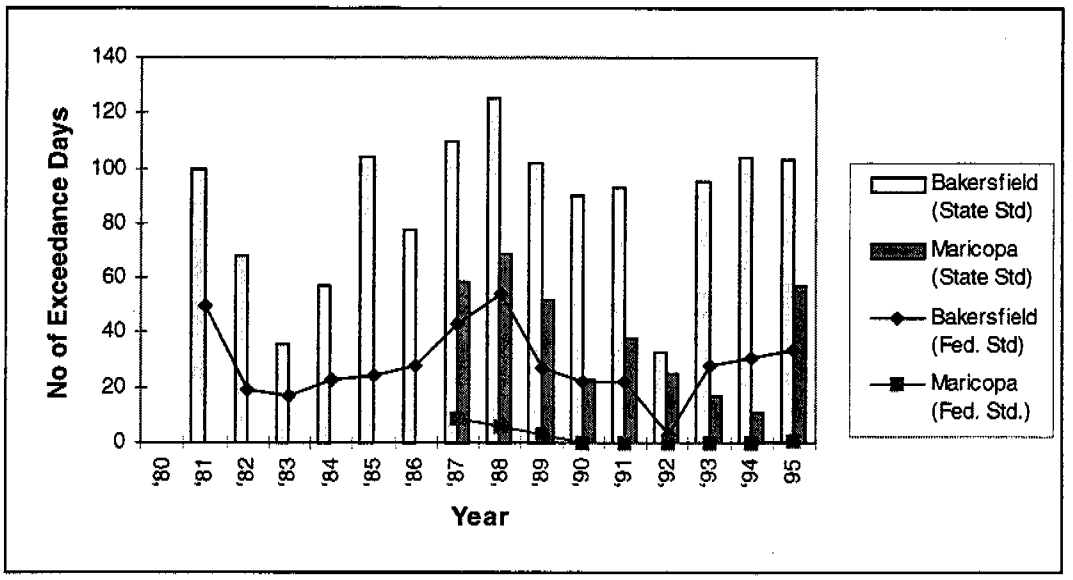

Table 3.3-2
1995 Annual Ozone Data in Kern County

Monitoring Station	Ozone Concentration (ppm)			
	1-hour Mean		Annual Mean	
	1st Highest	2nd Highest	All Hours	Dly Max Hr
Arvin	.15	.14	.043	.069
Bakersfield - Golden State Hwy	.13	.12	.025	.057
Bakersfield - California Ave	.13	.13	.029	.064
Edison - Johnson Ranch	.17	.17	.044	.074
Maricpoa	.13	.13	.049	.066
Oildale	.13	.12	.033	.058
Shafter	.11	.11	.027	.058

Appendix D, Section D.2 contains a detailed discussion of all ambient monitoring that has occurred around the NPR site since 1980. Table 3.3-3 shows the annual summary statistics PM_{10} and CO concentrations measured in Kern County in 1995. The annual NAAQS for PM_{10} (50 Tg/m^3 as an arithmetic mean) was exceeded in 1994 at all five monitoring stations where samplers were in operation throughout the year. The standard was exceeded by about 25 percent or more at these stations. These data show that PM_{10} emissions continue to be a major air pollution problem in the county as the trend of exceeding the Federal and state AAQS for PM_{10} continues. (Note that in 1996, the U.S. EPA also proposed an ambient air quality standard for $PM_{2.5}$ but these emissions have not been monitored. This standard is expected to be finalized in late July or early August, 1997.) In contrast, Table 3.3-3 shows that no violations of the state or Federal CO standard (9 ppm) were measured in Kern County.

Table 3.3-3
1995 PM_{10} and CO Data in Kern County

Pollutant Averaging Period	Monitoring Station			
	Bakersfield - Golden State Hwy	Bakersfield - California Ave	Oildale	Taft College
PM_{10} - 1 hour				
- 1st highest	132	130	195	93
- 2nd highest	131	126	111	84
PM_{10} - Annual				
- Geometric	48.9	41.8	37.8	31.7
- Arithmetic	58.0	49.7	31.7	38.5
CO - 1 hour				
- 1st highest	7	8	-	-
- 2nd highest	7	7	-	-
CO - 8 hour				
- 1st highest	4.6	6.4	-	-
- 2nd highest	3.8	4.9	-	-

3.3.3. Atmospheric Emissions at NPR-1

Emission sources at NPR-1 include surface disturbances, stationary sources, and mobile sources. A list showing the categories of stationary sources of air pollution that are located at NPR-1 and NPR-2 is shown in Table 3.3-4. Emission estimates for each of these sources were developed for 1995 based on actual operating conditions that occurred that year. This baseline emission inventory was developed using emission estimates submitted by NPR-1 to the SJVUAPCD for 1995. For this analysis, the SJVUAPCD inventory of atmospheric emissions was augmented to include additional stationary sources not typically included in the inventory or sources that are not permitted by the SJVUAPCD or U.S. EPA (e.g. tanks, soil disturbance).

Table 3.3-4
List of Emission Source Types at NPR-1 and NPR-2

Source Description	Types of Emissions				
	NO_x	VOC	PM	CO	SO_2
Fuel Combustion					
Internal Combustion Engines	√	√	√	√	√
Boilers	√	√	√	√	√
Flares	√	√	√	√	√
Evaporation/ Fugitive					
Well Cellars/Heads		√			
Components		√			
Tanks		√			
Other Miscellaneous Sources		√			

Table 3.3-5 summarizes the 1995 inventory of stationary source emissions at NPR-1. Emissions are reported in three categories: (1) stationary combustion sources; (2) drilling and construction (surface disturbance); and (3) evaporative sources. Detailed information is provided in Appendix D describing the emission sources in these three categories.

Table 3.3-5
1995 NPR-1 Stationary Source Emissions
under the Reference Case

Source Type	Average Hourly Emissions (lb/hr)				
	PM_{10}	CO	SO_x	NO_x	ROG
Stationary Combustion Sources					
Compressors Engines	3.68	384.77	0.35	169.36	45.86
Boilers and Heaters	0.68	3.04	0.09	15.22	0.35
Cogenerators	0.02	3.46	1.48	5.17	0.92
Flares	0.19	0.84	0.03	4.21	0.11
Pump Engines	0.15	9.83	0.01	5.55	2.37
Diesel Fired Engines	0.04	0.12	0.04	0.55	0.03
Subtotal	*4.76*	*402.06*	*1.99*	*200.06*	*49.64*
Drilling and Construction					
New Development Drilling	17.90	31.44	3.65	131.02	12.70
Remedial Drilling	14.00	29.21	3.33	122.36	12.00
Fugitive Dust - New Construction	0	0	0	0	0
Subtotal	*31.90*	*60.65*	*6.98*	*253.38*	*24.70*
Evaporative Emissions					
Tanks	0	0	0	0	117.05
Fugitive Emissions					
Valves, Connectors, etc.	0	0	0	0	92.53
Well Heads and Cellars	0	0	0	0	226.61
Stack Vent Releases	0	0	0	0	63.64
Oil-Spill related Emissions	0	0	0	0	1.53
Percolation Ponds	0	0	0	0	5.52
Subtotal	*0*	*0*	*0*	*0*	*506.87*
Total	36.66	462.72	8.97	453.44	581.22

Motor vehicles operating in and around NPR-1 also generate emissions of atmospheric pollutants. The emissions of PM_{10}, CO, NO_x, and hydrocarbons (ROG) resulting from mobile sources (such as cars and trucks transporting gas and oil in and out of the facility and employees commuting) at NPR-1 (and in surrounding areas) were analyzed for 1995. Emissions were estimated by multiplying a unit of activity (such as vehicle miles traveled for the Reference Case, or VMT) by an emission factor, or an estimate of the rate at which a pollutant is being emitted. Table 3.3-6 presents the estimated total emissions from mobile sources for the 1995 analysis year for several atmospheric pollutants.

Table 3.3-6
1995 NPR-1 Mobile Source Emissions

Source Category	Emissions (lbs/day)			
	ROG	NO_x	CO	PM_{10}
On-Site Emissions				
Light-duty autos	15.12	14.91	297.43	465.71
Light-duty trucks	22.95	36.65	364.09	746.83
Heavy-duty trucks	5.24	40.87	22.01	10.75
Off-Site Emissions				
Light-duty autos	6.93	11.22	150.19	13.74
Light-duty trucks	5.49	10.07	112.55	8.35
Heavy-duty trucks	21.59	373.15	108.57	64.56

To determine the effect of these emissions on the current concentration of pollutants surrounding the NPR-1 site, the U.S. EPA computer model, Industrial Source Complex Short Term (ISC3ST), was used to simulate dispersion of the emission sources to ground level locations within NPR-1 and in surrounding areas. The ISC3ST is recommended in the *U.S. EPA Guidelines on Air Quality Models* (EPA 1987) for dispersion modeling of complex industrial source facilities. ISC3ST accepts hourly meteorological data (e.g., temperature, wind speed and wind direction) and was used to predict one-hour, eight-hour, 24-hour, and annual average concentrations of pollutants. Due to the significant gains in elevation within NPR-1, the ground surface elevations at each emission source and at each receptor point were input to the computer model.

The air quality dispersion modeling indicates that concentrations of most pollutants (SO_2, NO_X, CO) are well below both national and California ambient standards within the facility boundaries and along public access corridors (this is confirmed by measured ambient concentrations as discussed in Section 3.3.1). However, concentrations of particulates, due to the impacts of routine fugitive particulate emissions associated with operation of the oil production facility, can be elevated at certain areas located within the NPR-1 boundaries unless mitigation measures are applied. However, mitigations currently being applied reduce these emissions to less than the California standard and consequently NPR-1 is not in violation of any state standard. The maximum predicted concentrations for all pollutants in 1995, before additional mitigation are shown summarized in Table 3.3-7 and are discussed in more detail in Appendix D.

Table 3.3-7
Maximum Predicted Total Concentrations of Air Pollutants
($\mu g/m^3$) - 1995 (without existing mitigation)

Pollutant	Averaging Period	Maximum On-site	Maximum Off-site	California Standard	National Standard
NO_x	Annual	69.8	0.45	n/a	100
SO_2	24 hr	3.14	0.26	131	365
	Annual	0.30	0.02	n/a	80
CO	1 hr	2,230	39.1	23,000	40,000
	8 hr	1,513	7.4	10,000	10,000
PM_{10}	24 hr	139.08	105.95	50	150
	Annual	36.21	33.38	30	50

Note: Total concentration includes background concentrations of 32 Tg/m^3 for the annual and 93 Tg/m^3 for the 24-hour standard for PM_{10}.

To estimate the impact of current motor vehicle operations at the NPR-1 facility, the CALINE4 model was applied to the intersection of Elk Hills Road and Skyline Boulevard. CALINE4 is a line source air quality model developed by the California Department of Transportation (Caltrans) to assess the air quality impacts near transportation facilities (FHWA 1984). CALINE4 uses vehicle emission data, meteorology, and roadway configuration information to predict pollutant concentrations for receptors located along the roadway. In 1995, the highest predicted one-hour concentration of CO was 200 Tg/m^3 at locations approximately 10 meters from the roadway. Since this concentration was predicted near the maximum modeled ISC3ST concentration, the maximum total predicted concentration for CO is 2,400 Tg/m^3, well below the state and national standards.

3.3.4. Atmospheric Emissions at NPR-2

Emission sources at NPR-2 include surface disturbances, stationary sources, and mobile sources. Surface disturbances include earth working, drilling activity and traffic-generated PM_{10} in the form of fugitive dust. Stationary sources include compressor engines, electrical generators, boilers, heaters, flares, pump engines and miscellaneous field engines (DOE 1993b). Mobile sources include vehicles that emit PM_{10}, CO, NO_x and hydrocarbon emissions. These mobile source emissions are also expected to be low in comparison to NPR-1 because the number of employees is significantly smaller. The emissions from NPR-2 are estimated to be much less than those from NPR-1 because production levels are much lower. NPR-2 wells produce approximately 1,000 barrels per day, compared to 80,000 barrels per day on NPR-1. Accordingly, NPR-2 has fewer actual emission sources than NPR-1.

3.3.5. References

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3.4. WATER RESOURCES

This section provides summary information on the hydrodynamic characteristics of the water resources found within the NPR-site. Both surface water and groundwater characteristics are discussed. Section 3.4.1 provides an overview of current applicable regulations affecting water resources. Section 3.4.2 discusses the water use requirements of the site. Section 3.4.3 discusses surface water issues. Section 3.4.4 discusses groundwater issues. Section 3.4.5 provides the reader with a list of references for further information.

3.4.1. Applicable Regulations

The protection of surface water resources at NPR-1 is governed by a set of Federal, state and local regulations. The Clean Water Act provides for the restoration and maintenance of the physical, chemical and biological integrity of the nation's waters. Surface water discharges are regulated under Section 13000 of the California Water Code by the California Regional Water Quality Control Board (CRWQCB) (which receives its authority through California Porter/Cologne Water Quality Control Act). The Waste Discharge Order 58-491 issued by the CRWQCB defines certain criteria for discharge to surface drainage channels or into unlined sumps on alluvial soils at NPR-1. Currently, there are no operations or activities at NPR-1 that require a standard NPDES (National Pollutant Discharge Elimination System) permit.

Under the provisions of the Clean Water Act, standards are also set to protect the nation's waters from polluted stormwater discharges. The only waterbody on NPR-1 that has been classified as a navigable waterway, and thus falls under the provisions of the Clean Water Act, is Buena Vista Creek. NPR-1 is presently exempt from the NPDES stormwater discharge permit requirements because there have been no reportable quantity spills into stormwater and because stormwater is basically non-existent at Elk Hills. As a best management practice, however, site personnel have been monitoring Buena Vista Creek and other drainages during storm events since 1992 to determine if any contaminated runoff occurs and if it contains an oily sheen. Existing procedures call for NPR-1 to submit a Notice of Intent to receive coverage under a general NPDES permit for stormwater runoff within 30 days to the California Regional Water Quality Control Board, if a reportable quantity spill occurs into Buena Vista Creek. Other environmentally sensitive areas that have been designated since the establishment of NPR-1 include the Kern Fan Element of the Kern Water Bank located adjacent to the northeast flank of Elk Hills, and the Buena Vista Aquatic Recreation Area located two miles southwest of NPR-1 (BPOI et al. 1995).

The seasonal drainages present on NPR-1 are generally under the jurisdiction of the California Department of Fish and Game. Under the Fish and Game Code (section 1600 et seq.), the Department must be notified and streambed alteration agreements must be obtained for work in the bed banks or channels of lakes, ponds, rivers, or streams.

Executive Order 11988, "Floodplain Management," and Executive Order 11990, "Protection of Wetlands" requires all Federal agencies to consider the effects of proposed actions on floodplains and wetlands, respectively. DOE's floodplain/wetlands regulations at 10 CFR 1022 establish criteria for assessing impacts to floodplains and wetlands on DOE lands. DOE Orders 0440.1, Environmental Protection, Safety and Health, and 0200-1.1 [4], General Design Criteria, require that any proposed action incorporate floodplain management goals into its planning process.

Groundwater resources at NPR-1 are protected by a series of Federal and state regulations. For example, the Safe Drinking Water Act provides for the establishment of a Federal Underground Injection Control program. California, which is classified as a Primary State, has adopted U.S. EPA guidelines for underground injection and administers its program through the provisions of Title 14 of the California

Code of Regulations (BPOI 1994). The drilling and operation of wells are regulated under the California Laws for Conservation of Petroleum and Gas, which are promulgated as CCR Title 14 and administered by the California Division of Oil, Gas, and Geothermal Resources (DOGGR). These provisions include a series of measures to protect groundwater resources.

In accordance with DOE Order 0440.1, a Groundwater Monitoring Plan and a Groundwater Protection Management Program have been in place since 1994. In addition, the water source wells located on the south flank of NPR-1 are monitored and sampled on a monthly basis in accordance with BPOI Operating Instruction (OI) 410-004I.ESG (BPOI 1994).

3.4.2. Water Use Requirements

The combined effects of topography and meteorology cause aridity to increase in the San Joaquin Valley from east to west and from north to south. The Elk Hills are located near the southwestern edge in the most arid portion of the San Joaquin Valley, with about four to six inches of annual precipitation, most of which falls during October through April. The extensive agricultural economy in Kern County requires large quantities of water for irrigation. Gross irrigated acreage in the San Joaquin Valley portion of Kern County covered 802,400 acres in 1994, with about 144,500 acres of farm land idle during 1994 due to the dry conditions. The gross water requirements for irrigation were estimated to be about 2,948,500 acre-feet. Municipal and industrial requirements reached approximately 181,800 acre-feet in 1994 (KCWA 1996).

An important portion of the water used in Kern County is obtained from groundwater resources (approximately 1,895,800 acre-feet were extracted in Kern County in 1994, and the average groundwater pumping in 1970 to 1994 was 1,399,100 acre-feet). The Kern County Water Agency (KCWA) has the primary power to acquire and contract for water supplies in the county. The KCWA distributes water to 16 local water districts. The districts located near NPR-1 include the West Kern Water District to the west of NPR-1, and the Buena Vista Water Storage District to the east. Water supplies include the State Water Project (668,577 acre-feet in 1994), the Kern River (425,053 acre-feet diverted in 1994), the Central Valley Project (186,303 acre-feet in 1994), and other minor sources like minor streams, precipitation, wastewater reuse and water produced for oilfield production (KCWA 1996). Oil-field wastewaters recharge the groundwater system (replace lost supplies) through the waste disposal practices of underground injection, sumping in unlined pits and discharging to natural drainageways. Wilson and Zublin (1988, referenced in DOE SEIS 1993) indicate that about 2,328 million barrels of petroleum-associated wastewater have been disposed of in the Midway Valley and Buena Vista Valley vicinity through percolation, while 253 million barrels have been reinjected into subsurface formations.

NPR-1 has a guaranteed purchase agreement with the West Kern Water District of a minimum of 987,000 gallons of water per day, and a maximum of 1,974,000 gallons per day. The average purchase (1988 to 1995) has been 1,257,900 gallons per day. NPR-1 also extracts groundwater from wells on the southern boundary, for use in an enhanced oil-recovery program. The average daily injection rate for waterflood (enhanced recovery) operations is 136,756 barrels per day (BPOI 1996).

3.4.3. Surface Water

3.4.3.1. Surface Water Drainage

Due to the arid conditions in the San Joaquin Valley, almost all of the streamflow that reaches the valley originates in the Sierra Nevada (Nady and Larragueta 1983). Most of the water enters the Central Valley from streams draining the eastern side, while the streams draining the western side are

ephemeral and carry water only during wet years (DOE SEIS 1993). The largest inflow of surface runoff to the southwestern San Joaquin Valley originates from the Kern River (DOE EA 1994).

NPR-1 is situated within the boundaries of the Tulare Lake Basin, which is a closed, hydrologic system. Surface and groundwater flows within the basin converge toward 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 reduce these lakes to dry lakebeds (BPOI 1992).

Two important surface water features near NPR-1 are the Kern River and the California Aqueduct. The Kern River is the southernmost of the major streams that rises in the Sierra Nevada and flows into the San Joaquin Valley (Maher et al. 1975). The California Aqueduct, a major conduit of freshwater for Los Angeles and southern California, borders NPR-1 to the north, east and south, and is located within the NPR-1 boundaries in Sections 23S, 24S and 25S (BPOI 1992).

NPR-1 has relatively limited surface water resources. The terrain of NPR-1 is characterized by numerous, rounded divides and smooth slopes. A drainage divide follows the crest of Elk Hills, causing runoff to flow generally to the north and south. There are no naturally occurring springs located within the boundaries of NPR-1 because there are no sources of continuous natural recharge available. Water has been observed intermittently at the surface on NPR-1 in Sections 3G, 4G and 35S. The most likely source appeared to be leaking underground freshwater pipelines, and not natural springs (DOE SEIS 1993).

A large number of ephemeral/intermittent streams draining the hills have created a highly dissected stream pattern of gullies and channels. The primary drainage channels do not merge into an integrated network. The natural course of some of the channels in the northern flank is interrupted by the California Aqueduct; many terminate naturally due to infiltration, and others terminate in gully plugs. Drainage channels in the central portion of the southern flank join Buena Vista Creek in Buena Vista Valley. Watersheds draining the western part of Elk Hills convey runoff in the direction of McKittrick Valley, which slopes towards the northwest (BPOI 1992, DOE SEIS 1993). DOE SEIS (1993) presents selected characteristics of drainage basins in the Elk Hills, obtained from topographic maps, as well as computed hydrologic data for some creeks near NPR-1.

NPR-2, as NPR-1, has limited surface water resources. Three ephemeral streams (Buena Vista Creek to the north, Broad Creek through the center and Sandy Creek to the south) drain NPR-2. Surface flow occurs entirely in the form of dry wash runoff during and immediately following periods of heavy precipitation. Such flows are easily evaporated into the atmosphere or accumulated in the vicinity of the lake bed at Lake Buena Vista (DOE EA 1994).

Portions of four drainage basins have been identified on NPR-2 (DOE EA 1994). The four drainage basins (going from the northwest to the southeast of NPR-2) are the Buena Vista Creek and tributaries, Broad Creek and tributaries, Buena Vista Hills tributaries and Sandy Creek and tributaries.

3.4.3.2. Wetlands and Floodplains

DOE completed a wetlands delineation study for NPR-1 in 1995 (DOE 1995). This study, which was conducted in accordance with the 1987 Army Corps of Engineers wetland delineation manual as well as more recent Corps guidance on the subject (dated October 7, 1991 and March 6, 1992), evaluated more than 40 sites located on the U.S. Fish and Wildlife Service's National Wetland Inventory maps within NPR-1. The study determined that none of the sites contain jurisdictional wetlands as defined in Section 404 of the Clean Water Act. The Sacramento District of the Corps of Engineers has subsequently confirmed this determination for all of the sites studied.

The Federal Emergency Management Agency (FEMA) has not analyzed the NPR-1 site to determine its flood potential. Since flood insurance rate maps stop at the boundary of NPR-1, the Corps of Engineers was contracted to perform a floodplain study of NPR-1 to comply with DOE Orders 5480.4 and 6430.1A. (DOE Orders 5480.4 and 6430.1A have subsequently been changed to DOE Order 0440.1 and 0200-1.1[4], respectively.) This study, completed in November 1993, delineates the 100-year floodplain boundaries on U.S. Geological Survey quadrangle (7.5 minute) maps (Army COE 1993). These maps show that the 100-year floodplain boundaries on NPR-1 are confined to isolated areas immediately adjacent to a few drainage channels. For example, on the northern flank of NPR-1, 100-year floodplains exist along the banks of North Elk Hills Tributaries No. 1 through 11. In every instance, the floodplain boundaries follow the drainage channel and are, with only four exceptions, approximately 100 feet wide. The exceptions are the very northern stretches of North Elk Hills Tributaries No. 6, 7, 10 and 11, where the floodplain boundaries fan out to widths ranging from 440 to 1,600 feet. Similarly, along the southern flank of NPR-1, narrow floodplains follow the channels of Buena Vista Creek Tributary No. 2 as well as South Elk Hills Tributaries No. 1, 2, 2-A, 3, 3-A, 4 and 5. The 100-year floodplain of Buena Vista Creek, which is approximately 1,000 feet wide, cuts across the extreme southwestern tip of NPR-1.

On NPR-2, a 1994 DOE wetland delineation study concluded that there are no jurisdictional wetlands on the reserve (DOE 1994a). The Corps of Engineers has reviewed and verified this study and confirmed the determination that no areas on NPR-2 meet wetland designation criteria. Within the drainage basins on NPR-2, several areas have been identified that potentially would be inundated during a 100-year flood. About 1,250 acres, representing approximately 12 percent of DOE-managed NPR-2 lands, are estimated to be part of a 100-year floodplain (DOE EA 1994). The 100-year floodplains are mapped on nine of the 15 Sections managed by DOE within NPR-2 (8B, 18B, 20B, 28B, 34B, 32G, 12C, 18D and 18H). Of these Sections, 100-year floodplains are largest on Sections 8B, 18B, 32G and 18H, covering a majority of these Sections. The remaining six Sections managed by DOE within NPR-2 (22B, 26B, 30G, 4D, 14D and 12D) do not have 100-year floodplains.

3.4.3.3. Surface Water Quality

Surface water quality data from NPR-1 is exceedingly sparse. A single surface water sample was collected from the northeast flank of Elk Hills (NPR-1), north to northeast of NPR-2 (DOE EA 1994 from Dale et. al., 1966). This sample reported a total dissolved solids (TDS) of 1,300 mg/l, which indicates that this water is unsuitable for most uses. For NPR-2, a single surface water sample analysis is available from Buena Vista Creek, which runs through the northern edge of NPR-2. This analysis reported a TDS level of 3,400 mg/l (DOE EA 1994 from BPOI, 1991a). The sample from NPR-2 is above the numerical water quality objectives (3,000 mg/l TDS concentration) for surface and groundwater as stated in CRWQCB, Central Valley Region Resolution Number 89-098 (DOE EA 1994).

3.4.4. Groundwater

3.4.4.1. Regional Groundwater

The San Joaquin Valley overlies the 1.5 million-acre Tulare Lake Hydrologic Basin, a closed storage area that controls the occurrence and movement of groundwater in the region. The overall direction of groundwater movement is from the flanks toward the axis in the valley, modified by local stratigraphic features. The complex hydrogeology of the San Joaquin Valley has been divided into four layers: (1) an unsaturated layer between the ground surface and the water table; (2) an unconfined, saturated layer; (3) a leaky, low conductivity, saturated, confining layer; and (4) a confined saturated layer. The unconfined and confined saturated layers are the San Joaquin Valley's two major aquifers. The confining layer, referred to as the Corcoran Clay or E Clay, does not cover the entire aquifer, and the two aquifers merge into a single unconfined system (BPOI 1995). More recently, KCWA has suggested a more complicated system consisting of an unconfined aquifer and more than one semi-confined aquifer

(KCWA 1992). As many as ten structural subbasins can be inferred for the southern San Joaquin Valley using seismic data (Pacific Geotechnical Associates 1992). In addition to the unconfined and confined aquifers, perched groundwater may exist at shallow depths (DOE SEIS 1993).

Figure 3.4-1, taken from KCWA (1996), provides groundwater surface elevation for the unconfined groundwater basin of the southern San Joaquin and the Buena Vista valleys. The depth to groundwater in the San Joaquin and Buena Vista Valleys ranges from approximately 50 feet beneath the Kern River channel to more than 650 feet in southern extremes of the valley near the White Wolf fault (KCWA 1990). The depth to perched groundwater is typically no more than 20 feet beneath the surface along western margins of the San Joaquin Valley (KCWA 1990). The general direction of groundwater flow is away from a northeast-southwest trending ridge beneath the Kern River, which is the major groundwater recharge source. In this area, the rate of horizontal groundwater flow in the upper portions of the aquifer is 50 to 700 feet per year (KCWA 1996). Recharge from the west side of the valley moves from streams sourced in the Temblor Range toward the southeast and to the east. A localized groundwater depression, representing a transitional zone between the east and west sides, is situated off the northeast flank of Elk Hills, near the town of Tupman, where numerous production wells are clustered. A groundwater mound is located in the Buena Vista Valley near the south flank of Elk Hills (BPOI et al. 1995).

Several entities in Kern County are actively engaged in groundwater replenishment operations. For example, the Kern River is recharged by a combination of deliberate spreading in recharge areas, by losses in unlined canals or by percolation in the Kern River channel. Such recharge efforts are needed to reduce groundwater overdraft. Since 1970, a total of about 8,566,000 acre-feet of water has been recharged (both deliberately and incidentally) to replenish groundwater supplies (KCWA 1996). Another option that has increased in use during recent years is groundwater banking, which involves storing surface water underground when available and recovering it during times of need. The Kern Water Bank program had been expected to provide as much as 100,000 acre-feet of annual dry-year yield for the State Water Project (KCWA 1996). The tract of land bought for this project is near the northeastern boundary of Elk Hills. However, the State Water Resources Board stopped all planning for the Kern Water Bank in January of 1995 (BPOI 1996).

Given that the groundwater basin in the Kern County portion of the San Joaquin Valley is a basin of interior drainage, with no appreciable surface or subsurface outflow except in extremely wet years, new salts introduced into the basin with imported water supplies are retained in the basin (KCWA 1996). Surface water supplies over the usable groundwater basin in 1994 (approximately 1,240,400 acre-feet) carried about 321,300 tons of new salts. This quantity was about half the amount that was introduced in 1993, due to the lower delivery of surface water in a dry year. In 1994, the State Water Bank introduced 215,100 tons of salt over the usable groundwater basin (67 percent); the Kern River 45,900 tons (14 percent); minor streams 18,200 tons (six percent); the Central Valley Project 10,200 tons (three percent); and other local sources, such as effective rainfall and oil field wastewater 31,900 (ten percent) (KCWA 1996).

Figure 3.4-2, taken from KCWA (1996), depicts the water quality character for the unconfined aquifer, using total dissolved solids (TDS), shown in parts per million (ppm). The wells used to collect this data are generally shallow, usually less than 400 feet. Water quality progressively degrades westward within the Buena Vista Valley (from 500 to 5,000 ppm TDS). Figure 3.4-3, taken from KCWA (1996), presents the TDS data from water wells producing from the confined or lower aquifer system, as the system was understood in 1989. KCWA (1996) indicates that data from recent studies strongly suggests that the area of confinement is smaller than what was understood in 1989. Contours in this figure show the groundwater of the lower aquifer to have relatively smaller TDS values than that of the unconfined zone, because the lower system is partially protected from surface contaminants by the Corcoran Clay (E Clay) (DOE SEIS 1993, BPOI et al. 1995, KCWA 1996).

Figure 3.4-1
Groundwater Surface Elevation

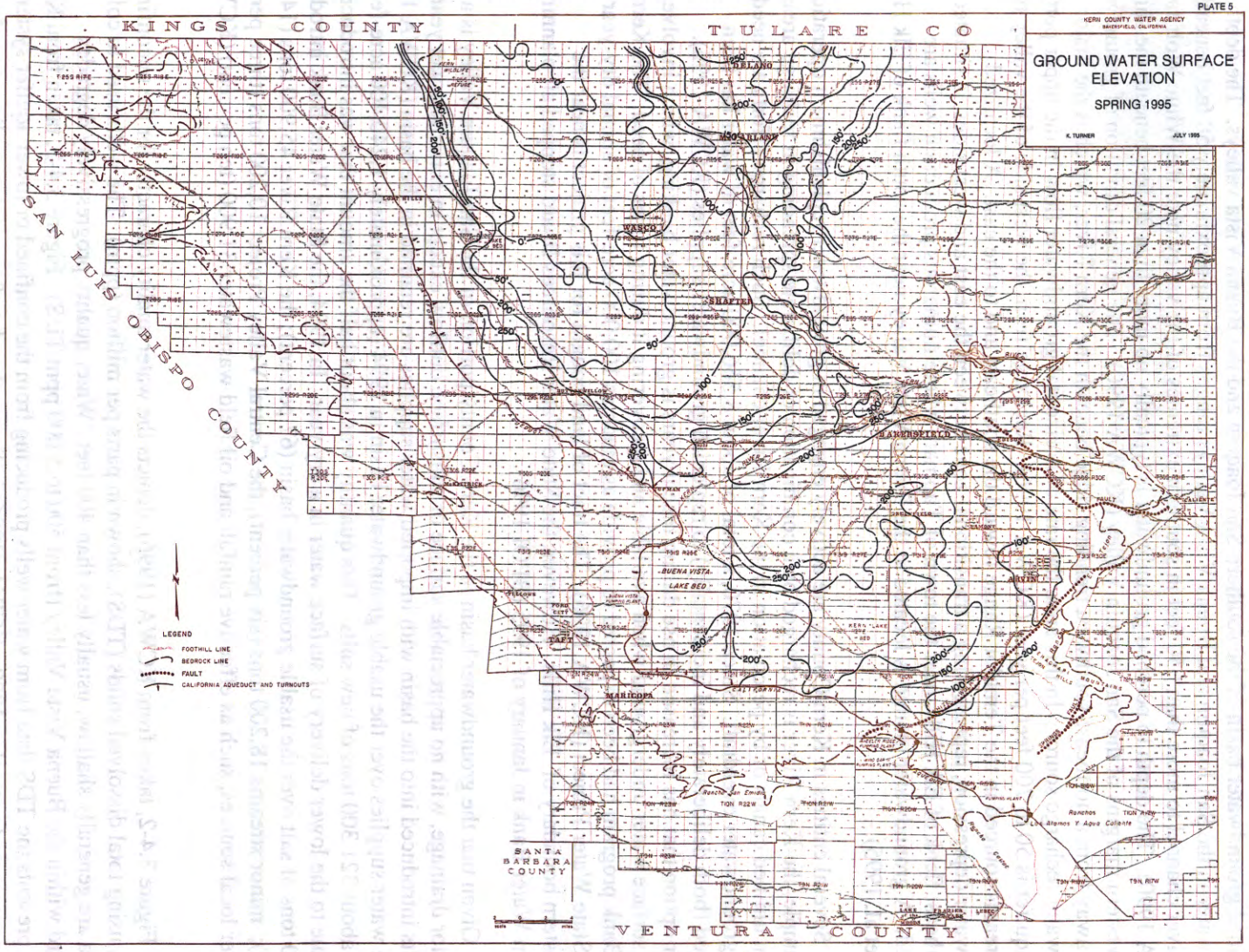


Figure 3.4-2
Groundwater Quality Map: Unconfined Aquifer

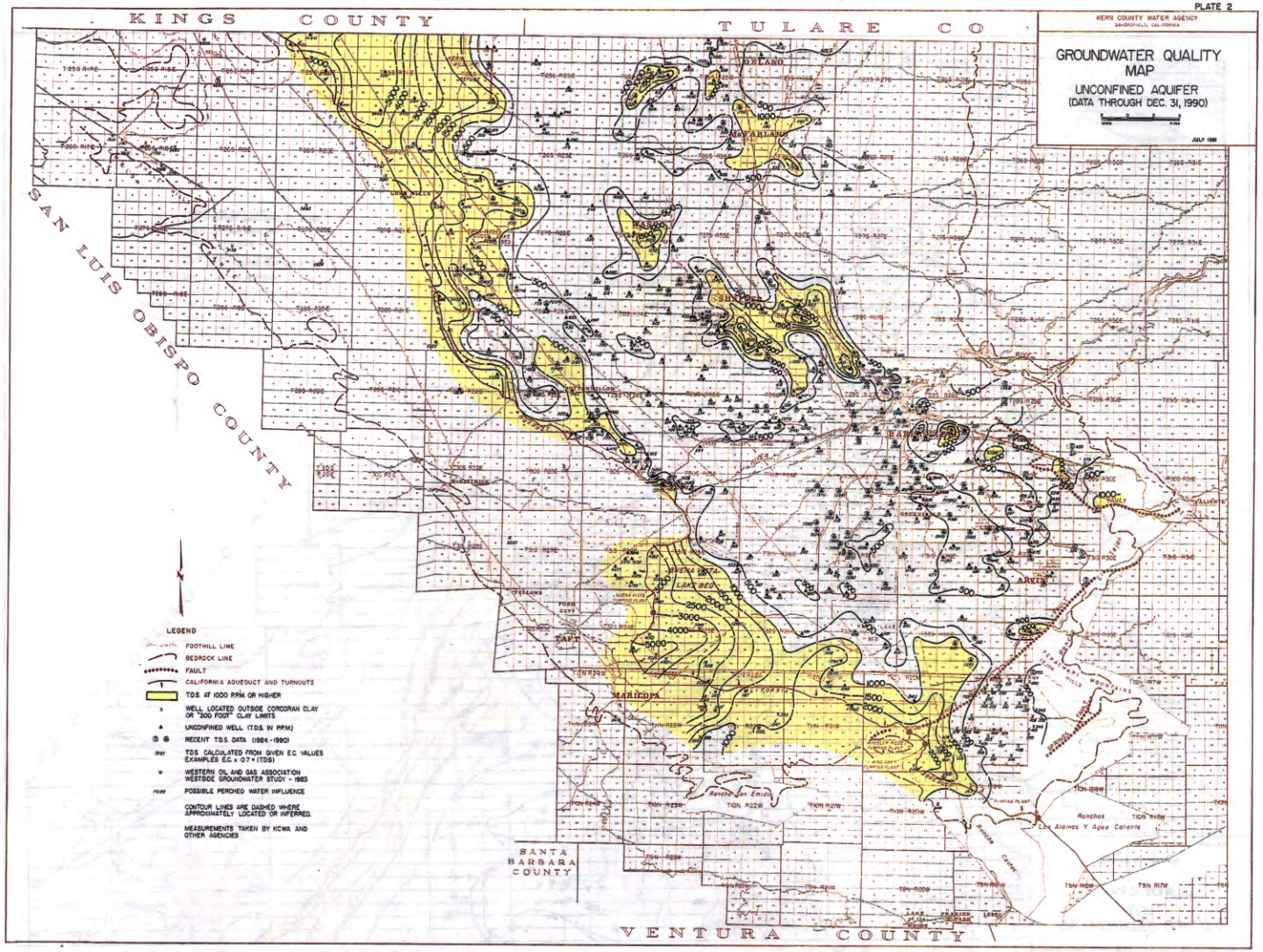
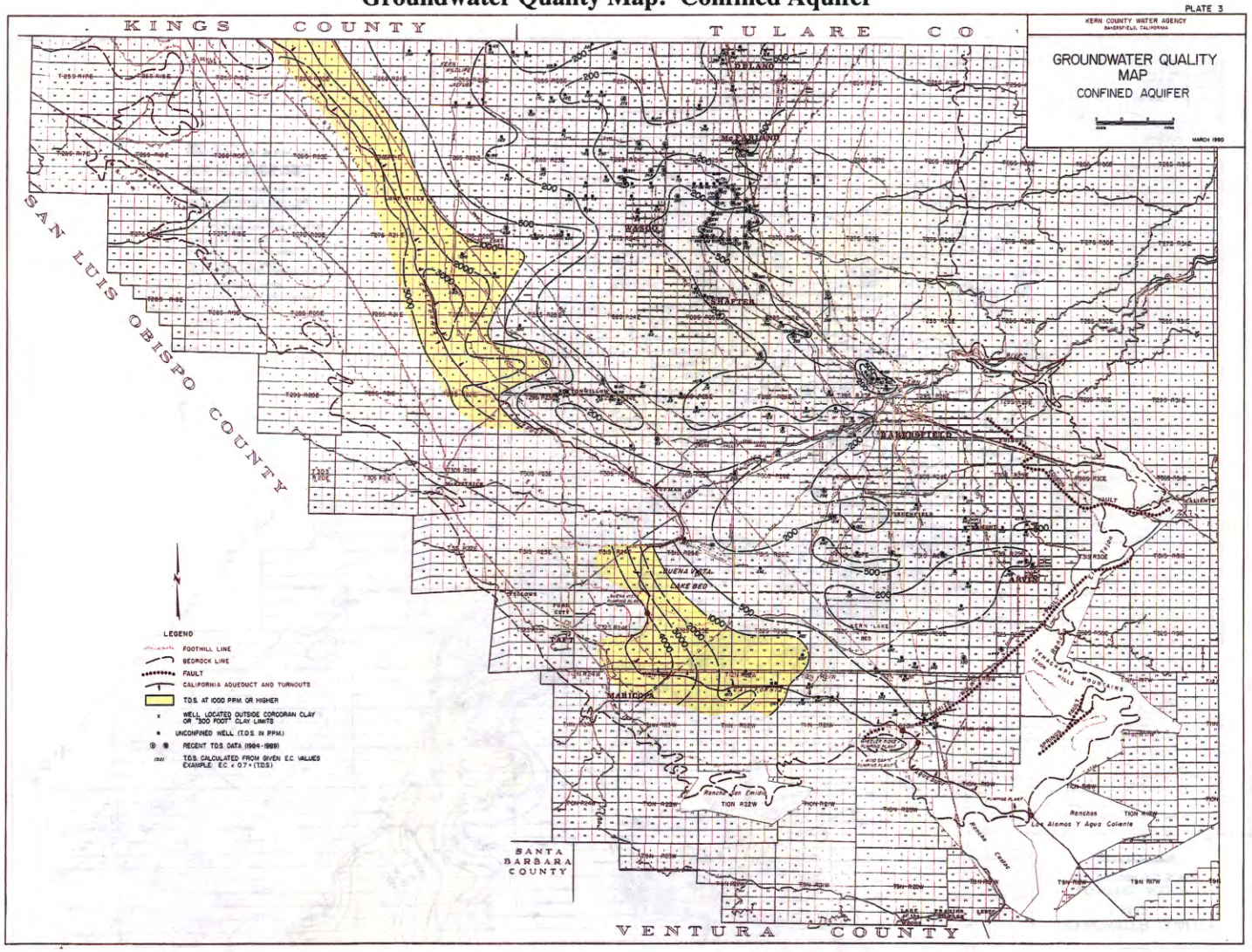


Figure 3.4-3
Groundwater Quality Map: Confined Aquifer



3.4.4.2. Local Groundwater

Groundwater aquifers underlying Elk Hills are located in the Tulare Formation and in older underlying marine formations. The main groundwater bearing unit underlying Elk Hills is the Plio-Pleistocene Tulare formation. The Quaternary alluvium surrounding Elk Hills is another important component of the hydrologic regime of Elk Hills. The groundwater regime within the Tulare formation at NPR-1 has been documented in BPOI et al. (1995) in a series of cross-sections, based on electric logs taken from oil wells drilled throughout the Elk Hills field. A lower, confined aquifer is separated from an upper unconfined zone in the Tulare Formation by a clay layer in some areas of the central and western sections of Elk Hills.

Figure 3.4-4, taken from BPOI et al. (1995), presents the depth to first occurrence of groundwater in the Tulare Formation in NPR-1. Groundwater depths range from approximately 200 feet below ground surface on the north flank of Elk Hills (23S) to almost 1000 feet below ground surface at the crest (35R). The elevation of the first occurrence of groundwater in the Tulare Formation has generally remained at approximately 300 feet above mean sea level (amsl) in those areas not affected by faulting. Near the crest of Elk Hills, levels increase slightly to 350 feet (amsl) and approaching the south flank, levels decrease to about 250 feet (amsl). The steeper gradients observed over the northern portion of NPR-1 appear to be the result of the faults present in the area, which were discussed in Section 3.1. (BPOI et al. 1995). Information provided by Phillips (1992) indicates that static water levels in the south flank area of the Tulare Formation have not changed significantly in the last 10 years.

Rector (1983) indicates that groundwater is flowing from Elk Hills to adjoining basins, as the result of an apparent groundwater mound along the axis of Elk Hills. However, the relatively high salinity of Tulare water in Elk Hills suggests a connate origin (Milliken 1993). Groundwater flow off the flanks of Elk Hills would require significant recharge, which does not exist due to the semiarid climate. Milliken (1993) presents other possible causes for the groundwater mound on NPR-1.

The groundwater areas that have received more attention in NPR-1 are the south and north flank areas, given the use of the Tulare aquifer as a wastewater disposal zone on the south flank, and the proximity of the Kern Fan Element of the proposed Kern Water Bank to the northeast of NPR-1. Recent work performed to support the 1993 SEIS hydrogeologic discussions have provided new understanding of the groundwater regime in these areas. To the north of Elk Hills, Faults 2 and 3 of the 31S structure form groundwater barriers, and other faults (including the Tupman Fault) may also behave like barriers (Milliken 1993). In the south flank of NPR-1, the Tulare clay forms a barrier to groundwater migration between the Tulare Formation and alluvium (Figure 3.4-5, taken from Milliken (1992)). Phillips (1992) and Milliken (1992) present water quality and resistivity (a measure of permeability) data indicating that the Amnicola clay acts as an aquiclude (impermeable barrier) separating the Tulare Formation groundwater above and below this clay layer. Therefore, the alluvium of Buena Vista Valley, from which agriculture water production is obtained, is geohydrologically isolated from the Tulare Formation groundwater in NPR-1.

Figure 3.4-4
Depth to First Occurrence of Groundwater in the Tulare Formation at NPR-1

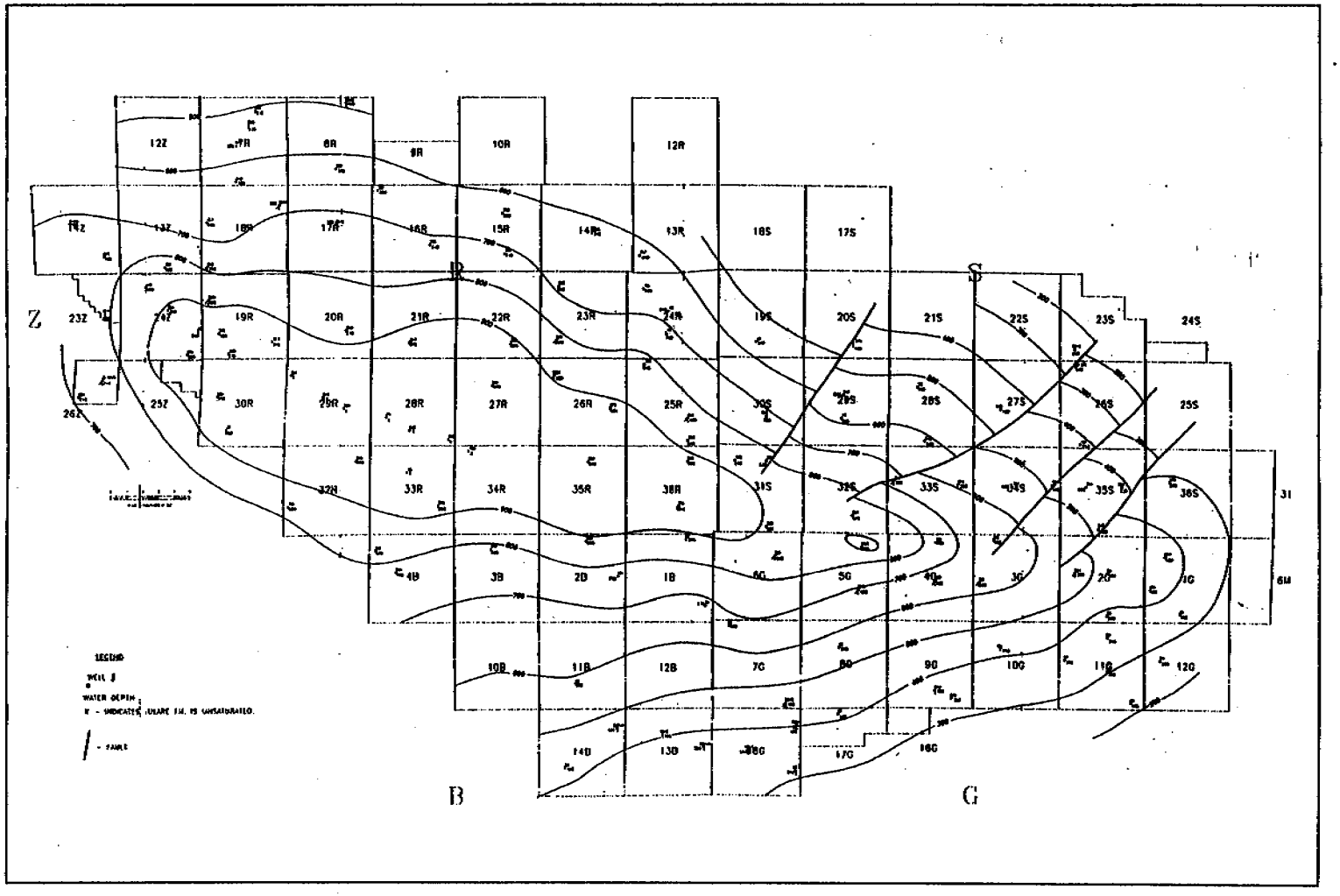
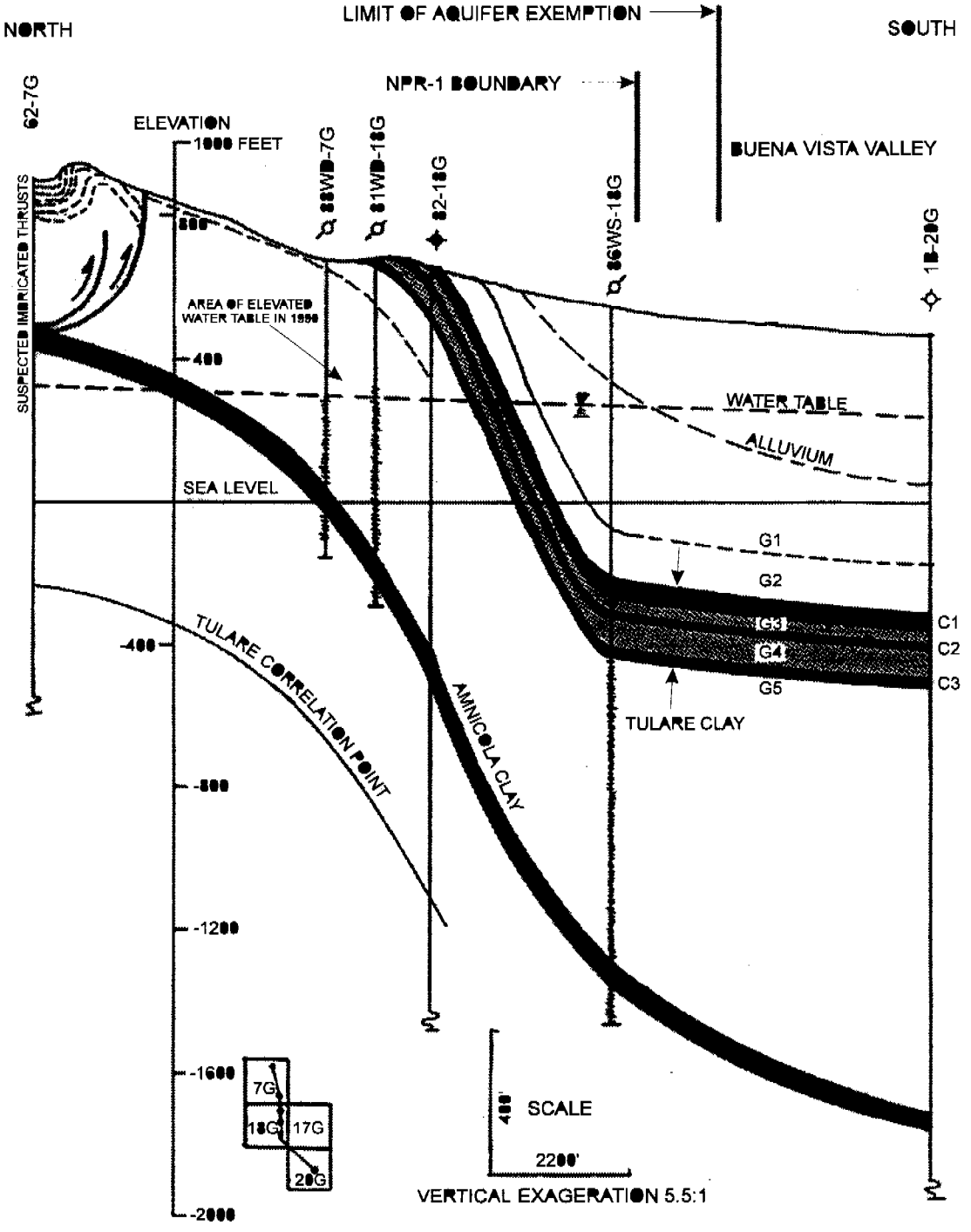


Figure 3.4-5
Structural Cross Section, South Flank of NPR-1 to the Buena Vista Valley



Portions of the Tulare Formation within the Elk Hills Field have been designated as an exempt aquifer by DOGGR because it is hydrocarbon-producing in the western part of the Reserve. A zone exemption does not necessarily include the entire vertical or lateral limits of a formation. The maximum zone exemption includes only the current productive limits of the field as set by DOGGR. The exempted portion of the aquifer coincides with the NPR-1 boundaries except in a few areas. The injection of produced wastewater into exempt portions of the Tulare Formation at NPR-1 has been occurring since 1981 (BPOI et al. 1995). In the period 1982-1992, between 60,000 to 100,000 BPD of produced wastewater have been injected into 19 wells. The location of these wells is shown in Figure 3.4-6 (DOE SEIS 1993). Approximately 70,000 barrels per day of produced wastewater are disposed in the southern flank of NPR-1 into the Tulare Formation (BPOI 1995). For NPR-2 (and the Buena Vista field in general), the producing horizons of the Tulare Formation are permitted for injection and are exempt aquifers.

In 1989, the CRWQCB, Central Valley Region adopted Resolution No. 89-098 as an amendment to the Water Quality Control Plan for the Tulare Lake Basin. This resolution designated all surface and groundwater within the Tulare Lake Basin that currently have no beneficial use designation as municipal and domestic supply (MUN) with the following exemptions (DOE EA 1994):

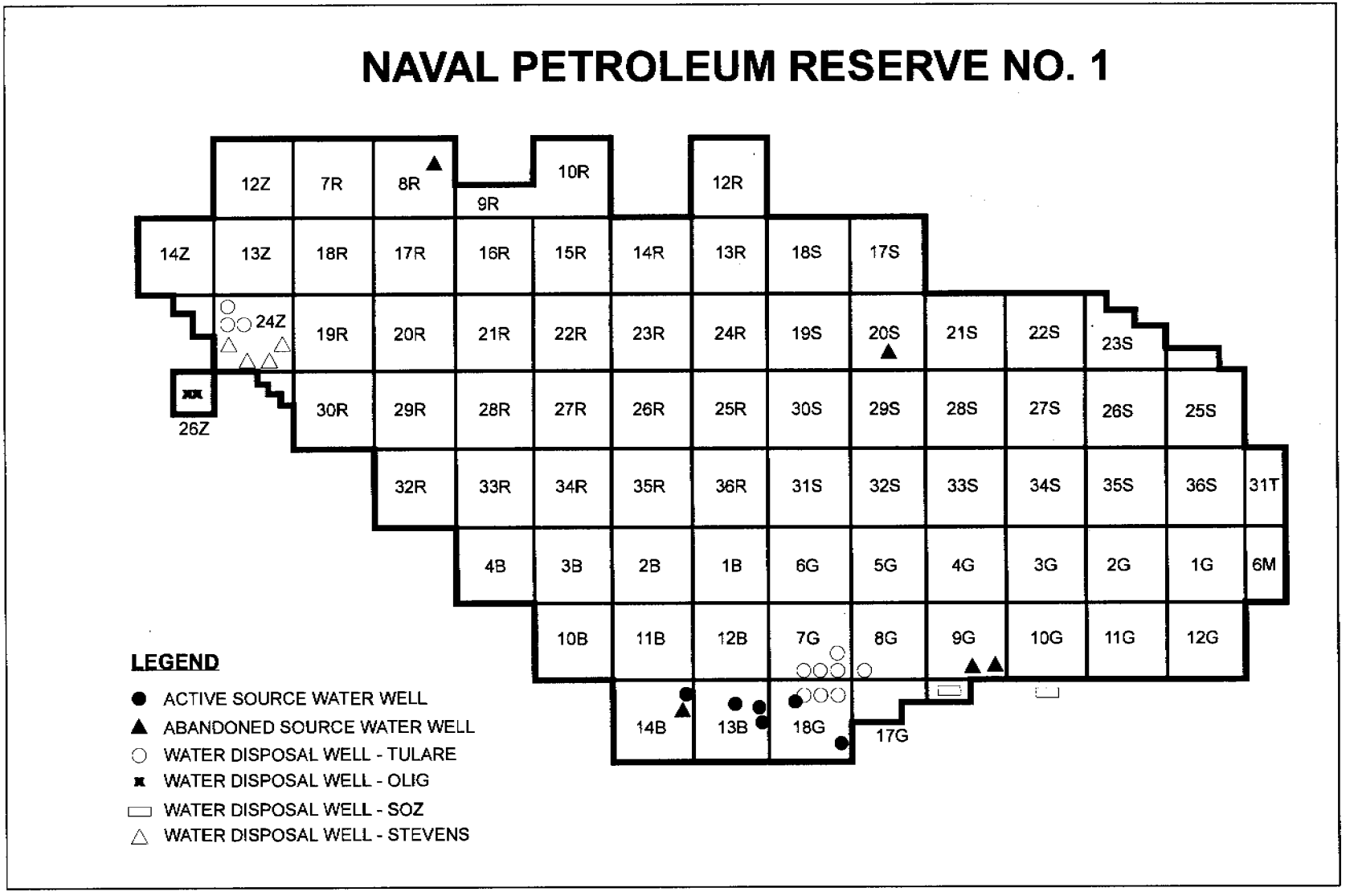
- The TDS exceeds 3,000 mg/l and CRWQCB does not reasonably expect the waters to supply a public water system. There is contamination, either by natural processes or by human activity unrelated to a specific pollution incident that cannot be treated for domestic use, using either Best Management Practices or best economically achievable treatment practices; or
- The water source does not provide sufficient water to supply a single well capable of producing an average sustained yield of 200 gallons/day.

3.4.4.3. Local Groundwater Quality

Since 1979, several wells have been completed in the Tulare Formation to supply water for enhanced oil recovery. There are five active source wells, and average daily source water withdrawal for Fiscal Year 1992 was 142,000 BPD (BPOI 1992). Water quality from these wells ranges from 4,482 to 6,142 ppm TDS (BPOI et al. 1995). A significant change in static water levels has not been observed downdip at the water source wells (Phillips 1992). The source wells are perforated in an interval such that a majority of the groundwater is withdrawn from that zone on the Tulare Formation located between the Tulare clay and the Amnicola clay (see Figure 3.4-6), which is the same zone into which most of the produced water is disposed at the injection wells updip (Phillips 1992).

A proactive program of groundwater monitoring is presently being conducted at NPR-1 on a voluntary basis. NPR-1 is not required to perform RCRA groundwater monitoring, and studies to date of NPR-1 disposal sites and CERCLA sites required by the State of California and DOE do not show groundwater contamination. The Groundwater Monitoring Plan for NPR-1 was completed in 1995 in accordance with DOE Order 5400.1 criteria. The plan includes monthly source well sampling; monitoring well design sitting; design and monitoring criteria; and methods to be applied in defining an NPR-1 hydrogeologic regime (BPOI et al. 1995). One of the objectives of this effort is to evaluate the potential for groundwater degradation to occur, especially from injection operations in the south flank, and from old sumps in the north flank area of NPR-1.

Figure 3.4-6
NPR-1 Source Water Wells and Produced Wastewater Disposal Wells



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Phillips (1992) reviewed data from previous reports (BPOI 1992) and performed additional investigations on Tulare Formation water quality. Data from one of the wells 4,000 feet downdip from the injection well area has not detected a significant change in water quality in ten years of groundwater monitoring (Phillips 1992). The injection operations have not significantly affected downdip exempted groundwater at the other source wells. The injected fluids appear to be diffusing through the Tulare Formation aquifer, as opposed to migrating through the aquifer. Overall, Phillips (1992) concluded that the injection project had been operated in compliance with the requirements of the Underground Injection Control Program. Isotope studies of the south flank disposal area indicated that no mixing of reinjected water and groundwater had taken place. BPOI et al. (1995) presents the results of a test based on December 1993 data taken from four of the five source wells. The results of the test indicate that no significant increases have occurred in any of the source wells for standard geochemical constituents or metals. However, low levels of benzene (averaging 0.3 ppm) have been identified in water samples retrieved from two source wells (BPOI et al. 1995), though the values observed are below the 0.5 ppm TCLP regulatory level.

The occurrence of surface seeps in the 24Z and 7G/18G wastewater disposal areas prompted the abandonment of Well 81WD-18G in 1992 and a change to lower injection rates, as well as the discontinuation in 1992 of produced wastewater disposal into the Tulare Formation in the 24Z area.

In the north flank area of NPR-1, a groundwater monitoring well was completed north of the arsenic contaminated 23S sumps as part of the Groundwater Protection Management Program. Samples are taken biannually, and they indicate that no organic constituents or metals (specifically arsenic) were present.

As part of groundwater investigations associated with NPR-2, Uribe and Associates (1992) examined water quality data from Midway Valley (DOE EA 1994). They reviewed samples taken from the Tulare Formation at depths ranging from 380 to 2,567 feet below surface, and over a 20-year time period. TDS data range from 2,782 to 25,583 mg/l, and they show an increase of TDS with depth.

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3.5. BIOLOGICAL RESOURCES

Activities associated with oil and gas production at NPR-1 and NPR-2 have the potential to impact biological resources. This Section discusses plant and animal communities at NPR-1 and NPR-2 with an emphasis on Federally and state listed species, and species of concern.[1] Section 3.5.1 presents an overview of applicable Federal and state regulations. The existing plant and animal communities at NPR-1 are discussed in Section 3.5.2 and 3.5.3, respectively. Section 3.5.4 focuses on Federal and state listed endangered and threatened species. The existing plant and animal communities at NPR-2 are discussed in Section 3.5.5 and 3.5.6 with subsequent discussions on listed species and species of concern in Section 3.5.7.

3.5.1. Applicable Regulations

3.5.1.1. Federal Endangered Species Act

The FESA of 1973 (16 USC 1531-1543) was created to ensure the protection of endangered species, both plant and animal, and to provide a means of conserving the ecosystems on which endangered and threatened species depend. Prohibited acts include the "taking" of threatened or endangered species, where the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect.

- Sections 2(b), 2(c) and 7(a)(1) of the Endangered Species Act require Federal agencies to affirmatively pursue programs and conservation actions to protect threatened and endangered species.
- Section 7(a)(2) and 50 CFR Part 402 require Federal agencies to consult with the FWS to assure that no agency engages in any action that would "jeopardize the continued existence" of any endangered or threatened species where "jeopardize" is defined as "...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." The result of this consultation process is the issuance of Biological Opinion under Section 7(b).
- Section 10 authorizes the FWS to issue permits to private parties for the incidental taking of threatened and endangered species in connection with otherwise lawful activity. The permittee must have a conservation plan that includes steps to minimize the taking and to conserve the habitat of the species to be affected by the activity.

3.5.1.2. California Endangered Species Act

Under CESA (Fish and Game Code Section 2050 et seq.), state agencies and private entities must consult with the California Department of Fish and Game (CDFG) if their actions may affect listed or

[1] For the purposes of this document species of concern are defined as those that (1) are recognized by the State of California as "special"; (2) are recognized by the U.S. Fish and Wildlife Service (FWS) as Category 1 candidate species (sufficient information on file to support issuance of a proposed rule to list the species as endangered or threatened); or (3) formerly had Federal status as Category 2 species (information previously indicated possible justification for the issuance of a rule but further information was needed; however, FWS no longer has a Category 2 designation). These species are all included as species of concern, because the loss of habitat/incidental takings at the NPRs may add to the factors already threatening the species. Species recognized as "special" by the state of California are those species listed in the California Natural Diversity Data Base or other similar California data bases listing plant and animals considered to be threatened, rare or sensitive under one or more criteria.

candidate species. CESA is similar in most respects to the FESA. Public agencies must evaluate impacts of proposed projects and consult with CDFG to ensure that proposed projects will not jeopardize the continued existence of endangered or threatened species. For projects that impact species listed by both the FESA and CESA where a Federal agency consultation pursuant to Section 7(a)(2) of the FESA is being conducted, CDFG will participate to the greatest extent practicable in the Federal consultation. CDFG will adopt a Federal Biological Opinion whenever possible. The CESA, like its Federal counterpart, prohibits taking of listed animals in Section 2080.

- Section 2081 of the California Fish and Game Code provides for the incidental taking of threatened and endangered species in order to "manage" the species. CDFG previously used this Section to provide for a private party or non-state lead agency to enter into a management agreement with CDFG, which has the effect of authorizing incidental taking of listed species. The process of completing a 2081 agreement with CDFG included determining the extent of taking to be authorized; establishing appropriate take avoidance measures; agreeing on habitat compensation and habitat management requirements; and providing adequate funds for long-term management.

- Section 2090 deals with state lead agency consultations with CDFG. No such agreement is in place for takings of state-listed species at NPR-1 because, as a Federal entity, the code did not apply. Although transferring the terms of the 1995 FWS Biological Opinion would authorize incidental taking under the FESA, the state agencies with jurisdiction over the new owner(s) might be required to complete a 2090 consultation with CDFG for the new owners to be authorized to take California-listed species or adversely impact their habitat.

3.5.1.3. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 USC 703) prohibits the taking, hunting, killing, selling, purchasing, etc., of migratory birds, parts of migratory birds, their eggs and nests, and calls for the protection of birds identified in treaties with Great Britain, Japan, Mexico and the USSR. In addition, it also contains a clause that prohibits baiting or poisoning of these birds. As used in this act, the term "take" is defined as meaning, "to pursue, hunt, shoot, capture, collect, kill, or attempt to pursue, hunt, shoot, capture, collect, or kill, unless the context otherwise requires."

3.5.1.4. Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668) applies mostly to hunting and trading activities that involve bald and golden eagles. The act prohibits the "taking" of any individuals of these species, as well as any part, nest, or egg. The term "take," as used in this act, includes "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" a bald or golden eagle. This act prohibits anyone, in the United States or any place under its jurisdiction, from taking, possessing, selling, purchasing, bartering, offering to sell, transporting, exporting or importing any bald eagle (as our national symbol, commonly known as the American eagle) or any golden eagle, dead or alive.

3.5.2. Plant Communities on NPR-1

NPR-1 vegetation is part of a major floristic zone within California known as the Valley Grassland, which is dominated by annual grasses (DOE SEIS 1993 (citing Heady 1977)). As a result of past grazing activities and introduction of adventive species, the new dominant annual grassland is extremely persistent and prevents reestablishment of native vegetation (DOE SEIS 1993 (citing Heady 1977; O'Farrell and Mitchell 1985; Sims 1988)). Distribution of vegetation depends on the microclimate of the north-facing and south-facing slopes.

Disturbances that have affected the vegetation on NPR-1 include grazing, fires, and gas and oil operation activities (DOE SEIS 1993 (citing O'Farrell and Mitchell 1985)). Disturbances at NPR-1 since the early part of the century amount to approximately 6,546 acres, and approximately half of this amount occurred after the mid-1970's. However, a reclamation program has been in operation on NPR-1 since 1985 (DOE SEIS 1993 (citing O'Farrell and Mitchell 1985)).

More detailed information on the plant communities at NPR-1 is provided in the 1993 SEIS from which this discussion is summarized (DOE SEIS 1993). Information on threatened and endangered species is provided in Table 3.5-1 and Section 3.5.4

3.5.3. Animal Communities on NPR-1

Even though the San Joaquin Valley may present relatively harsh environmental conditions, it supports a diverse vertebrate fauna that has adapted to the arid grassland environment or is tolerant to a wide range of environmental conditions. Most of the mammal species on NPR-1 are rodents (DOE SEIS 1993 (citing O'Farrell and Scrivner 1987)). The San Joaquin kit fox is the listed predator known to occur on NPR-1. However, the coyote population strongly increased from 1979 to 1984, and coyote predation on kit foxes prompted the establishment of a coyote-control program (DOE SEIS 1993 (citing Scrivner and Harris 1986; Scrivner 1987; EG&G/EM 1988a)). For the bird population, approximately half of the bird species found on NPR-1 are either permanent or seasonal residents; other species are migratory transients. Both the western whiptail and side-blotched lizard occur on NPR-1, as well as several species of snakes and lizards. Other than surveys for blister beetles and striped-skin snails in 1988 (EG&G/EM 1988b), no invertebrate surveys have been conducted and little is known about the invertebrates inhabiting NPR-1.

More detailed information on the animal communities at NPR-1 is provided in DOE SEIS 1993. For example, Table 3.5-2 of the 1993 SEIS shows results of comprehensive wildlife and habitat transect observations completed in 1979, 1984 and 1989. Information on threatened and endangered species is provided in Table 3.5-1 and in Section 3.5.4.

3.5.4. Threatened and Endangered Species on NPR-1

Five animal and one plant species listed as Federally or state endangered or threatened are known to occur on NPR-1. The listed species are presented in Table 3.5-1. In addition, 18 animal and ten plant species of concern are found there.

Table 3.5-1
Listed Endangered or Threatened Species Known to Occur on NPR-1

Species	Federal Status	State Status
Plants		
Hoover's woolly-star	T	S
Animals		
San Joaquin kit fox	E	T
Giant kangaroo rat	E	E
Tipton kangaroo rat	E	E
Blunt-nosed leopard lizard	E	E
San Joaquin antelope squirrel	None	T

T = Threatened; E = Endangered; S = Species of Concern

The removal of natural areas, due primarily to agricultural development in the San Joaquin Valley, has increased the significance of relatively undisturbed natural habitat to threatened and endangered species.

Undeveloped habitat on NPR-1 represents one of the largest contiguous areas of predominantly natural land in the San Joaquin Valley and thus supports several species. The Elk Hills, Buena Vista Hills, and Lokern region, of which NPR-1 is the largest Federally owned block, is considered to be crucial for recovery of the listed species that occur there (P. Kelly and D. Williams, pers. comm.), and "continues to be very important for the long-term survival and recovery of the San Joaquin kit fox" (Medlin 1995b).

The following Sections discuss: (1) "listed species," which include animal and plant species designated as threatened or endangered by either the Federal government or the State of California; and (2) "species of concern," which include, for the purposes of this SEIS/PEIR, California state designated species of special concern, Federal Category 1 species and former Federal Category 2 species. Species of concern are included because their status is such that they could be listed in the future or they are protected under other laws.

The information presented in this Section is largely adapted and summarized from the 1993 SEIS and updated where more current information is available.[2] The Background Section (Section 3.5.4.1) provides an overview of previous consultations that DOE has conducted with FWS regarding impacts of continuing operations at NPR-1 on threatened and endangered species. Section 3.5.4.2 describes listed plants and other plant species of concern, and Section 3.5.4.3 reviews listed animals and other animal species of concern. For each listed animal, Section 3.5.4.3 provides information on: (1) general description and ecology; (2) the status of the species on NPR-1; and (3) the effects of current operations. More detailed information about the San Joaquin kit fox and blunt-nosed leopard lizard is presented because these species have been studied on NPR-1 since 1979. Finally, other animal species of concern are discussed in four categories: mammals; birds; reptiles and amphibians; and invertebrates. Potential impacts to listed species and species of concern are evaluated in Section 4.5

[2] A detailed description of listed species, their life histories, distribution, abundance, and status on NPR-1, and potential impacts of on-going activities related to development at the maximum efficient rate (MER) of extraction consistent with sound engineering practices was presented in DOE's 1993 SEIS.

3.5.4.1. Background

In 1980, 1987 and 1995, FWS reviewed several proposed actions on NPR-1 related to continued oil and gas production at the maximum efficient rate (MER), and issued Biological Opinions on the impacts of these actions on Federally threatened and endangered species (Martinson 1980; Kobetich 1987; Medlin 1995b). Primarily as the result of the magnitude of the proposed disturbances, the 1980 Opinion concluded that impacts might jeopardize the continued existence of the San Joaquin kit fox and the blunt-nosed leopard lizard. The Opinion proposed six alternatives to avoid jeopardy to these species, while also allowing NPR-1 activities to continue. These alternatives focused on a commitment to avoid impacts to the maximum extent practical, reclaim disturbed habitat, offset loss of habitats through compensation and mitigation, and study the kit fox and blunt-nosed leopard lizard. The 1980 Opinion also specified the need for a subsequent consultation to evaluate the results of the studies.

To comply with the 1980 Opinion, DOE implemented preconstruction surveys (later called preactivity surveys) (Kato et al. 1985; O'Farrell and Scrivner 1987; Kato and O'Farrell 1987), a habitat reclamation program (O'Farrell and Mitchell 1985), and a number of research studies and surveys on both NPR-1 and NPR-2 to gain insight into the factors affecting endangered species population dynamics.

During the period 1980-1985, kit fox populations at NPR-1 fell significantly. The kit fox decline paralleled a significant drop in precipitation and food availability, an apparent significant increase in coyote predation from 1979-1984, and continued oil field development (DOE SEIS 1993). In 1986 and 1987, DOE submitted biological assessments (Kato and O'Farrell 1986; O'Farrell et al. 1986; O'Farrell and Kato 1987) to FWS that summarized the large body of information generated in connection with the survey and research requirements contained in the 1980 Opinion. Among other things, this information included an analysis of the kit fox population decline in developed and undeveloped areas of the site; at that time no differences were detected in the kit fox decline in developed versus undeveloped areas on NPR-1. FWS concluded in their 1987 Opinion that, although "there are no assurances" that development activities would not "eventually contribute to the extirpation" of the kit fox from the site, development activities were "not likely to jeopardize the continued existence" of the San Joaquin kit fox (Kobetich 1987). The Opinion also concluded that development was not likely to jeopardize the continued existence of the blunt-nosed leopard lizard or the giant kangaroo rat. The Opinion specified several reasonable and prudent measures to minimize impacts.

The most significant measure was an aggressive habitat reclamation program (Anderson 1995). This included a comprehensive up-to-date inventory of all disturbances before and after MER production; an estimate of future disturbances; an estimate of existing or future disturbances that can be reclaimed because they are not needed for operations (e.g., abandoned well pads and roads); and a program to provide an amount of habitat equal to past and future MER disturbances, through one or a combination of on-site reclamation, off-site compensation, or some other equivalent means.

The 1987 Opinion also suggested implementing additional conservation measures that were originally suggested by DOE in the Biological Assessments preceding the Opinion. These included changing "preconstruction" surveys that only address construction projects to "preactivity" surveys that address all land disturbances (including those associated with operations and maintenance activities) and studies to investigate the effects of oil-field chemicals on kit foxes. The 1987 Opinion suggested the need for DOE to continue its Endangered Species Program, and to reopen consultations in conjunction with the development and release of the 1993 SEIS.

In October 1991, DOE reinitiated consultation with FWS as part of its preparation of the 1993 SEIS, and because four plant species that could occur at NPR-1 were newly listed by FWS as endangered or threatened (Hoover's woolly-star, *Eriastrum hooveri*; Kern mallow, *Eremalche kernensis*; San Joaquin

woolly-threads, *Lembertia congdonii;* and California jewelflower, *Caulanthus californicus*; FR 55(138) 1990). As part of this consultation, DOE made several commitments to mitigate impacts of the proposed action, to compensate for the associated loss of habitat, and to continue monitoring the status of listed species. Commitments to continue to implement existing measures and to adopt any new measures required by FWS' Biological Opinion were made in DOE's Record of Decision to the 1993 SEIS, and detailed in DOE's Mitigation Action Plan (DOE 1994b). In November 1995, FWS issued a Biological Opinion stating that continued oil field activities, corresponding to the Reference Case in this SEIS/PEIR, were not likely to jeopardize the continued existence of listed species (Medlin 1995b). This Biological Opinion contained a number of terms and conditions (discussed further in Section 4.5).

3.5.4.2. Listed Plant Species and Plant Species of Concern on NPR-1

Four species of threatened or endangered plants, and as many as 14 additional state or Federal species of concern may occur at NPR-1 (Table 3.5-2). Hoover's woolly-star was Federally listed as threatened, and Kern mallow, San Joaquin woolly-threads, and California jewelflower were Federally listed as endangered in July 1990 (FR 55(139) 1990). Hoover's woolly-star is the only listed plant that has been observed on site; ten state or Federal species of concern have also been observed. Because all of the listed or other special-status plant species are highly adapted desert annuals, the amount and timing of yearly precipitation plays a strong role in determining when, and if, each of these species germinates and flowers. Some species can produce seeds that may stay in a latent stage for large periods of time and exist without germinating or flowering, and may easily be missed in surveys. Surveys of all these species were conducted in suitable habitat on NPR-1 in 1988 (EG&G/EM 1988b), 1991 (EG&G/EM 1992b), 1993 (EG&G/EM 1995a; Anderson et al. 1994), 1994 (EG&G/EM 1995b), and 1995 (EG&G/EM 1996, in press). More general biota surveys sampling the entire NPR-1 were conducted in 1979 (O'Farrell 1980), 1984 (O'Farrell and Mathews 1987), and 1989 (Otten et al. 1992). Observations of listed or plant species of concern also have been made by biologists working on other field projects at the site.

Listed Plant Species Known to Occur on NPR-1

Hoover's woolly-star (*Eriastrum hooveri*) (Federally threatened, state special) is the only listed plant species known to exist on NPR-1. Hoover's woolly-star (Figure 3.5-1) populations were found in areas where other vegetation was sparse, such as washes and formerly disturbed sites and on the rounded crests of ridges, upper slopes, alluvial fans and alluvial plains. During field surveys in 1988, 28 populations of Hoover's woolly-star, with an estimated total of more than 40,000 individuals, were observed on NPR-1 (EG&G/EM 1988b). Additional populations were recorded during surveys in subsequent years. To date, over 278 populations of Hoover's woolly-star have been observed on or adjacent to NPR-1 and NPR-2 (EG&G/EM 1996, in press). Numerous populations have been observed on formerly disturbed but currently unused sites (e.g., abandoned or little-used roadways).

Table 3.5-2
Special Status Plant Species that Occur or May Occur at NPR-1[3]

Common Name	Scientific Name	Federal Status	State Status	Observed at NPR-1
PLANTS				
Sunflower family	***Asteraceae***			
San Joaquin wooly-threads	*Lembertia congdonii*	E	S	
Kern tarplant	*Hemizonia pallida*	None	S	X
Oil neststraw	*Stylocline citroleum*	None	S	X
Borage family	***Boraginaceae***			
Forked fiddleneck	*Amsinkia vernicosa var. furcata*	None	S	
Mustard family	*Brassicaceae*			
California jewelflower	*Caulanthus californicus*	E	E	
Goosefoot family	***Chenopodiaceae***			
Lost Hills saltbush	*Atriplex vallicola*	None	S	X
Heartscale	*Atriplex cordulata*	None	S	X
Crownsdale	*Atriplex coronata var. coronata*	None	S	X
Bakersfield saltbush	*Atriplex tularensis*	None	S	
Mint family	***Lamiaceae***			
San Joaquin bluecurls	Trichostema ovatum	None	S	X
Mallow family	***Malvaceae***			
Kern mallow	*Eremalche parryi ssp. kernensis*	E	S	
Phlox family	***Polemoniaceae***			
Hoover's woolly-star	*Eriastrum hooveri*	T	S	X
Milkwort family	***Polygonaceae***			
Temblor buckwheat	*Eriogonum temblorense*	None	S	X
Hollisteria	*Hollisteria lanata*	None	None	X
Cottony buckwheat	*Eriogonum gossypinum*	None	S	X
Buttercup family	***Ranunculaceae***			
Recurved larkspur	*Delphinium recurvatum*	None	S	X
Gypsum-loving larkspur	*Delphinium gypsophilum*	None	S	X
Lily family	***Liliaceae***			
Alkali mariposa lily	*Calochortus striatus*	None	S	

E = Endangered; T = Threatened; C = Federal Category 1; S = Special; P = Protected

Although this species colonizes disturbed areas and thus benefits from some previous disturbance, its tolerance to ongoing disturbance is unknown (EG&G/EM 1988b).

[3] For the purposes of this table, special status includes species that are Federally or state endangered, Federally or state threatened, California state "special," Federal Category 1, or protected.

Listed Plant Species for which Suitable Habitat Exists on NPR-1

Kern Mallow. Kern Mallow (*Eremalche parryi ssp. kernensis*) (Federally endangered, state special) is a small annual plant with mostly small white flowers. There is some debate regarding the taxonomic status of Kern mallow and its distinction from Parry's mallow. Presently, mallows at NPR-1 have been identified as Parry's mallow, and FWS is in agreement with this classification (Medlin 1995a). Known populations of Kern mallow occur in a fairly restricted area known as Lokern, located adjacent to and north of NPR-1. Surveys for Kern mallow have been performed in 1988, 1991, 1993 and 1994. Although Kern mallow has not been observed, suitable habitat for Kern mallow apparently exists in the northwestern portion of NPR-1, and it is likely that the species either exists in low numbers or could establish itself on the site (EG&G/EM 1988b). Extant populations of Kern mallow occur within two to three miles of NPR-1's northern border.

San Joaquin Woolly-threads. San Joaquin woolly-threads (*Lembertia congdonii*) (Federally endangered, state special) is a small (5 to 30 cm tall) annual plant with small yellow flowers usually clustered toward the ends of branches (Munz and Keck 1959). No San Joaquin woolly-threads were observed during the special-status plant surveys conducted on NPR-1 in 1988 (EG&G/EM 1988b) and 1991-1995 (EG&G/EM 1992b, 1995a, 1995b, 1996 in press). Potential habitat for this species does occur along the northern flanks of NPR-1, but this habitat may be suboptimal because of the dense cover of red brome present at the site (EG&G/EM 1988b).

California Jewelflower. California jewelflower (*Caulanthus californicus*) (Federally endangered, state endangered) is an annual with oblong basal leaves, branching stems that can reach 20 inches high, and has purple-tipped sepals that are larger than the small white flowers (Munz and Keck 1959). California jewelflower was not observed during special-status plant surveys conducted in 1988 (EG&G/EM 1988b) and 1991 (EG&G/EM 1992b). Areas that could be suitable habitat for California jewelflower appear to be suboptimal due mainly to the dense swards of red brome found along the gently-sloping terrain at the periphery of NPR-1 (EG&G/EM 1988b).

Plant Species of Concern for NPR-1

Ten of the 14 plant species of concern have been observed on NPR-1 (Table 3.5-2). During the plant survey conducted in 1988, five species of concern to the State of California were observed to be present (rare to uncommon): Temblor buckwheat (*Eriogonum temblorense*), cottony buckwheat (*Eriogonum gossypinum*), Gypsum-loving larkspur (*Delphinium gypsophilum gypsophilum*), Kern tarplant (*Hemizonia pallida*), and hollisteria (*Hollisteria lanata*). Lost Hills saltbush (*Atriplex vallicola*), a Federal and state species of concern, was reported observed on NPR-1 (EG&G/EM 1988b), but the exact location was unconfirmed and could have been located just off of NPR-1 (DOE 1993). Two species of concern, recurved larkspur (*Delphinium recurvatum*) and oil neststraw (*Stylocline citroleum*) were observed during surveys in 1995 (EG&G/EM 1996, in press). The populations of oil neststraw on NPR-1 are the only extant populations known. Three species, heartscale (*Atriplex cordulata*), crownscale (*Atriplex coronata* var. *coronata*), and San Joaquin bluecurls (*Trichostema ovatum*) have been observed at other times (B. Cypher, pers. Comm.).

Figure 3.5-1
Hoover's Woolly Star

Figure 3.5-2
San Joaquin Kit Fox

3.5.4.3. Listed Animals Species and Animal Species of Concern on NPR-1

Five animal species that are Federally or state listed as endangered or threatened are known to inhabit NPR-1. These are the San Joaquin kit fox (*Vulpes macrotis mutica*) (Federally endangered, state threatened), blunt-nosed leopard lizard (*Gambelia silus*) (Federally endangered, state endangered), giant kangaroo rat (*Dipodomys ingens*) (Federally endangered, state endangered), Tipton kangaroo rat (*Dipodomys nitratoides*) (Federally endangered, state endangered), and the San Joaquin antelope squirrel (*Ammospermophilus nelsoni*) (not Federally listed, state threatened).

Six mammal, 13 bird and two reptile species of concern have been observed at NPR-1. The state-threatened Swainson's hawk (not Federally listed) has been observed as a seasonal visitor. The western burrowing owl and prairie falcon (state species of concern) nest on site. Seven other raptor species, including golden eagle and ferruginous hawk, are also seasonal visitors to the site. Golden eagles may occasionally nest on site (Table 3.5-3) and are protected under the Bald and Golden Eagle Protection Act.

San Joaquin Kit Fox

Prior to European settlement, the San Joaquin kit fox (*Vulpes macrotis mutica*) (Federally endangered, State threatened) presumably occurred throughout the arid plains of the San Joaquin Valley (FWS 1983). Although the San Joaquin kit fox (Figure 3.5-2) still is found over much of its original range, animal numbers have declined by 20 to 43 percent since 1930, and most of the population is now concentrated in the southern half of the valley in western Kern and eastern San Luis Obispo counties (FWS 1983). The total population size of the San Joaquin kit fox in 1975 was estimated at 6,961 individuals (FWS 1983). Although kit foxes have been studied at a number of locations (Berry et al. 1992; Briden et al. 1987; DOE SEIS 1993; White and Ralls 1993), no range-wide surveys have been performed since. The kit fox population apparently has declined as a result of the rapid conversion of native habitat to agriculture and other development (Morrell 1975). In addition to habitat loss and fragmentation associated with increased urban, agricultural, and industrial development in the San Joaquin Valley, other threats to the kit fox include secondary poisoning by rodenticides, competition from non-native red foxes, and other factors that haven't been studied enough to be directly correlated to the decline in kit fox population. Because of the significance of habitat loss and population declines, the San Joaquin kit fox was listed by the Federal government as an endangered species in 1967.

Status of the San Joaquin Kit Fox on NPR-1. Kit foxes are widely distributed on NPR-1. Their dens have been found in the vast majority of the Sections comprising Elk Hills (O'Farrell 1980; O'Farrell and Mathews 1987; Otten et al. 1992). The kit fox population was monitored on a 28,480 acres NPR-1 study area between 1981 and 1995 (Harris et al 1987; EG&G/EM 1995a, EG&G/EM 1995b; EG&G/EM 1996, in press).

Table 3.5-3
Special Status Animal Species that Occur or May Occur at NPR-1[4]

Common Name	Scientific Name	Federal Status	State Status	Observed at NPR-1
MAMMALS				
Greater western mastiff bat	*Eumops perotis californicus*	None	S	
American badger	*Taxidea taxus*	None	S	X
San Joaquin kit fox	*Vulpes macrotis mutica*	E	T	X
San Joaquin antelope squirrel	*Ammospermophilus nelsoni*	None	T	X
San Joaquin pocket mouse	*Perognathus inornatus*	None	S	X
Giant kangaroo rat	*Dipodomys ingens*	E	E	X
Tipton kangaroo rat	*Dipodomys nitratoides nitratoides*	E	E	X
Short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	None	S	X
Tulare grasshopper mouse	*Onychomys torridus tularensis*	None	S	X
BIRDS[5]				
White-tailed kite	*Elanus leucurus*	None	P	
Cooper's hawk	*Accipiter cooperi*	None	S	X
Sharp-shinned hawk	*Accipiter striatus velox*	None	S	X
Northern harrier	*Circus cyaneus*	None	S	X
Ferruginous hawk	*Buteo regalis*	None	S	X
Swainson's hawk	*Buteo swainsoni*	None	T	X
Golden eagle	*Aquila chryseatos canadensis*	P	S	X
Osprey	*Pandion haliaetus*	None	S	
Prairie falcon	*Falco mexicanus*	None	S	X
Sandhill crane	*Grus canadensis*	None	S	
Mountain plover	*Charadrius montanus*	C	S	
Western snowy plover	*Charadrius alexandrinus nivosus*	T	S	
Short-eared owl	*Asio flammeus*	None	S	X
Western burrowing owl	*Athene cunicularia hypugea*	None	S	X
Little willow flycatcher	*Empidonax traillii brewsteri*	None	None	X
Horned lark	*Eremophilia alpestris actia*	None	S	X
Le Conte's thrasher	*Toxostoma redivivum*	None	S	X
Loggerhead shrike	*Lanius ludovicianus*	None	S	X
Yellow warbler	*Dendroica petechia*	None	S	
Yellow-breasted chat	*Icteria virens*	None	S	
Tricolored blackbird	*Agelaius tricolor*	None	S	X
REPTILES AND AMPHIBIANS				
Western spadefoot toad	*Scaphiopus hammondi*	None	S	
Blunt-nosed leopard lizard	*Gambelia silus*	E	E	X
California horned lizard	*Phrynosoma coronatum frontale*	None	S	X
San Joaquin whipsnake	*Masticophis flagellum ruddocki*	None	S	X

[4] For the purposes of this table, special status includes species that are Federally or state endangered, Federally or state threatened, California state "special," Federal Category 1 or protected.
[5] Raptors, while in some cases being designated as California species of special concern, are also protected under the California Fish and Game Code.

Table 3.5-3
Special Status Animal Species that Occur or May Occur at NPR-1 (continued)

Common Name	Scientific Name	Federal Status	State Status	Observed at NPR-1
INVERTEBRATES				
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	T	S	
Hopping's blister beetle	*Lytta hoppingi*	None	None	
Moestan blister beetle	*Lytta moesta*	None	None	
Molestan blister beetle	*Lytta molesta*	None	None	
Morrison's blister beetle	*Lytta morrisoni*	None	None	
San Joaquin dune beetle	*Coelus gracilis*	None	None	
Ciervo aegialian scarab beetle	*Aegialia concinna*	Noe	None	
Longhorn fairy shrimp	*Branchinecta longiantenna*	E	None	
Vernal pool tadpole shrimp	*Lepidurus packardi*	E	None	
Vernal pool fairy shrimp	*Branchinecta lynchi*	T	None	

E = Endangered; T = Threatened; C = Federal Category 1; S = Special; P = Protected

The San Joaquin kit fox population has been monitored during winter trapping sessions conducted between 1981-1995 (EG&G/EM 1995a; EG&G/EM 1995b; EG&G/EM 1996, in press). During this period, the kit fox population decreased significantly from 1981-1982 to 1991-1992, followed by a small increase in 1994-1995. In the winter of 1996-97, however, only a few individual kit foxes were trapped (B. Cypher, pers. comm.). The kit fox population trends found were similar for each method. Two different methods were used for estimating kit fox populations: (1) capture and radiocollar data; and (2) tracking the number of individuals trapped.

Studies on populations of kit foxes have correlated specific variables to population declines and distribution. Several of the studies are summarized in the following paragraphs.

Concurrent with the decline in population size, the distribution of kit foxes on NPR-1 has also changed. In 1981, kit foxes were found throughout the study area (Figure 3.5.3), but as the population declined, few foxes have occupied the highly developed production areas; most were found in the flatter terrain along the periphery of NPR-1 where less production is occurring (Figure 3.5-4). It has been observed that kit fox densities are generally greater in lower flatland areas than in upland foothill areas that comprise the majority of NPR-1 (Egoscue 1962; Morrell 1975; FWS 1983).

Life table analyses of data collected between 1981 and 1988 reported an overall annual rate of decline of about 30 percent and postulated that low pup survival was the primary cause of the population decline (DOE SEIS 1993; EG&G/EM 1996, in press). However, recent analysis suggests that the high mortality rate in certain age classes is the primary reason for population decline (EG&G/EM 1996, in press).

Figure 3.5-3
Map of NPR-1 Study Area

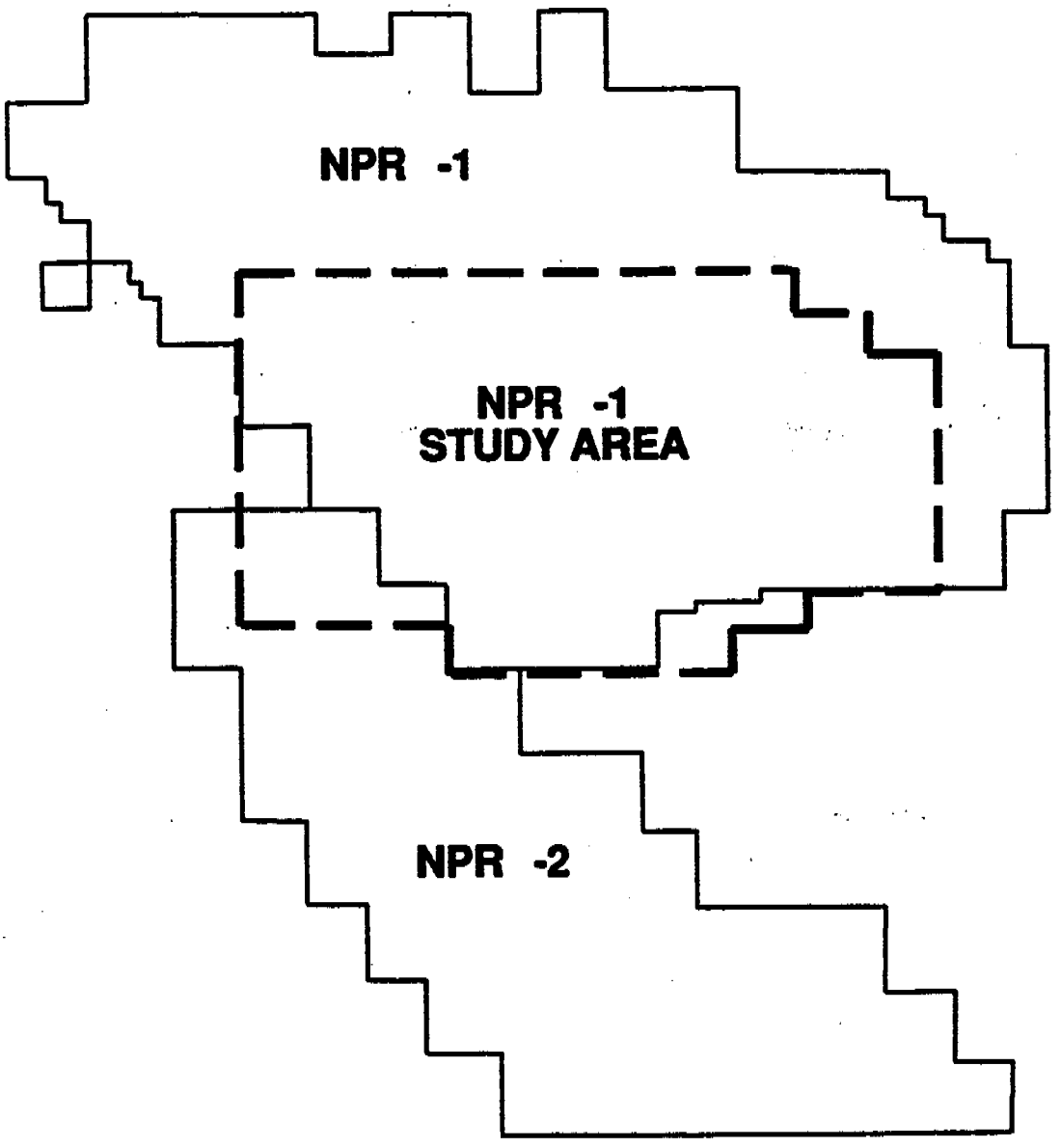
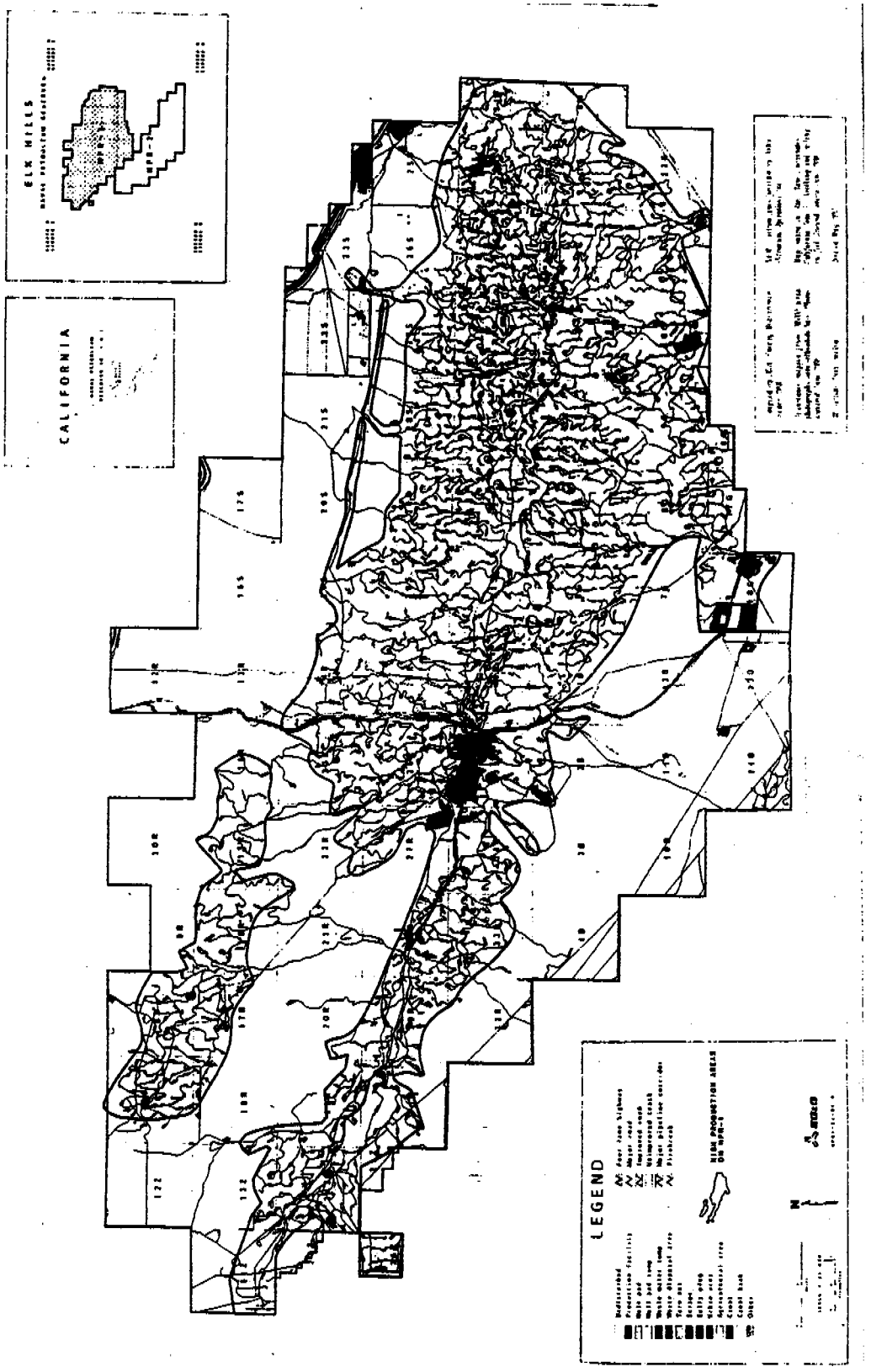


Figure 3.5-4
High and Low Production Areas of NPR-1



Several natural environmental factors, such as below-average growing season precipitation, could have played a role in the decline of kit fox numbers in the NPR-1 study area (DOE SEIS 1993). Below average annual precipitation results in lower annual plant production, which results in less forage for lagomorphs and kangaroo rats, and thus less food for predators such as kit foxes and coyotes (DOE SEIS 1993). Cypher and Scrivner (1992) found that lagomorph abundance is strongly correlated with kit fox and coyote population dynamics. During the past four years, growing season precipitation has been above average; and the kit fox population has generally increased (EG&G/EM 1996, in press).

A supplemental feeding study in 1988 and 1989 indicated that available food located close to dens increases kit fox survival and reproduction, and changes dispersal patterns (EG&G/EM 1993a; Scrivner and Warrick in prep). Despite the overall trends, the food chain effect cannot entirely explain changes in kit fox abundance (Medlin 1995b). Other studies have found no direct correlation between these variables.

Coyote and bobcat predation on kit foxes was the leading cause of death of kit foxes on NPR-1, with predation and probable predation accounting for nearly 55 percent of the mortality. Coyotes do not kill foxes for consumption (Berry et al. 1987), but rather, predation apparently acts as a mechanism to relieve interspecies competition. Recent analyses of kit fox trapping data, terrain ruggedness at NPR-1, coyote abundance, and prey abundance show that kit foxes occur more often in relatively flat terrain, and that coyotes and bobcats were generally found in more rugged, hilly terrain, and that prey species generally occurred equally in gentle and rugged areas (Warrick pers. comm.). This analysis suggests that the observed persistence of kit foxes in the generally flatter terrain along the periphery of NPR-1 is more related to avoidance of predators than abundance of prey (Warrick and Cypher 1996).

In an attempt to reduce coyote predation, a coyote control program was implemented between 1985 and 1990. An evaluation of the coyote control program concluded that the number of coyotes removed may have been insufficient to reduce the coyote population effectively, and that food availability may have had a greater effect on both kit fox and coyote population size. The report recommended that the control program should not be reinitiated unless new information indicated that coyotes are a limiting factor to the kit fox population (Cypher and Scrivner 1992).

In order to analyze the effects of disease, serum from trapped adult foxes was tested for the presence of antibodies for 10 infectious pathogens. No clinical indication of disease was observed in trapped foxes. It was suggested that canine parvovirus in particular could have caused high rates of juvenile mortality without being observed by the investigators (McCue and O'Farrell 1988). In an analysis from 1980 to 1986, seven of the 225 radiocollared kit foxes were suspected of having died as the result of disease (Berry et al. 1987). Although disease was not thought to be a significant contribution to kit fox mortality, it was recognized that disease could make foxes more susceptible to other sources of mortality, such as predation.

Past Effects of NPR-1 Operations on San Joaquin Kit Fox. Effects of oil field development and production under the Reference Case on NPR-1 have been previously discussed in detail (Martinson 1980; Kato and O'Farrell 1986; O'Farrell et al. 1986; Berry et al. 1987; Harris et al. 1987; Kobetich 1987; Scrivner et al. 1987a; Zoellick et al. 1987; DOE 1991; DOE SEIS 1993; Medlin 1995b).

Between 1980 and 1990, 25 kit fox dens and potential dens were destroyed; five were inadvertently lost during construction activities and 20 were intentionally excavated prior to construction to prevent the potential burial of foxes (O'Farrell et al. 1986; DOE SEIS 1993). It is unlikely that the loss of dens has resulted in the observed decline in kit fox numbers over the past decade. Further inadvertent loss of dens was eliminated as a result of the implementation of preactivity/preconstruction surveys (Kato et al. 1985; Kato and O'Farrell 1987; O'Farrell and Scrivner 1987).

Based on estimates derived from interpretation of aerial photographs, an estimated 6,467 acres (14 percent) of NPR-1 had been developed between the 1920s when the oil field was first produced and June 1988. An estimated 3,227 acres of disturbance resulted from DOE-sponsored activities since the inception of MER production in 1976 (DOE SEIS 1993; DOE 1995). Between 1985 and 1993, DOE has sponsored a large-scale habitat reclamation program which has treated 899 acres (EG&G 1995a). DOE expects to revegetate an additional 45 acres by fiscal year 1998 (DOE 1995).

These disturbances on NPR-1 have probably reduced the carrying capacity of the site (O'Farrell et al. 1986) and could have contributed to the reduction in kit fox numbers. Although kit foxes do not appear to be particularly sensitive to human disturbance (Egoscue 1962; O'Farrell and Gilbertson 1986; O'Farrell et al. 1986; O'Farrell 1984, 1987; O'Farrell and Mathews 1987; Reese et al. 1992), there is evidence to suggest that development may have had adverse effects. First, the density of kit fox dens was significantly lower in areas of greater oil development on both NPR-1 and NPR-2 (O'Farrell and Mathews 1987). Second, from 1982 to 1985, several measures of reproductive success were lower in developed areas than in undeveloped areas (Zoellick et al. 1987). Third, most kit foxes now inhabit the undeveloped periphery of the site, rather than in developed upland areas. The causes of these relationships are not known, but could include direct mortality, loss of dens, reduced availability of prey due to human disturbance of the food chain, or degraded habitat quality.

Oil and oil-field chemicals (e.g., chromium, arsenic, hydrocarbon gases, etc.) have been spilled or released on NPR-1 and may have been inhaled or ingested by kit foxes through contaminated drinking water or prey (O'Farrell et al. 1986). Oil-field wastewater often contains high concentrations of dissolved solids, salt, and various other minerals that can cause death, nervous disorders, tissue damage and decreased reproduction in livestock and wildlife if ingested (Therklesen 1973). Analyses of tissue, hair, and feces collected in 1983 indicated that levels of cadmium were low, but levels of vanadium and selenium were relatively high (O'Farrell and Scrivner 1987). However, an analysis of soil, water, and kit fox fur concluded that it was unlikely that oil-field chemicals were responsible for the decline in kit fox population at NPR-1 (Suter et al. 1992).

DOE SEIS (1993) postulated that differences in prey availability between developed and undeveloped areas of NPR-1 may have contributed to the low number of foxes trapped in the central uplands of NPR-1. In earlier studies, lagomorph densities were observed to be higher in the developed upland areas (Harris 1986; O'Farrell et al. 1986; O'Farrell and Mathews 1987; EG&G/EM 1988a, 1989b), whereas kangaroo rats were more common in the undeveloped lowlands (Scrivner et al. 1987b). The significant decline in lagomorph numbers in developed areas could have been a result of natural phenomena, such as climatically induced fluctuations in food supply, or it could have been a result of habitat degradation caused by oil-production activities, or a combination of both (Zoellick et al. 1987).

Intensive trapping and radiocollaring of kit foxes is part of DOE's Endangered Species Program and has occurred on NPR-1 since 1980. These activities could have affected kit fox population dynamics, if trapping resulted in the death of trapped individuals or facilitated the spread of disease. Radiocollars themselves could have conceivably reduced survivorship. Based on available evidence, trapping and handling apparently had no direct effect on kit fox survivorship. Very few individuals (four) died in traps, or died as a direct result of handling or collaring (Berry et al. 1987). In addition, it appears unlikely that trapping and handling significantly affected the spread of disease, because antibodies for pathogens were more prevalent in the beginning of the trapping program (McCue and O'Farrell 1988) before such an effect would be expected.

Blunt-nosed Leopard Lizard

The blunt-nosed leopard lizard (*Gambelia silus*) (Federally endangered, State endangered) was listed as endangered in 1967 because of continued habitat loss in the San Joaquin Valley and adjacent foothills (FWS 1985) (Figure 3.5-5). The original range of the blunt-nosed leopard lizard incorporated the San Joaquin Valley south of Stanislaus County, the Kettleman and Carrizo Plains, and the Cuyama Valley (FWS 1985). The range of the blunt-nosed leopard lizard extended to 7.5 million acres of the San Joaquin Valley in 1877. Agricultural development and urbanization have increasingly eliminated potential habitat for the blunt-nosed leopard lizard in the past 36 years (FWS 1985). The completion of the California Aqueduct, with subsequent development of irrigated agriculture, further reduced the habitat to small isolated patches (FWS 1985). By 1979, priority habitat for the lizard had been reduced from the original 7.5 million acres to 141,650 acres in the San Joaquin Valley (FWS 1985). While NPR-1 is not urbanized or developed for agriculture, suitable habitat for the blunt-nosed leopard lizard exists in only 28 of the 81 Sections that fall within the boundaries of the site (Kato et al. 1987a).

Status of the Blunt-nosed Leopard Lizard on NPR-1. The number of sightings of blunt-nosed leopard lizards on NPR-1 during comprehensive site-wide biological surveys conducted in 1979, 1984 and 1989 were 18, one, and seven, respectively (O'Farrell 1980; O'Farrell and Mathews 1987; Otten et al. 1992; DOE SEIS 1993). Between 1979 to 1987, 136 blunt-nosed leopard lizards were sighted in 28 of the 74 sections of NPR-1 (Kato et al. 1987a). Kato et al. (1987a) found that 70 percent of the blunt-nosed leopard lizards sighted during 1979, 1980, and 1981 surveys occurred on relatively gentle terrain at NPR-1.

Beginning in 1994, annual monitoring of blunt-nosed leopard lizard populations was initiated on two study plots (designated 4B and 18G) on NPR-1. In 1994, one adult and two juveniles were observed on the 4B plot; none were seen on the 18G plot. In 1995, 23 adult and two hatchling blunt nosed leopard lizards were seen on the 4B plot; again, none were observed on the 18G study plot.

Past Effects of NPR-1 Activities on Blunt-nosed Leopard Lizards. Loss of habitat due to construction and operational activities was identified as the most significant impact on the blunt-nosed leopard lizard of MER development at NPR-1 (Kato and O'Farrell 1986). Destruction of burrows, egg-laying chambers, and over-wintering hibernacula, as well as habitat degradation, could impact this species. Approximately 30 percent of NPR-1 is considered to be suitable habitat for blunt-nosed leopard lizards; and approximately 6 percent of this habitat area had been disturbed by ongoing activities by 1985 (Kato and O'Farrell 1986).

Blunt-nosed leopard lizards could also be indirectly affected by reduced food supplies resulting from habitat conversion. Other potential impacts occurring or potentially occurring at NPR-1 include burial in burrows, being hit by vehicles, getting caught in oil spills, reducing reproductive potential, and being trapped in sumps and well cellars (Kato and O'Farrell 1986).

Eight known cases of mortality or harassment of blunt-nosed leopard lizards occurred during the period 1980-1995 as the result of NPR-1 activities: one died when its radiocollar snagged the branches of a shrub in 1982, two died in pools of oil in 1982, two died in well cellars in 1987; and three have been killed by vehicles (DOE SEIS 1993; B. Cypher pers. comm.). One blunt-nosed leopard lizard was unearthed during construction activities, but was later released unharmed (B. Cypher pers. comm).

Giant Kangaroo Rat

Historically, the giant kangaroo rat (*Dipodomys ingens*) (Federally endangered, state endangered) inhabited 1.3-2.5 million acres of south-central California (FWS 1987). Because of the widespread development of irrigated cropland, the range of the giant kangaroo rat (Figure 3.5-6) was reduced to 77,000 acres by 1980. Range was further reduced to about 40,000 acres by 1985, and the giant kangaroo rat was listed as an endangered species in 1987 (FWS 1987).

During comprehensive site-wide surveys conducted on NPR-1 in 1984 and 1989, the number of burrow systems observed was 149 and 58, respectively. Giant kangaroo rat burrow systems have been found in 30 sections of NPR-1 (O'Farrell et al. 1987). The majority of the burrows were found in Township B along the Buena Vista Valley, but burrows also were found in upland sections of NPR-1. Burrow systems were discovered at elevations ranging from 316 to 1,510 feet, with most occurring on slopes of less than 10 percent (O'Farrell et al. 1987). However, all burrow systems were surrounded by annual vegetation and located in well-drained, sandy loams that could be excavated easily. Evidence of recent burrow activities (e.g., loose dirt, scats, footprints) was observed around 92 percent of all burrow systems. Dominant annual vegetation around the burrow systems included red brome, red-stemmed filaree, and Arabian grass; shrubs occurred within an average of 3.3 and 5.1 yards of burrows in valley and hilly locations, respectively (O'Farrell et al. 1987).

Human disturbances occurred within 50 yards of 71 intensively analyzed burrow systems 61 percent of the time, while 73 percent of the burrow systems had disturbances within 100 yards (O'Farrell et al. 1987b). Disturbances included roads, pipelines and well pads. Although burrows occur in areas of intensive oil development, the highest density of burrows occurs in Township B, where there is little oil and gas development. This distribution pattern is related primarily to habitat quality; Township B is located in the Buena Vista Valley, which contains prime habitat for the giant kangaroo rat.

In 1993, 20 sections on NPR-1 were surveyed for presence of giant kangaroo rat precincts. A total of 44 precincts were observed, and many were clustered in 23 colonies (two or more precincts clustered together). Annual monitoring of giant kangaroo rat populations was initiated in 1994. A 12x12 live-trapping grid was established around a known precinct. In 1994, 11 giant kangaroo rats were trapped (EG&G/EM 1995b; EG&G/EM 1996 in press); in 1995, five were trapped in the spring and only one was captured in the fall (EG&G/EM 1996 in press).

Past Effects of NPR-1 Activities on Giant Kangaroo Rats. Impacts of NPR-1 operations on the giant kangaroo rat include loss of habitat, burial in burrows, being struck by vehicles, getting caught in an oil spill, exposure to contaminants, and fire (O'Farrell and Kato 1987).

The only known cases of the types of impacts identified above during the period 1985-1990 are 66 burrow systems that were destroyed during fire break maintenance activities: 42 in 1987 and 24 in 1988. Immediately prior to the 1987 fire-break maintenance activity, four kangaroo rats were observed leaving their burrow systems (documented as cases of harassment). The other 62 systems that were destroyed were assumed to have resulted in the death of one kangaroo rat for each system; this assumption was based on the results of trapping activities conducted the day before the burrow systems were destroyed.

Research conducted on the giant kangaroo rat since 1980 under DOE's Endangered Species Program often requires live trapping and releasing of animals to determine their distribution or abundance. Since 1980, when live trapping of giant kangaroo rats began, there have been 12 giant kangaroo rats deaths out of 1,489 captures.

Figure 3.5-5
Blunt-Nosed Leopard Lizard

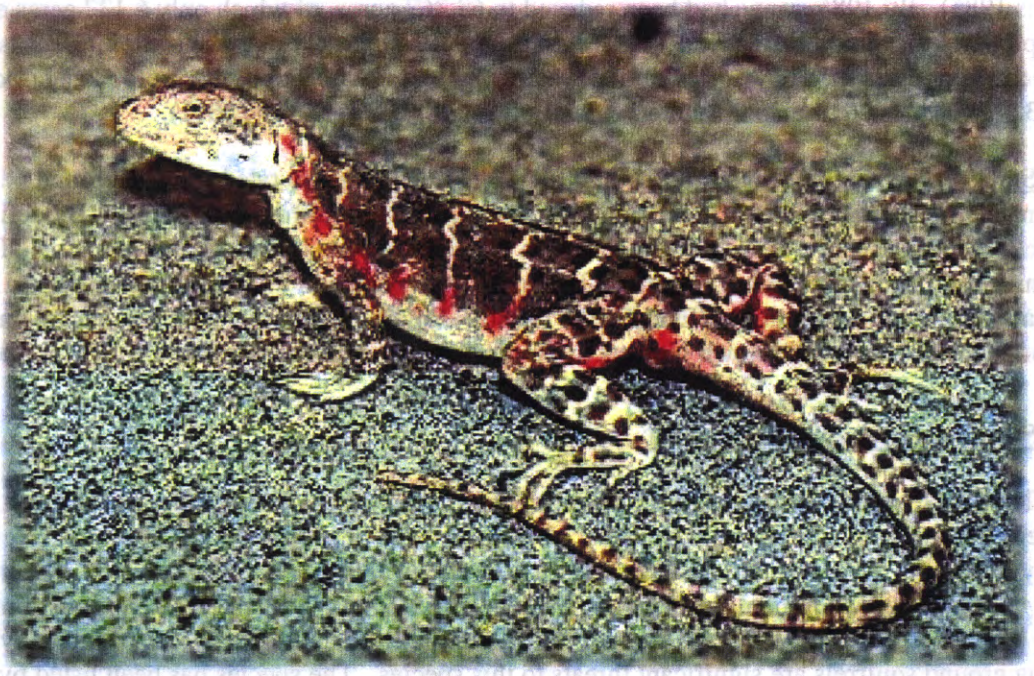


Figure 3.5-6
Giant Kangaroo Rat

Tipton Kangaroo Rat

The historical range of the Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*) (Federally endangered, state endangered) has been estimated at 1.7 million acres in south-central California (Williams 1985). By 1985, range had been reduced to 63,367 acres, of which only 6,137 acres existed on Federal property that could be restricted from agricultural development or urbanization. Because of continued habitat destruction by agricultural development and urbanization, the Tipton kangaroo rat (Figure 3.5-7) was listed as an endangered species on July 8, 1988 (53 FR 25611).

Status of the Tipton Kangaroo Rat on NPR-1. Tipton kangaroo rats have been found on approximately 63 acres of NPR-1 (in Section 23S) that border the California Aqueduct. By definition of the range of this subspecies, this is the only location that Tipton kangaroo rats can occupy on NPR-1. On three consecutive nights in 1988, 25 Sherman live traps were placed in this location and six to 12 individuals were captured per night (EG&G/EM 1988b). No oil and gas development occurs on these 63 acres, and there have been no known impacts to Tipton Kangaroo rats as the result of NPR-1 operations.

San Joaquin Antelope Squirrel

The San Joaquin antelope squirrel (*Ammospermophilus nelsoni*) (not Federally listed, state threatened) originally inhabited approximately 3.4 million acres of grasslands in California (Steinhart 1990); by 1981 only 20 percent of this area still supported San Joaquin antelope squirrels (Figure 3.5-8), much of it located in the southern San Joaquin Valley, Carrizo Plain, Elkhorn Plain, and Cuyama and Panoche Valleys (Brylski et al. 1994). Habitat loss, rodenticide poisoning, and displacement by California ground squirrels are significant threats to this species. The species has been listed by the State of California as threatened in 1980.

Status of the San Joaquin Antelope Squirrel on NPR-1. San Joaquin antelope squirrels are widely distributed on NPR-1 and are one of the more commonly observed diurnal mammals (O'Farrell and Mathews 1987; Otten et al. 1992). Between five and 22 percent of small mammals trapped on NPR-1 between 1980 and 1984 were San Joaquin antelope squirrels (EG&G/EMb 1988). Population trends of this species have not been monitored; but fewer were observed during surveys in 1989 (73) versus 1984 (271) (O'Farrell and Mathews 1987; Otten et al. 1992).

Past Effects of NPR-1 Activities on the San Joaquin Antelope Squirrel. Loss of habitat, displacement by California ground squirrels (usually found near human activity), mortality or injury from construction activities, vehicle impacts, and getting caught in oil spills or trapped in oil field facilities could adversely affect San Joaquin antelope squirrels at NPR-1. Effects of NPR-1 activities on this species have not been carefully studied, but based on results of sitewide surveys conducted in 1984 and 1989, the decline in observations of this species do not appear to be related to petroleum production activities.

Figure 3.5-7
Tipton Kangaroo Rat

Figure 3.5-8
San Joaquin Antelope Squirrel

Other Listed Species in the Region

The Swainson's hawk (*Buteo Swainsoni*) (not Federally listed, state threatened) is typically associated with riparian areas on the floor of the San Joaquin Valley. Suitable habitat for this species may occur just east of NPR-1 in the Kern River drainage; but nesting habitat probably does not occur on NPR-1. Swainson's hawk is an occasional visitor to the site, possibly using NPR-1 as a foraging area.

Known breeding areas for Western snowy plovers (*Charadrius alexamdrinus*) (Federally threatened, state special) include the coast of California and some inland lakes. This species is known to nest along levees and small ponds in the vicinity of NPR-1, but they have not been observed nesting on site.

Three species of fairy shrimp that were listed as endangered or threatened in 1994 are the longhorn fairy shrimp, the vernal pool fairy shrimp and the vernal pool tadpole shrimp. They require seasonally ponded water, which occurs rarely at NPR-1. Although no surveys for fairy shrimp have been conducted, it is unlikely that they occur.

Species of Concern on NPR-1

"Species of concern," as previously mentioned in Section 3.5.1, includes California state designated species of special concern, Federal Category 1 species and former Federal Category 2 species (for the purposes of the present SEIS/PEIR). Species of concern are those that could be listed in the future, or are protected under other laws (e.g., the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act).

Mammals

Small-mammal surveys were conducted on NPR-1 from 1980 to 1984 (EG&G/EM 1988b). Three state species of concern were observed: the short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), southern grasshopper mouse (*Onychomys torridus tularensis*) and San Joaquin pocket mouse (*Perognathus inornatus*). The relative abundance of short-nosed kangaroo rats was determined by live-trapping along four established transects in various portions of the site. During 20,076 trap-nights, 518 individuals were captured, representing approximately 31 percent of all rodents captured during the survey. Most captures were along the transect located on the flat valley floor (EG&G/EM 1988b). Southern grasshopper mice have been trapped during various small mammal studies, but their distribution and abundance at NPR-1 have not been studied. The San Joaquin pocket mouse population peaked dramatically during the winter of 1991 to the summer of 1992 and they have also been trapped during other small mammal studies. But like the southern grasshopper mouse, information concerning their distribution and abundance on NPR-1 has not been documented.

The American badger (*Taxidea taxus*) is found throughout NPR-1, but no systematic census for this species has been performed at the site. The greater western mastiff bat (*Eumops perotis californicus*) is known from a collection record near Bakersfield, but it has not been observed on NPR-1. No surveys for bat species have been performed at the site.

Birds

Eight raptors, considered species of concern by the State of California, have been observed at NPR-1, but their distribution and abundance have not been documented. The western burrowing owl (*Athene cunicularia hypugea*) and prairie falcon (*Falco mexicanus*) are known to nest on site; golden

eagles (*Aquila chryseatos*) may occasionally nest on site. The other species listed in Table 3.5.3 are seasonal visitors to the site (O'Farrell and Scrivner 1987; Cypher, 1996).

The mountain plover (*Charadrius montanus*) has not been observed on NPR-1, but it could be a winter visitor to the site.

Five California songbird species of concern have also been observed at NPR-1. The horned lark (*Eremophilia alpestris actia*) and loggerhead shrike (*Lanius ludovicianus*) are found throughout NPR-1. Le Conte's thrasher (*Toxostoma redivivum*) is found in the flatter terrain along the periphery of NPR-1. Tri-colored blackbirds (*Agelaius tricolor*) are residents of the San Joaquin Valley and have been observed on NPR-1. It is unknown if this species nests on site. The other species are observed less frequently.

Reptiles and Amphibians

The California horned lizard (*Phrynosoma coronatum frontale*) and the San Joaquin whipsnake (*Masticophis flagellum ruddocki*) both occur at NPR-1. The western spadefoot toad (*Scaphiopus hammondi*) has not been observed on NPR-1, but suitable habitat exists on site. The northwestern and southwestern pond turtle (*Clemmys marmorata marmorata and C. marmorata pallida*) are aquatic turtles inhabiting streams, ponds, and marshes. This habitat type does not occur at NPR-1.

Invertebrates

Surveys for four former Category 2 candidate species of blister beetles (*Lytta hoppingi, L. moesta, L. molesta*, and *L. morrisoni*) were conducted on NPR-1 from April to May of 1988 (EG&G/EM 1988b). Sixty sections were covered in an initial survey; 12 sites were deemed to have the most suitable habitat for these species and were studied more intensively. Although no individuals of these species were found during the survey, it is possible that this may have been due to drought conditions.

Surveys for the striped-skin snail (*Helminthoglypta callistoderma*) were conducted in May 1988. No striped-skinned snails were found, and suitable habitat for this species probably does not exist at NPR-1 (EG&G 1988b).

Surveys for the other invertebrate species of concern have not been conducted.

3.5.5. Plant Communities on NPR-2

The predominant shrub-steppe vegetation association on NPR-2 is described as either the San Joaquin saltbush (Küchler 1977) or Lower Sonoran grassland (Twisselmann 1967). Vegetation is dominated by perennial shrubs and annual grasses. However, nearly 20 percent of NPR-2 has little or no vegetation due to past petroleum-related operations, pipelines, roads, buildings, and other activities as stated in the NPR-2 Environmental Assessment (DOE EA 1994). NPR-2, unlike NPR-1, does not have a perimeter fence. Public access is open throughout the area, allowing hunting, grazing, dumping and off-road vehicle use.

The most common shrub throughout NPR-2 is desert saltbush (*Atriplex polycarpa*), which is especially dense in disturbed areas along roadsides and the edges of well pads. Other shrubs include spiny saltbush (*Atriplex spinifera*), cheesebush (*Hymenoclea salsola*), bladderpod (*Isomeris arborea*), buckwheat (*Eriogonum fasciculatum*), and snakeweed (*Gutierrezia bracteata*). Herbaceous plant cover consists chiefly of introduced winter annuals, such as red brome (*Bromus rubens*) and red-stemmed

filaree (*Erodium cicutarium*). Portions of Sections 12D and 18H adjacent to the Buena Vista Lake Playa are dominated by the alkali sink association characterized by inkweed (*Suaeda fruticosa*).

Listed Plant Species on NPR-2

Table 3.5-4 identifies five animal and two plant species that are Federally or state listed and known to occur on NPR-2.

Table 3.5-4
Listed Endangered or Threatened Species Known to Occur on NPR-2

Species	Federal Status	State Status
Plants		
Kern Mallow	E	S
Hoover's woolly-star	T	S
Animals		
San Joaquin kit fox	E	T
Giant kangaroo rat	E	E
Tipton kangaroo rat	E	E
Blunt-nosed leopard lizard	E	E
San Joaquin antelope squirrel	--	T

T = Threatened; E = Endangered; S = Special

The information presented in this section is largely adapted and summarized from the 1994 EA (DOE EA 1994). Section 3.5.7.1 describes listed plants and plant species of concern, and Section 3.5.7.2 reviews listed animals and animal species of concern. For each listed animal species, Section 3.5.7.2 provides information on the species related to NPR-2. More detailed information on the general description and ecology of the San Joaquin kit fox, the giant kangaroo rat, the Tipton kangaroo rat, the blunt-nosed leopard lizard, and the San Joaquin antelope squirrel was previously provided in Section 3.5.4.

Four Federally listed plant species are known to occur or could possibly occur on NPR-2 (Table 3.5-5). Only Hoover's woolly-star (*Eriastrum hooveri*) and Kern mallow (*Eremalche kernensis*) have been found on NPR-2. Approximately 15 populations of Hoover's woolly-star, with an estimated total of more than 6,000 individual plants, have been identified on NPR-2 through incidental sightings. Most of these populations are located in Township B, Sections 8, 9, 15 and 25; Township G, Sections 30 and 32; and Township D, Sections 2, 3, 12 and 13. A population of Kern mallow occurs on Section 18H in association with inkweed on alkali soils and in Sections 18B, 20B, 28B, 8D and 32G (See Figure 1.4-1). Limited habitat for California jewelflower (*Caulanthus californicus*) and San Joaquin woolly-threads (*Lembertia congdonii*) is found on NPR-2. However, neither species has been observed during surveys of NPR-2 (EG&G/EM, 1996 in press).

Table 3.5-5
Federally Listed Plant and Animal Species That Occur* or Possibly Occur on NPR-2

Scientific Name	Common Name	Status	
		Federal	State
PLANTS			
Caulanthus californicus	California jewelflower	E	E
Eremalche kernensis	*Kern mallow	E	S
Lembertia congdonii	San Joaquin woolly-threads	E	S
Eriastrum hooveri	*Hoover's woolly-star	T	S
MAMMALS			
Dipodomys nitratoides	*Tipton kangaroo rat	E	S
Dipodomys ingens	*Giant kangaroo rat	E	E
Vulpes macrotis mutica	*San Joaquin kit fox	E	T
BIRDS			
Charadrius alexandrinus	Western snowy plover	T	S
REPTILES			
Gambelia silus	*Blunt-nosed leopard lizard	E	E
INVERTEBRATES			
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle	T	None

Source: EG&G/EM, Inc. 1993; U.S. Department of the Interior 1993b.
*All listed species are former Category 2 candidates.
E = Endangered; T = Threatened; C = Federal Category 1; S = Special; P = Protected

Plant Species of Concern on NPR-2

Nine former Category 2 candidate and no Category 1 candidate plant species were identified by the FWS (EG&G/EM, Inc. 1993a; U.S. Department of the Interior 1993) as possibly occurring on Federally- owned portions of NPR-2. Table 3.5-6 presents Federal and state listed plant species of concern that may occur at NPR-2. Of these nine species, only hollisteria (*Hollisteria lanata*) is known to occur on NPR-2 (Section 12C, north of Ford City). Habitat for the other eight species is marginal or does not occur on NPR-2, nor were they located during plant surveys conducted in 1993.

3.5.6. Animal Communities on NPR-2

Surveys have documented the presence of 20 species of mammals, 45 species of birds, and eight species of reptiles on NPR-2 (O'Farrell et al. 1987a). The short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), desert cottontail (*Sylvilagus audubonii*), and black-tailed jackrabbit (*Lepus californicus*) are the more common mammal species observed on NPR-2 (O'Farrell et al. 1987a). Frequently occurring carnivores include the San Joaquin kit fox (*Vulpes macrotis mutica*) and the coyote (*Canis latrans*). Frequently observed birds are the California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), common raven (*Corvus corax*), Le Conte's thrasher (*Toxostoma lecontei*), western meadowlark (*Sturnella neglecta*), and lesser goldfinch (*Cardulelis psaltria*). Commonly occurring raptors include the northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), great-horned owl (*Bubo virginianus*) and the burrowing owl (*Athene cunicularia*). Several species of lizards and snakes make up the reptilian fauna of the NPR-2, including the side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), coachwhip (*Masticophis flagellum*) and western rattlesnake (*Crotalus viridis*). (See Tables 3.5-4, 3.5-5 and 3.5-7.)

Table 3.5-6
Plant Species of Concern that Occur* or Could Possibly Occur on NPR-2

Scientific Name	Common Name	Status	
		Federal*	State
Amsinckia furcata	Forked fiddleneck	None	None
Atriplex cordulata	Heartscale	None	None
Atriplex tularensis	Bakersfield saltbush	None	E
Atriplex vallicola	Lost Hills saltbush	None	S
Calochortus striatus	Alkali mariposa lily	None	S
Cirsium crassicaule	Slough thistle	None	None
Delphinium recurvatum	Recurved larkspur	None	S
Eriogonum temblorense	Temblor buckwheat	None	S
Hollisteria lanata	*Hollisteria	None	None

Source: EG&G/EM, Inc. 1993; U.S. Department of the Interior 1993b.
*All listed species are former Category 2 candidates.
E = Endangered; T = Threatened; C = Federal Category 1; S = Special; P = Protected

Listed Animal Species on NPR-2

Five Federally or state listed animal species are known to occur or possibly occur on NPR-2. San Joaquin kit foxes are relatively abundant and widely distributed on NPR-2. The San Joaquin kit fox population on NPR-2 has been monitored by live trapping (O'Farrell et al. 1987a). The most recent estimate of the minimum population size on NPR-2 was 58 foxes in the winter of 1992 (EG&G/EM 1996 in press). Typical subterranean dens have been found in all but three sections (26B, 5D, 15D) of NPR-2 by EG&G/EM, Inc. (O'Farrell and Sauls 1987). The relative density of typical dens was 9.2/1,000 acres for all of NPR-2 and 9.6/1,000 acres for DOE-administered lands. The number of kit fox dens was inversely correlated with the intensity of petroleum development (O'Farrell and Sauls 1987).

Giant kangaroo rat (*Dipodomys ingens*) burrow systems have been found in eight of the 18 DOE-administered sections of NPR-2 (O'Farrell et al. 1987b; O'Farrell and Sauls 1987). The greatest densities were found in Section 8B on a gently sloping alluvial plain of sparse shrubs. The estimated density of burrows (28.2 burrows) in this section exceeded that reported for optimum habitat (Grinnell 1932; O'Farrell and Kato 1987).

Tipton kangaroo rats (*Dipodomys nitratoides*) are known to occur in Section 18H and potentially to occur on portions of Section 12D that border the California Aqueduct (EG&G/EM 1988b). The western boundary of Tipton kangaroo rat distribution was defined by Williams (1985) as being approximately coincident with the route of the California Aqueduct, which is located on the extreme eastern edge of NPR-2.

Blunt-nosed leopard lizards (*Gambelia silus*) have been sighted on 12 of 18 sections of DOE-administered lands on NPR-2 between 1979 to 1992 (Kato et al. 1987a; EG&G/EM 1996 in press). The greatest concentration of blunt-nosed leopard lizard sightings was in Section 12D on a large, flat, sandy-soiled, shrubless and sparsely revegetated man-made plateau adjacent to the California Aqueduct (O'Farrell and Sauls 1987). Virtually all blunt-nosed leopard lizards were observed in either flat terrain (53 percent), gentle ridges near the flats (19 percent), or broad sandy washes (19 percent) (O'Farrell and Sauls 1987). Only a few blunt-nosed leopard lizards have been observed in hilly portions of NPR-2.

San Joaquin antelope squirrels (*Ammospermophilus nelsoni*) are widely distributed and abundant on NPR-2 (O'Farrell and Sauls 1987; O'Farrell et al. 1987a). San Joaquin antelope squirrels were the second most commonly observed vertebrate on transect surveys (O'Farrell and Sauls 1987). Estimated relative density was 34.4/1,000 acres and was not related to intensity of development. The only section where San Joaquin antelope squirrels were not observed was adjacent to urban areas in the north end of Taft in Section 12C (O'Farrell and Sauls 1987).

More detailed information on the general description and ecology of the San Joaquin kit fox, the giant kangaroo rat, the Tipton kangaroo rat, the blunt-nosed leopard lizard, and the San Joaquin antelope squirrel was previously provided in Section 3.5.4.3.

Neither the valley elderberry longhorn beetle nor the western snowy plover has been documented as occurring on NPR-2 (California Department of Fish and Game 1992). The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is endemic to moist valley oak woodlands along the margins of rivers and streams. This habitat type does not exist on NPR-2. Known breeding sites for western snowy plover (*Charadrius alexandrinus*) include the California Coast and China Lake. The species is also known to nest along the levees of some wastewater and percolation ponds (Chichester 1993). The Western snowy plover may travel through the fringes of NPR-2; however, habitat for the species is generally submarginal, and the possibility that the species would nest there is remote.

Animal Species of Concern on NPR-2

One amphibian, two reptile, five mammal, three bird, and eight invertebrate Federal Category 1 or former Category 2 species have been either observed on NPR-2 or may occur there (Table 3.5-7). Additionally, one mammal and two bird species are listed by the State of California as either threatened or endangered. Of these 21 species, only two mammal species have been documented as occurring on NPR-2 (California Department of Fish and Game 1992a, 1992b; O'Farrell et al. 1987; O'Farrell and Sauls 1987).

The distribution and relative abundance of short-nosed kangaroo rats on NPR-2 was determined by live-trapping between July 1983 and August 1984 (O'Farrell et al. 1987a). During this period, short-nosed kangaroo rats were trapped on all trap lines (Sections 18B, 21B, 22B, 28B and 35B), indicating this species is numerous and widely distributed on NPR-2.

Although the five bird species may occasionally travel or forage on NPR-2, their presence has not been documented (CDFG 1992) and suitable nesting habitat is not likely to exist. No habitat exists for the amphibian or reptile species. Similarly, no habitat exists for one bat species (*Eumops perotis californicus*) and two insects (*Aegialia concinna* and *Coelus gracilis*). The presence of the remaining two mammalian and six invertebrate species has not been documented on NPR-2 (EG&G/EM, Inc. 1988; California Department of Fish and Game 1992a, 1992b) and suitable habitat for these species is poor or of limited size.

Table 3.5-7
Candidate and State-Listed Animal Species That Occur* Or Possibly Occur on NPR-2

Scientific Name	Common Name	Status	
		Fed.	State
AMPHIBIANS			
Scaphiopus hammondi	Western spadefoot toad	None	S
REPTILES			
Clemmys marmorata pallida	Southwestern pond turtle	C	S
Clemmys marmorata	Northwestern pond turtle	None	S
MAMMALS			
Ammospermophilus nelsoni	*San Joaquin antelope squirrel	C	T
Dipodomys nitratoides brevinasus	*Short-nosed kangaroo rat	C	S
Eumops perotis californicus	Greater mastiff bat	None	S
Plecotus townsendii	Pacific western big-eared bat	None	S
Sorex ornatus relictus	Buena Vista Lake shrew	None	S
BIRDS			
Agelaius tricolor	Tri-colored blackbird	None	S
Charadrius montanus	Mountain plover	None	S
Buteo regalis	Ferruginous hawk	None	S
Empidonax traillii	Willow flycatcher	None	E
Buteo Swainsoni	Swainson's hawk	None	T
INVERTEBRATES			
Aegialia concinna	Ciervo aegialian scarab beetle	None	None
Coelus gracilis	San Joaquin dune beetle	C	None
Helminthoglypta callistoderma	Striped-skinned snail	None	None
Lytta hoppingi	Hopping's blister beetle	None	None
Lytta moesta	Moestan blister beetle	None	None
Lytta molesta	Molestan blister beetle	None	None
Lytta morrisoni	Morrison's blister beetle	None	None
Pholisora libya	San Joaquin sootywing skipper	None	None

Source: EG&G/EM, Inc. 1988 and 1993; U.S. Department of the Interior 1993b.
E = Endangered; T = Threatened; C = Federal Category 1; S = Special; P = Protected
*All listed species are former Category 2 candidates.

3.5.7. References

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3.6. CULTURAL RESOURCES

3.6.1. Applicable Regulations

Pursuant to the National Historic Preservation Act of 1966, as amended, and implementing regulations at 36 CFR 800, "Protection of Historic Properties," DOE is required to consider whether its actions may affect "historic properties," those listed on or potentially eligible for listing in the National Register of Historic Places. They may include buildings or other structures as well as archaeological sites.

To identify historic properties in the project area, DOE conducted a search of archaeological site records for NPR-1. DOE notified the California State Historic Preservation Officer (SHPO) about the SEIS/PEIR in preparation. SHPO staff indicated that DOE must provide eligibility recommendations for previously recorded sites on NPR-1 and consult with the SHPO about potential project effects. Preparation for determination of eligibility is underway for NPR-1 historic and prehistoric sites. In addition, Native Americans with traditional ties to NPR-1 are being consulted to determine whether any of the previously recorded sites (or newly identified sites) may be eligible for the National Register as traditional religious or cultural properties. SHPO and Native American consultations are presently underway. It is expected that additional information will be available for inclusion in Section 3.6.3 of the Final SEIS/PEIR about numbers of historic properties, CEQA-important properties, and places of concern to Native Americans.

While NPR-1 remains under Federal ownership, the provisions of the Archeological Resources Protection Act of 1979 and the Native American Graves Protection and Repatriation Act of 1990 apply to archaeological investigations on and archaeological materials recovered from NPR-1 lands.

3.6.2. Prehistory and History Overviews

3.6.2.1. Prehistory

The prehistory of the greater Central Valley, within which the project area is located, is rich, although only a limited amount of research has been conducted in the immediate vicinity of NPR-1. Most information directly pertinent to NPR-1 comes from the adjacent Buena Vista Lake area. Detailed overviews of the prehistoric, ethnographic, and historic periods of the region are available in Peak and Associates, Incorporated (PAI) (1991a; 1992); and Hartzell (1992). The following, largely abstracted from those sources, comes from a draft Cultural Resources Management Plan for NPR-1 (DRI and EG&G 1995).

A broad chronological framework for regional prehistory of the Northern San Joaquin Valley and the Delta area is summarized in Table 3.6-1, which outlines two alternate cultural sequences. PAI (1992) notes that while the Central California Taxonomic System has application to the area, there are distinct temporal and spatial limits. There is a growing recognition of these limits as new research has provided data that do not fit into this scheme with any precision.

Nonetheless, the Central California Taxonomic System still is widely used despite many attempts to find new integrative models for both regional and areal syntheses (Moratto 1984).

Table 3.6-1
Two Alternate Cultural Sequences for the Northern San Joaquin Valley (from PAI 1992).

Fredrickson Sequence	Bennyhoff, Heizer, and Schulz Sequence
Upper Emergent--A.D.	Phase 2, Late Horizon--A.D. 1500
Lower Emergent--A.D. 300	Phase 1, Late Horizon--A.D. 500 (Hotchkiss)
Upper Archaic--2000 B.C.	Middle Horizon--IOOO B.C. (Cosumnes)
Paleo-Indian--10,000 B.C	Early Horizon--2500 B.C. (Windmiller)

Source: Bennyhoff and Heizer 1958; Fredrickson 1973; Schulz 1981

Archaeological work began in the Central Valley at least as early as the late 1800s. By the 1930s, enough data had been accumulated to identify three distinct cultural traditions or groups: Early, Transitional and Late. This sequence was later refined (e.g. Beardsley 1954), and for the northern San Joaquin Valley and Delta areas, alternate designations were proposed (Ragir 1972): Windmiller Culture for the Early Horizon, Cosumnes Culture for the Middle Horizon, and Hotchkiss Culture for the Late Horizon.

Information for earlier, Paleo-Indian, occupation is sparse. To date, most of the evidence for early human presence in Central California has been limited to surface finds (Beck 1971; Heizer 1938; Riddell and Olsen 1969; Sutton 1989), or in mixed contexts not providing a clear temporal association (Peak and Weber 1978). Although Fredrickson and Grossman (1977) defined a possible San Dieguito component at CA-Ker-116, the radiocarbon determinations were on freshwater clam shell, and these dates may not be valid (Michels 1973).

The Windmiller Culture, or Early Horizon, is characterized by ventrally-extended burial positions, a high percentage containing grave goods, frequent presence of red ocher in graves, large projectile points, rectangular *Haliotis beads, Olivella* shell beads (Types Ala and L), rare use of bone, some use of baked clay artifacts, and well-fashioned charmstones, usually perforated.

The Cosumnes Culture (Middle Horizon) is considerably different from the earlier cultural expression. Burials are predominantly in a flexed position, with variable cardinal orientation and some cremations. Fewer burials contain grave goods. Ocher staining in graves is common. *Olivelia* beads (Types Cl, F and G), abundant green *Haliotis sp.* rather than red *Haliotis sp.*, perforated canine teeth, asymmetrical and "fishtail" charmstones also occur. Other diagnostic features include cobble mortars and evidence of wooden mortars, extensive use of bone for tools and ornaments, large projectile points, and use of baked clay.

For the Hotchkiss Culture (Late Horizon), the burial pattern retains the use of flexed positions, and there is widespread evidence of cremation, lesser use of red ocher, heavy use of baked clay, *Olivella* beads (Types E and M), extensive use of *Haliotis* ornaments in many elaborate shapes and forms, shaped mortars and cylindrical pestles, bird bone beads with elaborate geometric designs, and clam shell disc beads. Small projectile points suggest the use of the bow and arrow. Flanged tubular pipes of steatite and schist also occur (Moratto 1984).

In the western San Joaquin Valley, research has resulted in a slightly different cultural sequence (Olsen and Payen 1968, 1969; Pritchard 1970). This is summarized by PAI (1992). Finally, research in the southern San Joaquin Valley, in which NPR-1 is located, has provided some modifications to the sequences established for adjacent regions. Most work here has concentrated on the old shorelines of the interior lakes (e.g., Tulare, Kern, and Buena Vista) (PAI 1992).

Since the Buena Vista Lake area is most applicable to NPR-1, research there will be summarized. Hartzell (1992) provides a detailed contemporary summary, while Schiffinan and Garfinkel (1981) present an overview intended to set the foundation for archaeological research in Kern County and assist in managing cultural resources.

In 1899, Dr. P. M. Jones directed fieldwork in the Buena Vista-Tulare Lake area of Kern County. He investigated 150 mounds, including CA-Ker-53. In 1909, N. Nelson studied CA-Ker-49, which is located to the west of Buena Vista Lake. Later, the University of California conducted four surveys and excavations in the same locale. In 1926 Gifford and Schenck published a compilation of these investigations.

The presence of Paleo-Indian materials (ca. 10,000 > BP), although not found in direct association with extinct animals, is demonstrated by the frequency of chipped stone crescents and fluted points similar to those of the Clovis-Folsom Complex in the Southwestern United States. Although fluted points have been found near the shores of Tulare Lake, an area that has also produced surface finds of extinct mammal bone of Pleistocene age, the association has not been substantiated by controlled excavations and remains speculative (Riddell and Olsen 1969). Thus, while Paleo-Indians may have sporadically visited the project area, the earliest convincing evidence for human occupation dates to ca. 8,000 BP (Hartzell 1992).

While early (and subsequent) research in the area has done little to illuminate the early periods of human occupation in the area, an elaborate cultural complex was defined for the late prehistoric period. This complex can probably be ascribed to the Yokuts Native Americans and their direct ancestors. The material culture of this late temporal period complex includes steatite vessels and beads, finely-made projectile points, pottery, shaped stone mortars, Tivela disc beads, use of asphaltum, and the presence of metates and manos. Flexed burials were the predominant internment mode. Earlier complexes were represented by chipped stone crescents, large projectile points, atlatl spurs and weights. Mortuary practices include extended rather than flexed burial positions, a situation analogous to that of the northern valley (Gifford and Schenck 1926; Lilliard et. al. 1939; Moratto 1972).

Under the direction of Wedel (1941), the Civil Works Administration, in conjunction with the Smithsonian Institution, initiated the first major excavations in the area using stratigraphic controls. Hartzell (1992) provides a detailed summary of this research. Wedel's investigations at CA-Ker-39 (Site 1) and CA-Ker-60 (Site 2), as well as at several smaller sites near Buena Vista Lake, produced evidence of two distinct cultural occupations. Although Wedel lacked precise methods dating these two entities, he tentatively stated that the early occupation at Buena Vista Lake appeared to be temporally older and less developed than the Early Horizon (or Windmiller) of the Delta region. He compared this early component to the Oak Grove or Milling Stone culture of the Santa Barbara area (Rogers 1939). He divided the later cultural entity into two distinct phases, both clearly distinguished from the earlier phase by artifact types. Wedel (1941) estimated that neither of these cultural periods exceeded 1,500 BP. Later, other investigators proposed far earlier ages for the early occupations, with dates ranging from 2,000 to 7,000 BP (Baumhoff and Olmstead 1963, 1964; Heizer 1964; Meighan 1959).

Later investigations in 1963 and 1964 at CA-Ker-116 near Buena Vista Lake produced materials similar to Wedel's early occupation. These materials occurred in the lower levels of the "upper deposit,"

while an even deeper cultural deposit yielded materials similar to those of the San Dieguito Complex. Artifacts included a chipped stone crescent, crude point fragments, and an atlatl spur. Radiocarbon determinations on shell from the lowest cultural levels returned a date of ca. 8,200 BP (Fredrickson and Grossman 1966, 1977; Fredrickson 1967).

In 1988, the University of California at Davis Archaeological Field School, under the direction of Leslie Hartzell, participated in a field survey in and near NPR-1. Hartzell selected eight quadrants of 500 by 1,500 meters to sample the varied terrain in the Elk Hills and vicinity. Four sites were recorded from four quadrants. The site in Quadrant 8, located on the slopes above Buena Vista Slough, contained a diverse artifact assemblage in contrast to the other three sites. Of the four sites recorded, only one was located in NPR-1.

Following the U.C. Davis and Wedel's earlier studies, Hartzell (1992) completed a dissertation on the archaeology of the Elk Hills region and Buena Vista Lake. Her work is the most thorough, systematic, and problem-oriented research that has been conducted in the region. She examined five sites in considerable detail. Three of these were shellmounds (Wedel's sites 1 and 2 and CA-Ker-116) and two were small camp sites (CA-Ker-180 and CA-Ker-1611), located along Buena Vista Slough. Hartzell concentrated on chronostratigraphic analysis of site stratigraphy, radiometric determinations, obsidian sourcing and hydration, temporally diagnostic artifacts, and faunal analyses to interpret lake productivity through time, seasonality of resource areas and diet.

Archaeological investigations within the boundaries of NPR-1 itself have been limited. These are summarized in Section 3.6.3.1.

For interpreting prehistoric adaptations in the study area, the past distribution and composition of lake-marsh habitats is critical. Considerable research has documented that these features were key variables in hunter-gatherer adaptations throughout the Great Basin. Questions of sedentarism vs. mobility in relation to lake environments are one of the major research themes in the region. Hartzell (1992) thoroughly summarizes various pertinent issues involved with prehistoric human/lake interactions in the Great Basin.

Perhaps the most critical environmental features for prehistoric inhabitants of the Elk Hills region was the Buena Vista Lake. The lake was created by the development of a depositional fan from the Kern River drainage. The fan coalesced with the Elk Hills, forming a barrier to northward drainage (Hartman 1970). Buena Vista Lake water levels fluctuated during the late Pleistocene and the Holocene, although the timing of these fluctuations is unknown. Presently dry due to agricultural water use, Buena Vista Lake probably was never dry during the prehistoric period (Gifford and Schenck 1926). The lake had a maximum depth of 295 to 300 feet, with an overflow at 295 feet into Buena Vista Slough. For a distance of nearly 40 miles, the slough carried the basin overflow into Tulare Lake Basin. Although the slough did not exceed some 100 feet in width near Buena Vista, this width increased to two or three miles as elevation decreased to the 220 foot level of Tulare lake. Gifford and Schenck (1926) proposed that the southern end of Buena Vista Slough and the lake itself were the most desirable habitat for permanent settlements in the San Joaquin Valley. Hartzell (1992) deals explicitly with prehistoric human adaptations to the Buena Vista Lake.

Hartzell's examination of the archaeology of Buena Vista Lake provides a contemporary context from which future research should be evaluated. In particular, she concludes that:

> A consideration of the Buena Vista Lake sites suggests the following. Firstly, an archaeological midden deposit contained evidence for the earliest known occupation of the lake ca. 8,000 BP indicating extensive use of lacustrine resources. Secondly, there is

a gap or hiatus in the archaeological record ca. 7,000 to 4,000 BP for which no evidence is presently available. Thirdly, an increasingly complex archaeological record appears in mid-late Holocene deposits which includes house structures and an overall broader assemblage of archaeological material at lake shore sites. Fourth, an apparently diminished archaeological record (with particular regard to lake shore village sites) occurs in the latest period (Hartzell 1992).

3.6.2.2. Protohistoric and Ethnographic Periods

NPR-1 lies within the ethnographic territories of the Yokuts. An excellent summary of the ethnology of the southern Yokuts and archaeological implications is provided by Hartzell (1992). Several studies provide thorough ethnographic overviews of the protohistoric Yokuts. These include Driver 1937; Gayton 1945, 1948; Gifford and Schenck 1926; Kroeber 1925; Latta 1949; Osborne 1992; Wallace 1978a, 1978b; and Wedel 1941). Much of the following summary is abstracted from PAI (1991a) and Hartzell (1992).

Linguistically, the Yokuts are grouped with the California Penutian family, which includes Miwok, Costanoan, Maiduam and Wintuan languages (Silverstein 1978). The Yokuts occupied the San Joaquin Valley from the delta, south of the Buena Vista and Kern Lakes. The Northern Valley Yokuts tribes included the Asirin and Taunan, who lived south of the Bay Miwok and bordered the Costanoans west of Arroyo Valle Creek, and the Leuchas, who lived along Hospital Creek (Bennyhoff 1977; Map 2). The Hounonme lived along the west side of the San Joaquin Valley. Their territory extended from Orestixnba Creek south to Los Banos Creek (Latta 1949). The Southern Valley Yokuts tribes included the Tachi, who lived at the northern perimeter of Tulare Lake, and the Wowol, who lived along the southern edges of the Lake. The Chuxoxi and Tulamni occupied the Kern River and Buena Vista Lake drainages, respectively.

The archaeology of the northernmost San Joaquin Valley suggests that the Yokuts were relative latecomers to that area. Cultural differentiation from the Plains Miwok culture occurred before AD 1500. Artifacts recovered from sites in the western side of the San Joaquin Valley have been assigned to the time between AD 1500-1600 and the beginning of contact with the Spanish. Linguistic data suggest that the Northern Valley Yokuts were pressured by their eastern neighbors, the Monache, who moved down the Sierra foothills and caused the Yokuts to spread northward across the valley into what had formerly been Costanoan and Miwok territory. This territorial shift took place over a span of two hundred years, leaving the Yokuts well-established in the San Joaquin Valley before the first Spanish expeditions (Wallace 1978b). The Southern Valley Yokuts may have been established in their ethnographic territory somewhat earlier, perhaps as early as 2,000 years ago (Wallace 1978a).

Hartzell provides a concise summary of protohistoric Yokut lifeways. These clearly have archaeological implications, at least for sites dating to late prehistory. She writes that:

> ...Southern valley Yokuts resided in near-permanent villages along the lakes, sloughs, and rivers of the valley. Village size varied from an estimated 30-50 people. The primary staple foods were lacustrine resources such as tule seeds and bulbs, fish, waterfowl, turtles, and mussels. Elk, pronghorn antelope, and jackrabbits were hunted communally with large numbers of people acting in concert to surround the quarry and dispatch them. Grass seeds and salt were collected from the plains around the wetlands. Steatite, asphaltum, and tabular cherts were available locally for manufacture of tools. Obsidian, materials for making bows and arrows, and marine shell beads and ornaments were traded with neighboring groups. Acorns may have been traded to valley groups from foothill Yokuts. And finally, tule boats were constructed and used for fishing and

fowling and [sic] as transportation, particularly during seasonally high water within the lakes and sloughs (Hartzell 1992).

The Yokuts experienced rapid and severe depopulation after contact with the Spanish and subsequent European explorers. Many Yokuts were taken to missions, where Old World diseases newly introduced to California decimated Native populations. Three major epidemics ravaged the missions, causing thousands of deaths (Castillo 1978). These epidemics at the missions were followed in 1833 by a severe malaria epidemic that claimed thousands more lives and virtually destroyed many villages and tribes. Up to seventy five percent of the population in the San Joaquin Valley was killed by this contagious disease, which was brought to California by a party of Hudson Bay fur trappers from the Oregon country. In 1834, the Mexican government de-secularized the missions and many of the Native residents returned to their former territories, where they survived by a combination of strategies that included traditional hunting and gathering and livestock raiding (Wallace 1978a; 1978b).

3.6.2.3. Historic and Modern Periods

There is a huge literature on the historic era in Central California, both from early Spanish contacts up to the present. In terms of cultural resources, historic sites form the most common resource on NPR-1. All of these, however, are oil and drilling related.

The structure of historical development in the project can be effectively classified within a sequence of five historic eras. This sequence is related to broad historic trends in California, the American West, and the nation, and within the wider realm of world history. It provides a framework for the description of historic occupation and land use patterns within the project area, and it can also be adapted to the analysis of specific historic cultural resources present in the project area. This sequence is based on an array of political, social, cultural, and economic criteria that are familiar to historical specialists (PAI 199la).

The historic sequence for the project area is summarized in Table 3.6-2. Detail on each sequence may be found in PAI (1991a). Since all known historic cultural resources at NPR-1 relate to relatively late Euro-American developments and the oil industry, it is useful to provide a very brief summation of this period here.

Table 3.6-2

Historic Period Sequence for the Project Area.

Frontier Era	1760s-1840s
Pioneer Era	1840s-1890s
Modernization Era	1890s-1920s
Centralization Era	1930s-1950s
Recent	1950s-1980s

Geography, climate, biology, and ecology have set severe conditions for historic development in the project area. Since the San Joaquin Valley is a landlocked interior region, it lacked effective access to commercial centers and markets until after the beginning of railroad construction in the 1870s. Severe

summer temperatures in the valley, and fog-filled winters gave the region little natural attractiveness for immigrants. Endemic diseases, including valley fever (coccidiomycosis) and malaria also inhibited settlement of the area. Especially critical has been the scarcity of water on the west side of the San Joaquin Valley, in the region in which NPR-1 is located. The shortage of timber for fuel and construction was another deterrent to settlement by Euro-American immigrants. Much like the Great Plain region described by historian Walter Prescott Webb, the San Joaquin Valley's west side was an environment difficult for people of European background to occupy and exploit (PAI 1991a).

The project area remained part of a marginal land use region, characterized by sheep and cattle ranching until the closing decades of the nineteenth century. Irrigation projects, first sponsored by the region's largest land owners, brought the first cycle of farm development to the west side. Intensive agriculture and the accompanying growth of small farm towns began to reshape the cultural geography of the area during the late nineteenth century. The same time period witnessed the beginning of an oil boom based on rich petroleum resources within the southern section of the project area. Railroad construction then overcame in some measure the isolation of both the farming and oil-producing districts. Subsequently, the west side agricultural districts were reached by large-scale irrigation projects, sponsored by state and federal agencies, that brought an expansion of commercial farming typified by corporate land ownership and control of water allocation. At the same time, the region's petroleum resources remained productive, providing the project region with a second basic industry under corporate management (PAI 1991a).

Oil clearly has played an important role in the modern history of the project area. It is, therefore, useful to consider its development in some detail. The following is abstracted from PAI (1991a).

The first oil activity in the area was undertaken by the Buena Vista Petroleum Company in 1864 in a region of extensive oil seeps near the present-day village of McKittrick. In 1866, the company produced about 4,000 gallons of illuminating oil or kerosene at a location to the northwest of the seeps.

The oil seeps continued to attract prospectors, although transportation was a problem in the cost-efficiency of production. In 1891, Solomon Jewett and J. A. Blodgett of Bakersfield established an asphalt refinery southeast of Maricopa. They used the oil from shallow wells to flux the asphalt. The refined asphalt was then hauled 40 miles to Bakersfield in freight wagons to be transferred to railroad cars. To reduce transportation costs, Jewett and Blodgett arranged for a branch of the Southern Pacific Railroad to be built from Bakersfield to the McKittrick area. In 1895, the branch railroad was completed through Railroad Gap at the west end of the Elk Hills.

The region continued to produce asphalt and oil at commercially insignificant levels through 1900. In 1899, the Kern River oil field near Bakersfield was discovered. This, and the presence of the railroad line to the McKittrick area, spurred energy activity on the west side of the valley.

In 1910, the Associated Oil Company, controlled by Southern Pacific, acquired leases in Elk Hills and drilled wells in the region. The first successful well was completed on June 6, 1911, with an initial production of 75 barrels per day. Associated Oil had two other discovery wells on public lands in Elk Hills, but did not press its claim for patent or the productive leases, nor did they conduct additional development or exploration.

In the early 1900s, increased awareness of conservation brought a change in government attitudes toward resource development and public land use. The U. S. Navy was shifting to oil-burning ships in its fleet. The increasing need for fuel brought about a request in 1908 from the director of the United States Geologic Survey to the Secretary of the Interior recommending the withdrawal of the remaining public oil lands. In September of 1909, the first withdrawal order was issued. Lands of NPR-1 were included in

this withdrawal. In January, the Pickett Act was passed, which confirmed existing withdrawals, and authorized the President to make additional withdrawals in the public interest. President Taft confirmed the earlier withdrawals by Executive Order, and again withdrew all public lands classified as ore lands.

In December of 1910, the Government filed suit against Southern Pacific to recover lands that had been selected for patent by the railroad that were oil lands, including 6,000 acres in the west Elk Hills. Two years later, the General Board of the Navy recommended that permanent reservations be set aside to assure a future supply of fuel oil for Navy ships. President Taft signed an Executive Order creating NPR-1, at that time appearing to contain over 12,000 acres of land patented to private interests, and about 26,000 acres of public lands withdrawn from entry in 1909. NPR-1 was established subject to valid existing rights. There were some fuller's earth mining claims recorded, but most, if not all, were fraudulently located and long dormant. The Navy anticipated some litigation to clear titles, but believed that NPR-1 was secure from drainage except from patented lands.

NPR-2 in the Buena Vista Hills was created in December of 1912 because of Navy fears that the Elk Hills would not have enough oil for the fleet. In 1915, the NPR-3 at Teapot Dome in Wyoming was created. It also consisted of lands closed by the 1909 withdrawal order.

United States entry into World War I brought increased drilling and exploration throughout the nation. In 1918, Standard Oil began drilling on the Hay Lease, a school land section near the center of NPR-1. Hay No. 1 was completed in January of 1919, and is generally regarded as the discovery well of the Elk Hills field. Standard Oil also purchased the Carman lease in the same area and began drilling operations in 1919.

At the same time, Standard Oil also started drilling on the Tupman lease, another school-land section. The first well came in on February 12, 1920. Production in these areas resulted in drainage of oil from the adjacent Navy lands. To combat problems of drainage, the Navy arranged to trade leases outside NPR-1 for quitclaim deeds to claims within NPR-1.

In 1921, President Harding transferred the responsibility for the Naval Petroleum Reserves to the Department of the Interior. This transfer and subsequent actions by Secretary of the Interior Fall resulted in the notorious "Teapot Dome" scandal. In 1927, the jurisdiction for the Naval Petroleum Reserves was restored to the Secretary of the Navy.

By 1938, Standard Oil of California was the only owner of private lands inside NPR-1. World War II brought on expansion of NPR-1 eastward to include adjacent producing land on the Elk Hills structure. In 1942, the Navy and Standard Oil signed a unit plan contract for the joint operation of the field.

In 1944, a shortage of oil developed on the west coast. Congress authorized development of NPR-1 to increase the rate of production to 65,000 BPD. A drilling program was initiated, with 312 wells drilled before the end of the war in August of 1945. It took only eight months to reach the authorized rate of production.

After World War II, production was reduced to 8,000 barrels per day. The unit plan contract between the Navy and Standard Oil was amended in 1948. In 1949, President Truman added 2,290 acres to NPR-1 (Maher et. al. 1975). In 1976, Congress passed Public Law 94-258, directing that NPR-1 be opened up and produced at the maximum efficient rate consistent with sound engineering practices. "Opening-up" of NPR-1 began on July 3, 1976 (DOE 1979) and operations continue to the present.

PAI (1991a) summarizes the historic period as follows:

> Overall, a historic overview of the project area and the adjoining region demonstrates that the influence of geography and environment have promoted patterns of land use that have sharply restricted population density along the west side of the San Joaquin Valley. Legal and administrative structures regulating land ownership and water rights have reinforced these land use patterns. The project area has not experienced any recent changes in land ownership and subsistence patterns because it has been set aside as a petroleum reserve. Any extant resources, however, will require careful recordation and evaluation as possible additions to sparse data base that now exists for interpreting the settlement history and historical geography of the project region.

The regional setting for cultural resources is described in Section 3.6.1 of the 1993 SEIS. No additional overviews of regional history have been prepared since that time. However, dissertation research on five Buena Vista Lake prehistoric sites was completed (Hartzell 1992) and a revised draft Cultural Resources Management Plan for NPR-1 was prepared (DRI and EG&G 1995). Both documents emphasize the likelihood that Buena Vista Lake was the most important environmental feature for prehistoric inhabitants of the Elk Hills region. The Cultural Resources Management Plan provides the current conclusions regarding areal prehistory from Hartzell's work (DRI and EG&G 1995):

Hartzell's examination of the archaeology of Buena Vista Lake provides a contemporary context from which future research should be evaluated. In particular, she concludes that:

> A consideration of the Buena Vista Lake sites suggests the following. Firstly, an archaeological midden deposit contained evidence for the earliest known occupation of the lake ca. 8,000 BP indicating extensive use of lacustrine resources. Secondly, there is a gap or hiatus in the archaeological record ca. 7,000 to 4,000 BP for which no evidence is presently available. Thirdly, an increasingly complex archaeological record appears in mid-late Holocene deposits which includes house structures and an overall broader assemblage of archaeological material at lake shore sites. Fourth, an apparently diminished archaeological record (with particular regard to lake shore village sites) occurs in the latest period (Hartzell 1992).

3.6.3. Elk Hills Resources (NPR-1)

3.6.3.1. Cultural Resources Surveys

The area surrounding NPR-1, especially the region around ancient Lake Buena Vista, is known to contain substantial cultural resources. Of particular significance are those sites initially investigated by Wedel (1941) (see previous Section 3.6.2. for additional detail). Until the 1990's, only limited cultural resource investigations had taken place within the boundaries of NPR-1. These investigations documented 23 cultural resources, comprised of 16 sites and seven locations. All but one were prehistoric occurrences.

DOE SEIS (1993) cited a number of surveys that had been conducted on NPR-1 since 1973, ending with the PAI sampling survey of 18,650 acres (approximately 40 percent of the acreage on NPR-1) in 1991. According to a record search of June 1996 by the Southern San Joaquin Valley Information Center of the California Archaeological Inventory, three additional surveys were conducted after 1991. These include two short linear surveys along proposed alignments for powerline routes (Garcia 1993 and Hall 1994), and a survey of 5,900 acres of NPR-1 lands for a proposed seismic survey project (Parr 1996). Between PAI and Parr, more than 50 percent of NPR-1 acreage has been intensively surveyed.

In addition, PAI (1992a, 1992b) conducted test excavations at 12 sites and Parr (1995) evaluated the section of the historic Asphalto Line of the Southern Pacific Railroad that is on NPR-1.

3.6.3.2. Prehistoric Sites

Through the completion of PAI's 1991 survey, 41 prehistoric archaeological sites had been recorded on NPR-1. PAI reported that one of these had been destroyed by construction of the California Aqueduct. PAI also considered that a 42nd site, CA-Ker-50, may be on NPR-1. It was described in Gifford and Schenk's 1926 report based on information from another archaeologist and PAI felt that the reported location might be incorrect. None of the post-1991 surveys recorded prehistoric sites on NPR-1. Of the 42 total sites recorded on NPR-1, most have not been formally evaluated for National Register eligibility. Based on PAI's (1992a, 1992b) test excavations at 12 prehistoric sites, DOE has determined that four of these are eligible, but the SHPO has not yet been asked to concur (DRI and EG&G 1995). The destroyed site is presumably ineligible but no formal determination has been made. As indicated in Section 3.6.1, information is being compiled on all recorded prehistoric sites prior to requesting SHPO concurrence on eligibility determination and CEQA importance evaluations. Once concurrence is received, this section will be updated in the Final SEIS/PEIR.

The recorded sites vary in size and complexity. All contain some freshwater shell, native to ancient Buena Vista Lake and slough. Currently archaeologists are reviewing site records and collecting additional information to determine which sites may be National Register eligible or important under CEQA criteria. The new field work has resulted in the recording of ten additional sites within the PAI survey area. As of June 1997, it appears that at least 20 of the approximately 50 prehistoric sites are Register-eligible and several of these are CEQA-important.

Twelve prehistoric archeological sites at NPR-1 have been evaluated for NRHP eligibility and four have been determined by DOE to be potentially eligible for NRHP listing according to 36 CFR 60.4 (Criterion D): CA-KER-3082 and CA-KER-3085/H. SHPO concurred in this determination in August 1997. Results of a review of all sites and prehistoric resources recorded as of late 1996, with field testing of some in 1997, form the basis for recognition of an Elk Hills Archeological District that is eligible for the NRHP under criterion 36 CFR 60.4(d), based on its potential to yield information important in prehistory.

3.6.3.3. Historic Sites

To date, all of the historic archaeological sites recorded on NPR-1 are related to oil exploitation. PAI's survey recorded 106 historic archaeological sites; this total includes five sites that also have prehistoric components. None have been formally evaluated for National Register eligibility. The draft Cultural Resources Management Plan indicates that most lack integrity:

> ...the original surface components of these sites are either absent or modified and have low integrity due to apparent systematic salvaging efforts common in mineral exploitation situations. Trash deposits and scatters associated with these sites could potentially provide ethnographic information; however, many of these sites appear to have been disturbed to some degree by bottle/relic hunters (DRI and EG&G 1995).

Hall (1994) recorded three historic archaeological sites that he considers ineligible because of lack of integrity. Parr (1996) recorded 19 historic archaeological sites on NPR lands. Of these, 18 are oil well sites that he considers ineligible because of lack of information or integrity, and one segment of a historically important rail line. The SHPO concurred on ineligibility of the 18 oil well sites. Parr's 1995 evaluation of the rail line segment finds it ineligible, while his 1996 evaluation suggests that eligibility of the segment cannot be determined until a greater length of the line (outside NPR-1) is documented for

evaluation. According to the draft Cultural Resources Management Plan (DRI and EG&E 1995), this railroad segment on NPR-1 was determined ineligible by the SHPO in 1987, due to lack of integrity.

Also according to the draft Plan, an old gas plant and eight historic buildings dating to the 1920s-1930s were also determined ineligible by the SHPO prior to the PAI survey (DRI and EG&E 1995).

The recorded historic sites include abandoned wells, well pads, brick kiln remnants, and trash dumps. In April 1995, an historian prepared a draft historic context for NPR-1. It will be included in a final report of historic archaeological evaluations currently underway. Field visits have resulted in more detailed recording of some sites. All of the sites visited have been disturbed to some extent by recent ongoing vandalism following a May 1997 grass fire. While the historical archaeology analysis has not been completed, preliminary results indicate that none of the sites appears to retain sufficient integrity to be eligible for the National register. Nor do any appear to have the unique importance required to be considered significant under CEQA.

Following completion of the studies, DOE will consult with the SHPO for concurrence on these evaluations. This section will be updated in the Final EIS if SHPO concurs on eligibility and CEQA importance.

3.6.3.4. Native American Concerns

In 1993, DOE completed a programmatic notification and summary in accordance with the NAGPRA agreement. The Native American Heritage Commission indicated that a January 1997 search of the Sacred Lands file was negative for NPR-1. DOE's contractors are consulting with Native Americans with traditional ties to Elk Hills to determine whether there are sites or issues of concern related to the proposed action or alternatives. Two site visits occurred in June 1997. Native Americans are concerned that some of the sites may contain burials that might be disturbed in the future. They are also concerned about disposition of artifacts currently curated at NPR-1.

3.6.3.5. Paleontological Sites

As indicated in Section 3.6.2.4 of the 1993 SEIS, a broad surface reconnaissance conducted in 1980 found few fossil exposures on the site (Repenning 1980). Two localities that Repenning said had been previously described by Woodring, Roundy and Farnsworth (1932) are considered significant in the reconstruction of geologic history of the area and of the history of specific ancient small mammals, primarily cotton rats, pack rats and rabbits.

3.6.4. Buena Vista Resources (NPR-2)

3.6.4.1. Cultural Resources Surveys

According to a record search of March 1997 at the Southern San Joaquin Valley Information Center of the California Archaeological Inventory, approximately 40 surveys have been conducted on lands of NPR-2, covering more than 3,000 acres. Many of these were small surveys specific to linear pipeline routes or well pads, but ten included larger amounts of land, from 40 - 640 acres. Unlike NPR-1, no systematic sampling survey of NPR-2 has been conducted.

Prehistoric Sites.

A total of three prehistoric sites have been recorded on NPR-2. Test excavations have been conducted at one site. According to records at NPR, DOE has received concurrence from SHPO that this site is ineligible for the National Register. Formal determinations have not been made for the other two sites.

Historic Sites

A total of 102 historic sites have been recorded on NPR-2. All appear to relate to oil exploration and production. According to records at NPR-2, DOE has received concurrence from SHPO that four of these are ineligible for the National Register. Formal determinations have not been made for the other sites.

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3.7. LAND USE

The following section discusses land use characteristics for NPR and surrounding areas. Section 3.7.1 describes land use in Kern County. Section 3.7.2 provides an overview of the land use at NPR-1. Land use characteristics for surrounding areas can be found in Section 3.7.3. Section 3.7.4 presents references for acquiring further information.

3.7.1. Kern County

The predominating land uses in Kern County include agriculture, mineral extraction, petroleum production, recreation, and urban development. The County's varied terrain, ranging from plains to hills to mountains, as well as limited water access influence its land use patterns. The majority of the County's total land area is devoted to agriculture, including sheep and cattle grazing and crop production. As a result, most of the residential, commercial and industrial development is located within Bakersfield and its surrounding metropolitan area, with an estimated population of 384,700 as of January 1, 1997, according to Kern County Council of Governments. In addition to Bakersfield, other smaller communities are located throughout the County.

Within Kern County, the Federal government owns and manages a large amount of land. Major Federal land holdings within the area include the Sequoia and Los Padres National Forests, Kern National Wildlife Refuge, Edwards Air Force Base, China Lake Naval Weapons Center, NPR-1, and NPR-2. In addition, the Bureau of Land Management manages extensive Federal land holdings, especially in the eastern portion of the County. The mountain, desert, and valley environments provide a variety of recreational opportunities such as camping, hiking, hunting, and biking. Visual resources in the region are varied and include such features as Red Rock Canyon, fields of colorful wildflowers, and pastoral foothills with little or no noticeable human development (Kern County Planning Department 1974).

The County is connected by major transportation corridors that include Interstate 5, State Route 99, and a network of other state, county, and local roads. In addition, the California Aqueduct extends north and south through the western portion of the County.

3.7.2. Naval Petroleum Reserve No. 1

NPR-1 comprises 47,409 acres located 35 miles west of Bakersfield in Kern County and has been used for petroleum extraction and processing since the early 1900s. Oil production, gathering, and processing dominate the land uses within the boundaries of the site. In 1996, NPR-1 produced 60,000 BD of oil, 350 MMCFD of natural gas, and 440 MGD of natural gas liquids. While sheep and cattle grazing were widespread on NPR-1 in the past, the practices were discontinued in 1960 when 500 sheep died after drinking arsenic-contaminated water from a sump in section 6M (DOE 1989). It is anticipated that NPR-1 lands will continue to be used for petroleum extraction and processing for several decades.

The Elk Hills, a six-mile wide and 16 mile long ridge that features up to 1,200 feet of topographic relief, comprise most of NPR-1 and makes up a portion of the southwestern edge of the San Joaquin Valley. Sparsely covered with a saltbush/red brome steppe vegetation and fragmented by a number of small canyons and gullies (DOE 1985), the Elk Hills are bordered by the flat valley floor. In addition, much of the periphery of NPR-1 lies within the flat valley floor. Drilling rigs, pumps, pipelines, storage tanks, processing facilities, utility lines, and communication towers, are prevalent through out almost all of the Elk Hills portions of NPR-1.

Currently, NPR-1 has a "State or Federal Land" designation under the Kern County General Plan Land Use, Open Space and Conservation Element. The Federal government controls the land use of the site. The site consists of 67 sections of land, 78 percent of which is owned by the Federal government and 22 percent by Chevron, U.S.A.. Since 1944, these lands have been developed and operated as a unit pursuant to a Unit Plan Contract (UPC). Under the UPC, the Federal government has the exclusive control of the land, which includes the exploration, development, and operation of NPR-1.

The site contains various state, county and private roads. For example, State Route 119 extends through the southeastern section of NPR-1, and Elk Hills Road (county) and Skyline Road (private) extend through the center of the site in a north/south and east/west direction, respectively. In addition, many paved and unpaved access roads run throughout the site. However, fences and/or patrols along portions of the perimeter restrict public access to the site.

The site contains various geodetic control monuments of the National Geodetic Survey. The following list of monuments in the general region of the longitude and latitude of NPR-1 found in Table 3.7-1 was prepared from the Survey's website at http://www.ngs.noaa.gov. Federal Agencies are required to contact the Survey prior to moving any such monuments.

3.7.3. Adjacent Land Uses

Land uses in the area surrounding NPR-1 follow the general patterns found throughout Kern County, which are dominated by agriculture and oil and gas extraction and production. Surface and mineral rights on lands surrounding the site are owned primarily by major oil companies. The Kern County Year 2000 General Plan (Kern County Planning Department 1982) acknowledges the economic importance of petroleum and agricultural resources and states that one of its goals is "to contain new development within an area large enough to meet generous projections of foreseeable need, but in locations which will not impair the economic strength derived from the petroleum, agriculture, rangeland or mineral resources, or diminish the other amenities which exist in the County." This goal is to be implemented by the Kern County Zoning Ordinance. The major types of land uses surrounding the site are presented below.

3.7.3.1. Agriculture and Open Space

Much of the area surrounding NPR-1 consists of agricultural land and open space, with oil extraction occurring as a compatible land use. Intensively irrigated agriculture occurs to the north and east of the site near the California Aqueduct. Numerous canals, ditches, drains and wells serve the farms in this area. The Bureau of Land Management's land holdings in the area are leased for grazing. For example, sheep and cattle are grazed to the south and west of the site on lands that are not irrigated for crop production. In addition, numerous oil extraction facilities coexist with these agricultural activities.

Lands zoned as exclusive agriculture districts have been determined by the County to be suitable for agricultural uses. Thus, the zoning helps to prevent the encroachment of incompatible uses and the premature conversion of such lands to nonagricultural uses.

Although various portions of open space have been impacted by grazing, some parcels remain in a relatively unspoiled condition and are being sought by the Nature Conservancy for habitat reclamation. Other major open areas include the 6,000 acre Coles Levee Ecosystem Preserve. Many of these lands have been zoned by Kern County as resource areas (Kern County Planning Department 1988) and future commercial or residential development would be discouraged. Also, the Williamson Act of 1965 provides tax relief for lands that are dedicated solely to agricultural or open space purposes.

Table 3.7-1
Geodetic Control Monuments within the Vicinity of NPR-1

PID	Designation	Lat	Lon
FU1982	V 548	351239	1192412
FU1400	Y 326 UOCO	351259	1193354
FU1401	R 951	351300	1193353
FU2311	LAKE RM 3	351301	1192237
FU2312	LAKE RM 4	351301	1192237
FU2310	LAKE	351302	1192237
FU1980	U 548	351315	1192320
FU1402	1275 USGS	351321	1193414
FU1403	CDS	351324	1193417
FU2309	195 DWR	351326	1192232
FU1977	EH 11 DWR	351328	1192643
FU2303	S 548	351345	1192035
FU2308	T 548	351346	1192232
FU3243	J 1292	351352	1193447
FU2302	R 548	351358	1192048
FU2305	L 1098	351358	1192126
FU2297	192 DWR	351402	1192016
FU1976	EH 10 DWR	351403	1192642
FU1406	Z 326	351425	1193517
FU1975	EH 9 DWR	351442	1192725
FU1407	A 951	351444	1193538
FU1589	EH 8 DWR	351516	1192747
FU1588	EH 7 DWR	351605	1192758
FU3676	PUFF	351606	1192427
FU3679	PIPE MARK NEAR STA PUFF	351606	1192427
FU3675	ELK 2	351611	1192519
FU3677	ELK	351612	1192519
FU3678	BFI 1334	351612	1192519
FU1587	EH 6 DWR	351635	1192804
FU1503	184 DWR	351711	1192009
FU3682	WEST ELK	351717	1193038
FU1586	EH 5 DWR	351722	1192751
FU1506	K 1098 K CO	351734	1192047
FU1514	183 A DWR	351747	1192101
FU1518	182 A DWR	351801	1192128
FU1517	183 DWR	351801	1192130
FU1525	182 DWR	351825	1192217
FU1571	181 DWR	351839	1192305
FU1576	180 A DWR	351906	1192338
FU1584	EH 3 DWR	351911	1192750
FU1568	Z 980	351929	1192335
FU1581	180 DWR	351934	1192443
FU1565	H 981	351950	1192442
FU1583	EH 2 DWR	351953	1192744
FU1558	179 DWR	351958	1192550
FU1582	EH 1 DWR	352020	1192755
FU1551	178 DWR	352022	1192649

3.7.3.2. Oil and Gas Production

Since the early 1900's, NPR-1 and other facilities in the area surrounding the site have been major oil producers. Currently this area supplies about two-thirds of California's total oil production and over one-third of the state's natural gas. NPR-2 lies immediately to the south of NPR-1. The Federal government owns about one-third of the 30,181-acre NPR-2 site and most of the rest is owned by major oil companies. NPR-2 land owned by the Federal government is leased in 17 separate units, with the lessees responsible for all development and production operations. The surface characteristics and land use patterns on NPR-2 are essentially the same as those on NPR-1. Several large and extensively developed oil fields, each covering thousands of acres, are located east, south and west of NPR-1, with additional petroleum development occurring on a smaller scale to the north (Bureau of Land Management 1978). Elements of the infrastructure associated with petroleum production are found throughout this area. For example, drilling rigs, pumps, pipelines, storage tanks, processing facilities, utility lines and communication towers are prevalent.

3.7.3.3. Water Banking

Water management and storage (known as banking) is an important activity in Kern County (see section 3.4.3.1 for additional details). The Kern Water Bank Plan is part of the Kern Water Bank Authority and will be managed for water recharge and endangered species. The Bank is approximately 20,000 acres, which is located near the eastern border of NPR-1and is the subject of an HCP application. Only a small amount of this land will be used for long-term recharge. A substantial portion of the remaining acreage may be used for intermittent recharge of local flood flows and habitat conservation, including the restoration of native habitat suitable for threatened and endangered wildlife.

Two-thirds of the lands within the Kern Fan Element Project area are currently devoted to agriculture, and the remaining one-third is covered in native vegetation (with less than one percent located within urban-industrial areas). Oil extraction occurs and is expected to continue on about two-thirds of the native vegetation area. It is anticipated that use of the area for petroleum extraction would continue at about its present rate, while some irrigated cropland would be taken out of production (California Department of Water Resources 1986). Several other water districts in the vicinity of NPR-1 are developing plans to join the Kern Water Bank.

3.7.3.4. Parks and Recreation

The Sequoia and Los Padres National Forests, and Kern National Wildlife Refuge are located near the site. In addition, the two major parks in the vicinity of NPR-1 are the 1,585-acre Kern County Buena Vista Aquatic Recreation Area and the 955-acre Tule State Reserve. Buena Vista Park, located about two miles east of NPR-1, is an extremely popular local recreational area, featuring boating on two lakes, camping, picnicking, swimming and fishing. Fishing also occurs along portions of the California Aqueduct and the Kern River. A 165-acre golf course and park complex is located west of the recreational area at the edge of Elk Hills. The Tule Elk State Reserve shelters a small herd of elk and is considered ecologically sensitive, with most of the area closed to public access. The reserve located next to the northeast corner of NPR-1 contains a small viewing and picnicking section that receives about 30,000 visits per year.

Several small parks are located in the communities of Taft, Buttonwillow, McKittrick, Derby Acres, Valley Acres, Ford City and Fellows. Kern County's Scenic Highway Plan includes a scenic route consisting of Elk Hills Road extending north and south through the center of NPR-1, State Route 119, and various country roads that border the eastern half of the site (Kern County Planning Department 1974). However, this scenic route is ranked low in the recommended order of implementation.

3.7.3.5. Local Community Development

Development surrounding NPR-1 includes the incorporated area of Taft and numerous unincorporated areas such as the rural communities of Tupman, Buttonwillow, Derby Acres, McKittrick, Dustin Acres and Valley Acres. The city of Taft, with an estimated population of 6,600, and the surrounding developed areas of South Taft, Taft Heights and Ford City, cover an area of about 2,000 acres. Taft is largely residential, with some commercial and light industrial development. In addition, a small airfield is located nearby. The remaining communities are surrounded by lands zoned for resource use (e.g., agriculture, mineral and petroleum development, open space) by the County. When residential or urban development takes place in petroleum resource areas, conflicts may arise. With proper mitigation measures (e.g., setbacks, landscaping, acoustic wraps, screens) petroleum production and urban development can be mutually compatible. However, some of these areas are considered to be hazardous (e.g., floodplain, landslide area, seismic area), and future development is likely to be limited.

3.7.4. References

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California Department of Water Resources, 1986, Final Environmental Impact Report: Artificial Recharge, Storage and Overdraft Correction Program, Kern County California (Kern Water Bank), State of California, Bakersfield, California.

DOE -- See U.S. Department of Energy.

Kern County Planning Department, 1974, Scenic Highways - an Element of the Kern County General Plan, Kern County, Bakersfield, California.

Kern County Planning Department, 1982, Kern County General Plan - Land Use, Open Space and Conservation Element: Year 2000 General Plan Program (2nd ed.), Kern County, Bakersfield, California.

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U.S. Department of Energy, 1985, Environmental Assessment of a Proposed Steam Flood of the Shallow Oil Zone, Naval Petroleum Reserve No. 1 (Elk Hills), U.S. Department of Energy Report, DOE/EA-0261, Tupman, California.

U.S. Department of Energy, 1989, Environmental Survey Preliminary Report, Naval Petroleum Reserves in California, Safety & Health, Office of Environmental Audit, Washington, DC, February.

3.8. NOISE

This section provides an overview of the acoustical environment at NPR-1 and NPR-2. Section 3.8.1 discusses the applicable noise regulations used to guide this analysis. Section 3.8.2 summarizes the acoustic environment at NPR-1. Section 3.8.3 summarizes the acoustic environment at NPR-2. Section 3.8.4 provides the reader with a list of references for additional information on this topic.

3.8.1. Applicable Regulations

The Noise Control Act of 1972, P.O. 92-574, provides noise-level guidelines to protect public health and welfare with a sufficient margin of safety. The guidelines provide a basis for assessing the effectiveness of noise regulations and land use policies. The Kern County General Plan Noise Element also establishes standards to protect the public health and welfare by regulating noise levels.

3.8.2. Acoustic Conditions at NPR-1

The major audible-noise sources within NPR-1 include compressors, steam generators, drilling rigs, heavy-duty vehicles and miscellaneous engines. In areas of NPR-1 that are remote from these noise sources, the acoustic environment is that of a rural location with typical residual sound levels of 30-35 decibels (A-weighted) (Miller 1968; Fidell et al. 1981; BB&N 1984). (A residual level represents a low-limit value to which the ambient environmental noise drops frequently, but below which it seldom goes.) However, closer to the noise-generating facilities the residual environmental noise levels rise to those typical of industrial and construction sites, i.e., on the order of 60-80 decibels (DOE 1979).

The nearest residential areas to the existing major noise sources within NPR-1 are in the towns situated along bordering roads, such as Tupman, Dustin Acres, and Valley Acres. If NPR-1 were not present, these residences would have residual night time sound levels typical of rural communities near a lightly traveled highway (30-40 decibels) (Miller 1968; Fidell et al. 1981; BB&N 1984). However, acoustic emissions from the multitude of sources such as compressors, drilling rigs, and well pumps at NPR-1 raise the residual background environmental noise levels in these residential areas to the range of 40-45 decibels (DOE 1979). These levels are consistent with the Kern County General Plan Noise Element and are still low enough not to be generally noticeable to the community; no complaints have been recorded.

The ambient environmental noise level in these residential areas is substantially increased when traffic is passing on nearby roadways. An automobile can produce a momentary level of up to 77 decibels when passing along a roadway at a distance of 50 feet from a residence. A large, heavily loaded tractor-trailer truck can create maximum levels as high as 87 decibels when passing at a distance of 50 feet (Harris 1979; Fuller and Brown 1981). At such times, vehicular noise completely masks (makes inaudible) all other environmental background noise, including the levels attributable to the noise sources within NPR-1.

3.8.3. Acoustic Conditions at NPR-2

The following information is based upon the 1994 Environmental Assessment for NPR-2 (DOE 1994), which analyzed conditions equivalent to the NPR-2 No Action Alternative in this document.

As at NPR-1, the ambient noise environment is a result mostly of contributions from petroleum production activities and equipment, such as well pumps, drilling operations, a gas plant and a compressor station. As of 1994, the major noise sources at NPR-2 are the Buena Vista Gas Plant located in Section 8 of T31S/R24E and a small compressor station located in Section 20 of T31S/R23E.

A 1993 noise survey at a gas plant and compressor station on NPR-1 found that residual noise levels from the gas plant ranged from 82 to 100 decibels at a distance of one to 13 feet, with residual noise levels from the compressor station ranging from 85 to 99 decibels at an average distance of ten feet. It is assumed that NPR-2 equipment generates similar noise levels. Drilling operations at NPR-2 cause residual noise levels ranging from 80 to 90 decibels immediately adjacent to the noisiest area. These drilling noise levels are typical of a construction site and are temporary, lasting only until a well is drilled. Noise levels near well pumps are localized and occur throughout NPR-2.

The closest residential areas to NPR-2 are in Ford City and Taft, at the southern border of NPR-2 and within 5,000 feet of NPR-2 operations. The gas plant mentioned above is remote from any residential communities while the compressor station is more than one mile away from Ford City residences.

The 1994 Environmental Assessment applied a formula provided in the Noise Element of the Kern County General Plan that shows a decrease in residual sound levels of approximately six decibels each time the distance from the source is doubled. Using this formula, the contribution of NPR-2 operations to Ford City/Taft residual noise levels would be about 46 decibels.

3.8.4. References

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DOE-See U.S. Department of Energy.

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3.9. SOCIOECONOMICS

The following subsections contain a socioeconomic description of Kern County, in which NPR-1 is located. Section 3.9.1 describes the population of Kern County. Section 3.9.2 describes income and employment. Sections 3.9.3 and 3.9.4 cover trade and housing, respectively, while Section 3.9.5 describes transportation. Section 3.9.6 describes public services and utilities, while Section 3.9.7 reviews public finances. Special emphasis has been placed on the southwestern areas of the county near NPR-1. When possible, separate information has been included for Bakersfield and Taft, the communities most likely to be affected by operations at the site.

3.9.1. Population

The population of Kern County is currently just under 625,000 and has increased by 114 percent from 1960 to 1996. During the 1980's, population grew at an annual rate of 3.2 percent and population growth slowed as expected during the 1990's to an annual rate of 1.9 percent. Population growth slowed significantly beginning in 1993. The expected growth through 2020 is outlined in Table 3.9-1. Compared with 1996, total population is expected to be 66 percent higher in 2010.

Table 3.9-1
Kern County Population Growth Trends

Year	Total Population	Population Density (persons/mi^2)	Average Annual Rate of Increase (percent)
1960	291,984	36	
1970	330,234	40	1.2
1975	355,808	44	1.5
1980	403,089	49	2.5
1985	479,500	59	3.5
1987	504,200	62	3.2[1]
1990	543,477	67	2.7[2]
1996	624,700	77	2.4
2000	801,991	99	7.1
2010	1,037,673	128	2.9
2020	1,310,050	161	2.6

Source: Kern Council of Governments undated.

Table 3.9-2 lists the 1990 and 1996 populations of Kern County cities and unincorporated areas. In both years, nearly half of the county's residents lived in unincorporated areas. Bakersfield had the highest concentration of population of any incorporated area, with 34 percent of the county's 1996 total. Delano is second with just over five percent of the population, and Taft accounts for only 1.1 percent of the county's population. The population distribution by city within the county remained about the same throughout the 1980's and 1990's.

[1] 1980 to 1987
[2] 1985 to 1990

Table 3.9-2
Kern County Population by City, 1990 and 1996

City	1990	1996	Percent of 1996 Total
Arvin	9,286	10,700	1.7
Bakersfield	174,820	212,700	34.1
California City	5,955	8,825	1.4
Delano	22,762	31,450	5.0
Maricopa	1,193	1,240	0.2
McFarland	7,005	7,950	1.3
Ridgecrest	27,725	29,000	4.6
Shafter	8,409	11,000	1.8
Taft	5,902	6,600	1.1
Tehachapi	5,791	6,550	1.1
Wasco	12,412	18,200	2.9
Unincorporated Areas	262,217	280,500	44.9
County Total	543,477	624,715	

Sources: Kern Council of Governments
U.S. Bureau of Census

In 1990, the median age of Kern County residents was approximately 29 years, with 55 percent of the population being between 20 and 64 years old. School-age children (5-19 years old) made up 24 percent of the population, preschool children (under five) nine percent, and the elderly (65 and older) ten percent (U.S. Bureau of the Census 1990). About 70 percent of the county's population consisted of non-Hispanic whites, 20 percent Hispanics, five percent Blacks, and five percent others.

3.9.2. Income and Employment

Table 3.9-3 shows that real median household income in Kern County increased by less than one percent from 1970 to 1980 but increased more than 50 percent from 1980 to 1989. The 1989 median household income for Kern County was approximately 0.5 percent lower than the U.S. median of $30,056 (U.S. Bureau of the Census 1990).

In absolute terms, the number of Kern County residents below the poverty level decreased by four percent from 1970 to 1980 but increased 79 percent from 1980 to 1989 (Table 3.9-3). Most of the increase in absolute terms was due to a general increase in population. The portion of residents under the poverty level increased from about 12 percent in 1980 to about 17 percent in 1989 (U.S. Bureau of the Census 1990).

Employment trends in Kern County are shown in Table 3.9-4. The total labor force and the number of employed persons increased by about 48 percent from 1970 to 1980. Between 1980 and 1986, the labor force grew by 24 percent, while the number of employed persons increased by 19 percent; however, between 1986 and 1996 the total labor force increased by 24 percent and the number of employed persons increased by 26 percent. As a result the county's unemployment rate decreased slightly from 11.8 percent to 11.1 percent. Some of the increase in unemployment during the 1980's was due to structural changes in the economy of Kern county during this period (Table 3.9-5). From 1985 to April 1996, there was an overall 24 percent increase in employment; however, some industries grew rapidly (such as services, up 40 percent) while others decreased (such as mining, down 11.7 percent).

Table 3.9-3
Trends in Kern County Household Income and Poverty Level
(in constant 1986 dollars)

Category	1970	1980	1989
Income Level			
Median Household Income ($)	18,974	19,088	28,634
Mean Household Income ($)	23,681	23,137	-*
Per Capita Income ($)	6,721	8,156	12,154
Poverty Level			
Persons Below Poverty Level	52,051	49,904	89,312
Percent Below Poverty Level	15.8	12.4	16.9

Source: Kern Council of Governments undated.
* Not Available

Table 3.9-4
Employment Trends in Kern County

Category	1970 Average	1980 Average	1986 June	1996 April
Total Labor Force	122,167	180,410	224,085	277,900
Number Employed	109,539	162,190	192,400	242,000
Number Unemployed	7,851	13,489	25,800	30,800
Percent Unemployed	6.7	7.7	11.8	11.1

Source: Kern Council of Governments undated.

Table 3.9-5
Kern County Employment Trends by Industry

Industry	1975	1980	1985	1996	Percent Change 1985-1996
Agriculture	23,640	31,600	26,500	49,800	87.9
Mining	8,310	11,900	11,900	10,500	-11.7
Construction	4,010	7,300	7,300	8,600	17.8
Manufacturing	8,010	9,300	9,300	9,400	1.1
Transportation and Public Utilities	6,610	7,700	8,300	8,900	7.2
Wholesale Trade	6,310	7,900	7,600	7,900	3.9
Retail Trade	19,920	25,700	31,000	34,000	16.1
Finance, insurance, and Real Estate	3,710	4,800	5,800	6,100	5.2
Services	16,530	23,600	28,900	40,500	40.1
Government	30,050	33,000	36,000	48,600	35.0
Other Industries	--	--	225	--	--
All Industries	127,100	162,800	180,125	224,300	24.5

Sources: Kern Council of Governments undated; California EDD 1988. 1996 data based on April, 1996 estimates.

Table 3.9-6 shows the percentage of Kern County employment associated with export activities compared to the national average. The table shows that Kern County generally has a larger percentage of workers in these fields than found in the U.S. These figures, however, do not indicate to what extent export-related employment is dependent on petroleum and natural gas extraction activities and therefore makes it difficult to predict how changes in petroleum-related production activities would affect such employment. The number of Wholesale Trade jobs is due to Kern County's (especially Bakersfield's) central location and may not have anything to do with oil and gas production. Trucking and Warehousing export employment is probably due to agricultural production. Special Trades may be the single largest category of export employment dependent on oil and gas extraction. However, employment in this category is only about four percent of total export employment in Kern County.

Table 3.9-6
Selected Export Employment in Kern County Compared with U.S. Employment Data, 1993 Data

SIC	Description	U.S. Employment (percent)	Kern County Employment (percent)
17	Special Trade	2.88	4.00
42	Truck and Warehousing	1.72	2.70
50	Wholesale Trade	3.60	3.83
54	Food Stores	3.19	4.08
55	Auto	2.10	3.34
58	Eating and Drinking	7.10	9.12
59	Miscellaneous Retail	2.56	3.12
73	Business Services	6.15	5.58

Source: U.S. Bureau of the Census 1993

Between 1984 and 1993, Kern County lost jobs in eight of the two-digit SIC categories detailed in Table 3.9-7 and gained employment in 38 others.

3.9.3. Trade

Kern County is one of the top three agricultural producing counties in the United States. The value of all farm production in the county annually exceeds $1.5 billion. Crops consist of over 250 different types, including 30 types of fruit and nuts, 40 types of vegetables, 20 field crops and 160 miscellaneous crops, livestock and poultry. Kern County also provides 60 percent of California's oil production, which represents eight percent of the nation's oil production and one percent of the total world oil production. The four largest employers are government (21.8 percent), services (19.3 percent), retail trade (15.9 percent) and agriculture (17.3 percent). Mineral extraction accounts for about 5.7 percent of the total employees.

Table 3.9-7
Employees by Industry, United States and Kern County, 1993

SIC Code/Industry	United States	Kern County
Construction	**4,524,110**	**8,761**
15 General Construction	1,096,289	1,750
16 Heavy Construction	679,578	2,010
17 Special Trade	2,731,774	5,115
All Others	16,469	0
Manufacturing	**18,183,381**	**9,929**
24 Lumber and Wood Products	675,081	593
27 Printing and Publishing	1,500,580	957
28 Chemicals and Allied Products	851,720	279
32 Stone, Clay, and Glass	471,639	717
34 Fabricated Metal Products	1,371,072	349
35 Machinery except electrical	1,749,735	738
38 Instruments and Related Products	878,379	243
All Others	10,703,125	6,053
Transportation and Public Utilities	**5,621,550**	**9,044**
42 Trucking and Warehousing	1,633,543	3,457
47 Transportation Services	363,103	175
48 Communication	1,299,658	1,822
49 Electric, Gas, and Sanitary Services	924,373	2,056
All Others	1,400,873	1,534
Wholesale Trade	**6,258,154**	**9,563**
50 Wholesale Trade - durables	3,414,441	4,903
51 Wholesale Trade - nondurables	2,504,260	4,356
All Others	339,453	304
Retail Trade	**19,776,732**	**33,707**
52 Building Materials and Garden Supply	696,228	1,273
53 General Merchandise	2,141,964	4,308
54 Food Stores	3,027,828	5,225
55 Auto Dealers and Service Stations	1,992,774	4,272
56 Apparel and Accessory Stores	1,194,121	1,542
57 Furniture and Home Furnishings	754,024	1,230
58 Eating and Drinking Places	6,727,618	11,674
59 Miscellaneous Retail	2,422,923	3,991
All Others	819,252	192
Finance, Insurance, and Real-Estate	**6,905,493**	**6,097**
60 Banking	2,095,049	2,270
61 Credit Agencies other than banks	483,133	516
63 Insurance Carriers	1,570,356	547
64 Insurance Agents, Brokers, and Service	656,007	662
65 Real Estate	1,335,048	1,836
All Others	765,900	266

Table 3.9-7
Employees by Industry, United States and Kern County, 1993 (cont'd)

SIC Code/Industry	United States	Kern County
Services	**32,258,944**	**41,230**
70 Hotels and Other Lodging	1,527,126	1,516
72 Personal Services	1,252,777	1,610
73 Business Services	5,832,261	7,146
75 Auto Repair, Services, and Garages	903,806	1,656
76 Miscellaneous Repair	439,495	1,088
79 Amusement and Recreation	1,201,248	1,104
80 Health Services	10,403,118	14,126
81 Legal Services	962,374	956
82 Education Services	1,967,024	602
83 Social Services	2,028,694	2,458
86 Membership Organizations	2,062,501	2,233
89 Miscellaneous Services	84,960	145
All Others	3,596,560	6,590
Nonclassifiable Establishments	**64,441**	**44**
Total	**93,592,805**	**118,375**

Source: U.S. Bureau of the Census, County Business Patterns, 1993

3.9.4. Housing

Characteristics of the Kern County, Taft and Bakersfield housing markets are summarized in Table 3.9-8. Bakersfield contains about 34 percent of all housing units in Kern County and Taft contains about 1.1 percent. Taft's portion of the county's total housing units is less than one percent for all categories -- single-family, multi-family and mobile homes. Bakersfield has only about nine percent of Kern County's mobile homes but about 62 percent of all multifamily complexes greater than five units each. Vacancy rates in both Taft and Bakersfield are lower than the overall vacancy rate for the county.

Table 3.9-8
Kern County Housing Characteristics, January 1996

Location	Total Units	Single-Family	2-4 Units	5 or More Units	Mobile Homes	Occupied Units	Vacancy Rates percent
Kern County	624,695	222,227	20,466	23,263	25,805	203,123	8.6
Taft	6,594	611	138	250	113	2,207	6.8
Bakersfield	212,715	78,098	9,610	14,527	2,231	73,677	5.66

Source: California Department of Finance, 1996

According to the Kern Council of Governments (undated), the total number of housing units in the county increased 230 percent to 624,695 units between 1987 to 1996. Trends in the composition of housing from 1970 to 1980 indicate a ten percent relative decline in single-family homes, offset by a six percent relative increase in multiplex units and a four percent relative increase in mobile homes.

3.9.5. Transportation

Access to the NPR-1 site is principally from the Taft-Bakersfield Highway (State Highway 119) (Figure 3.9-1). Other points of access are from Tupman, via Tupman Road; McKittrick, via Skyline Road; and Elk Hills Road, which intersects Skyline near the center of NPR-1. Payroll records indicate that 85 percent of NPR-1 employees commute from Bakersfield, 14 percent from Taft and the remaining one percent from a variety of other local areas, such as Tupman, McKittrick or other unincorporated areas in Kern County. It appears that most professionals employed at NPR-1 live in the Bakersfield area rather than Taft, but the reverse is true for clerical staff and field workers, including contractors and their employees Public Services and Utilities

Public services and utilities are affected directly by NPR-1 and NPR-2 operations at the site, as well as by residential demand of employees and their families, and indirectly by businesses that support these families. In general the most significant ongoing socioeconomic effects of NPR-1 operations are those associated with the population and economic activity created by the project, as opposed to those directly resulting from the operation of the facility. Because the population-related effects are dispersed throughout the county (primarily in the cities of Bakersfield and Taft and unincorporated areas of Kern County), the effects of NPR-1 operations on the public services and utilities are difficult to isolate and are not likely to tax existing capacities.

3.9.5.1. Police Services

Police services are provided in the unincorporated areas of Kern County by the county sheriff. In FY 1995-96, the Kern County Sheriffs Department had about 900 positions; about half of which are sworn officers. In addition, the Sheriff's Department also operates the county's detention facilities. The detention facilities staff is based on occupancy. In Bakersfield, the city police department has 258 sworn officers and 42 reserve officers (City of Bakersfield 1996) (DOE SEIS 1993). In Taft, the city police department has ten sworn officers and five reserve officers (City of Taft 1996).

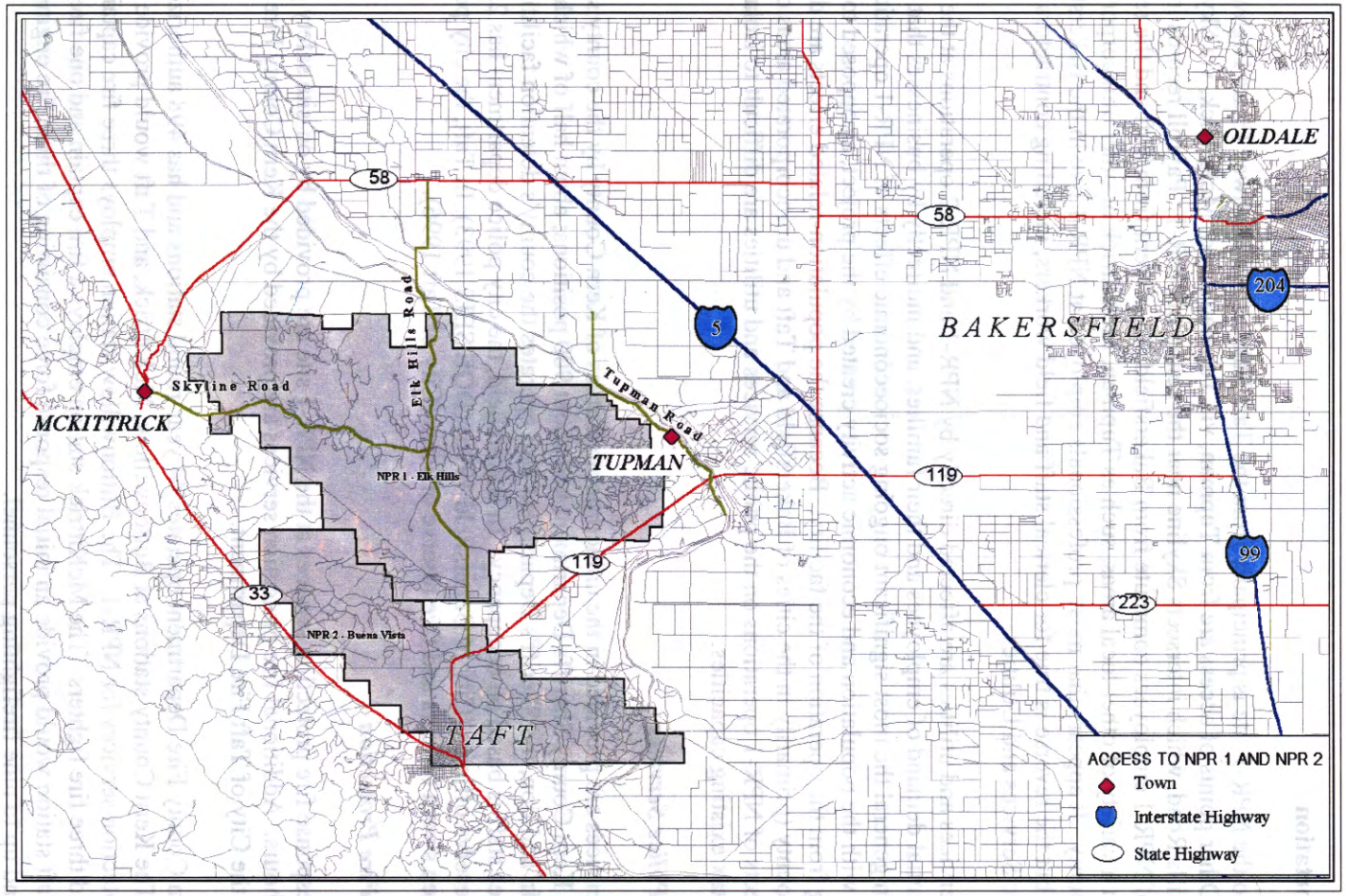
3.9.5.2. Fire Protection

Quick-response fire protection services at the NPR-1 site are provided by on-site safety personnel during working hours. Additional fire protection services are provided by the Kern County Fire Department and the City of Taft Fire Department.

The Kern County Fire Department operates 44 year-round stations and has 498 authorized full-time positions. The Kern County stations at Buttonwillow, McKittrick, and Taft would provide initial response fire protection services for NPR-1. The Buttonwillow station employs three fire captains, three fire engineers and three fire fighters. The McKittrick station employs a fire captain and one fire engineer. The Taft station would provide an initial response force consisting of three fire engines, two patrol vehicles and up to nine firefighting personnel.

Currently, the Taft Fire Department employs three Battalion chiefs, three fire captains, three fire engineers and three fire fighters.

Figure 3.9-1
Access to NPR-1 and NPR-2



3.9.5.3. Schools

As indicated above, a majority of NPR-1 employees live in Bakersfield and their children attend school there, with the remainder spread throughout the westside area of the county. Education is provided in Kern County by 37 elementary school districts, seven unified districts, four high school districts and two community college districts. California State University, Bakersfield, is the region's four-year university (Flaim 1989).

Although children of NPR-1 employees are concentrated somewhat in the Panama Elementary School District in southwestern Bakersfield, the general distribution of students throughout the city schools means that the effects of NPR-related population growth are small relative to the capacities of the school systems.

3.9.6. Public Finances

Table 3.9-9, which summarizes Kern County's sources of financing for FY 1995-96, shows that about 63 percent ($415 million) of the county's revenue comes from intergovernmental sources, principally the state of California and the Federal government. Property taxes ($97.8 million) account for about 15 percent of the county revenues. Total taxes and fees collected within the county (including licenses, permits, fines, forfeitures, penalties, charges for services and miscellaneous revenues) total approximately $111 million.

Table 3.9-9
Summary of Kern County Financing for Budget Year 1995-96

Source of Funds	Amount ($ million)	Percent of Total
Current Property Taxes	98.0	15
Other Taxes	23.8	4
Intergovernmental Revenues		
State Aid	272.9	41
Federal Aid	142.4	22
Charges for Services	76.2	12
Fines, Forfeitures, and Penalties	6.6	1
Revenues from Use of Money/Property	8.6	1
Licensee and Permits	8.0	1
Misc. Other Revenues	7.3	1
Balance from Prior Year	17.9	3

Source: Kern County 1996

Table 3.9-10 lists the distribution of all $325 million in property taxes collected in the county. School districts are allocated more than half of all property taxes (58.7 percent). The county is allocated 27 percent of property taxes, which is a nine percent decrease from FY 1987-88. Special districts governed by local boards account for five percent and the cities account for about six percent. The assessed value of CUSA's portion (about 22 percent) of NPR-1 totaled about $1.5 billion in 1987.

Table 3.9-10
Summary of Kern County Property Tax Billing for Budget Year 1995-96

Allocation	Amount ($ Million)	Percent of Total
County of Kern	89.4	27.5
Cities	20.0	6.1
Special Districts	17.0	5.2
School Districts	191.1	58.7
Redevelopment Agencies	8.1	2.5

Source: Kern County 1996

Table 3.9-11 shows how Kern County's budget was spent during the 1995-96 budget year. Public protection (the courts, police and similar services) accounted for about $215 million (33 percent); public assistance for $257 million (39 percent); general government for $65 million (ten percent); health and sanitation for $66 million (ten percent); and public ways and facilities for $20 million (three percent). The categories of education, recreation and cultural services, reserves and debt service accounted for two percent or less of the total.

Table 3.9-11
Summary of Kern County Budget Allocations for Budget Year 1995-96

Application	Amount ($ Million)	Percent of Total
General Government	64.9	10
Public Protection	215.3	33
Public Ways and Facilities	19.7	3
Health and Sanitation	66.4	10
Public Assistance	257.0	39
Education	6.5	1
Recreation and Cultural	9.4	1
Services	9.4	1
Reserves	13.9	2
Debt Service		
Total	**663**[3]	**100**

3.9.7. References

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3.10. HAZARDS RISK ASSESSMENT

This section compares and discusses hazards for typical petroleum-production facilities as well as those at NPR-1 and NPR-2. Section 3.10.1 includes discussions of existing regulations, guidelines and standards applicable to NPR-1 and NPR-2, as well as existing response capabilities. Section 3.10.2 updates hazards that were investigated in DOE EIS-0158 (DOE SEIS 1993) for NPR-1 and DOE/EA-0997 (September 1994) for NPR-2. Section 3.10.3 discusses various types of hazards that exist at NPR-1.

Two major types of hazards are inherent at petroleum-production facilities: 1) spills (which primarily threaten the environment); and 2) blowouts, fires, and explosions (which primarily threaten personnel and property and, secondarily, the environment). Additional hazards at NPR-1 and NPR-2 include other types of accidents, naturally occurring radiation and occupational hazards. Because the hazards of dealing with large quantities of oil, gas and natural gas liquids are well recognized at petroleum-production facilities, standards and precautions to prevent spills and accidents are highly developed, as are the capabilities of coping with such events should they occur. Despite precautions, a degree of risk remains. These are discussed in Section 3.10.4.

Risk has two major components: frequency and magnitude. Frequency is the likelihood that an event would occur in a given time period; magnitude is the size of the event. Generally, in risk assessment the larger the magnitude of an event, the lower the frequency of occurrence.

3.10.1. Applicable Regulations

Many regulations and standards exist to ensure the safe operation of facilities that handle, store and transport petroleum products. These include Federal, state and local regulations (with agency enforcement provisions) and industry-accepted guidelines. In particular, the preparation of oil spill prevention, preparedness and response plans are required under Federal and state rules. Key Federal requirements include EPA's Spill Prevention, Control and Countermeasures rule at 40 CFR 112.1-7 and EPA's Facility Response Plan rule at 40 CFR 112.20.

3.10.2. Historical Spills, Fires and Explosions at NPR-1 and NPR-2

One of the notable hazards associated with oil-field operations is that of oil spills. Spills and leaks are inevitable in the transfer, processing and storage of large quantities of crude oil and natural gas liquids. Historically, about three percent of nationally reported oil-field spills have involved less than 100 gallons (2.4 barrels); 82 percent have involved 100 to 10,000 gallons (2.4 to 240 barrels); and 15 percent have involved more than 10,000 gallons (240 barrels) (Ritchie et al. 1973). The major cause (about 80 percent of the cases) of reported spills was pipe failure, which in turn was caused by external corrosion in 46 percent of the cases. Other spill factors included ruptures, external corrosion and failures of valves and pumps.

The other major hazard associated with oil field operations are fires and explosions. Well blow-outs, in which the oil or gas is ignited, is a major cause of fires and explosions.

3.10.2.1. Oil Spills at NPR-1

Records of the number and volume of spills at NPR-1 have been maintained since July 1976. Table 3.10-1 summarizes reported spills from 1979 through 1995. The number of spills involving less than 100 barrels has fluctuated from 17 to 54 per month, with an average of about 30 per month. The number of incidents increased steadily from 1983 to 1990. This may be attributed, in part, to increasing corrosion associated with aging equipment and more stringent reporting requirements. Since 1990,

Table 3.10-1
NPR-1 Oil Spill History

Year	Minor Spills[a]			Major Spills			Total		
	Total Incidents	Barrels Spilled	Barrels Recovered	Total Incidents	Barrels Spilled	Barrels Recovered	Total Incidents	Barrels Spilled	Barrels Recovered
1979	[b]	2,452	633	0	0	0	[b]	2,452	633
1980	298	2,557	895	2	500	430	300	3,057	1,325
1981	209	1,995	1,034	4	632	579	213	2,627	1,613
1982	213	1,616	598	7	14,807	11,304	220	16,423	11,902
1983	201	1,619	620	6	1,817	1,519	207	3,436	2,139
1984	218	1,348	627	9	2,091	1,595	227	3,439	2,222
1985	253	1,395	627	7	1,303	985	260	2,698	1,612
1986	284	1,379	645	7	3,004	2,791	291	4,383	3,436
1987	390	2,421	1,237	5	907	840	395	3,328	2,077
1988	523	2,584	923	9	2,152	1,710	532	4,736	2,633
1989	573	2,237	816	7	3,070	2,970	580	5,307	3,786
1990	648	1,974	717	2	1,155	1,125	650	3,129	1,842
1991	539	2,505	1,410	4	1,069	1,005	543	3,574	2,415
1992	520	2,289	1,373	5	1,533	1,419	525	3,822	2,792
1993	510	1,520	834	2	320	305	512	1,840	1,139
1994	417	1,425	946	5	3,047	614	422	4,472	1,560
1995[c]	446	1,263	715	7	1,839	1,477	453	3,102	2,192
TOTAL	6,242	30,127	14,017	88	39,246	30,668	6,330	69,373	44,685

[a] Minor spills are those involving less than 100 barrels; major spills are those involving 100 barrels or more.

[b] Data not available.

[c] Oil spill data for 1995 taken from May 1996 Bechtel analysis.

however, the number of minor spill incidents has decreased fairly dramatically (over 30 percent from 1990 to 1995). The recent downward trend may be attributed, in part, to decreased production volumes, as well as improved corrosion control and pipeline monitoring/inspection/replacement programs. Also, increased contingency planning activity (e.g., update of the Spill Prevention, Control and Countermeasure Plan (SPCC), development of an oil spill response plan) may have helped increase awareness of potential spill risks. Spills of greater than 100 barrels have occurred on NPR-1 at an average rate of 5.2 spills per year over the period 1979-1995. The average size for these spills was approximately 450 barrels. With few exceptions, the spilled oil has been contained, and overall recovery has approached 78 percent. With the exception of 1994, recovery rates have shown marked improvement in recent years.

Vacuum trucks recover spilled oil and place it into the 27R oil recovery sump. Spilled oil that cannot be recovered is contained within secondary containment facilities or within NPR-1 site boundaries by use of berms and diversions. Additional resources (i.e., response/cleanup contractors) have been identified as a backup mechanism in the event spills escape secondary containment and overwhelm on-site response equipment or other resources.

As demonstrated in Table 3.10-2, the most common cause of spills in recent years (1989-1995) is corrosion of tanks and piping (42 percent on average), followed closely by mechanical failure (35 percent on average). Spills caused by human error make up a smaller percentage (seven percent on average) of total spill incidents occurring at NPR-1.

Table 3.10-2
Total Number and Percent of Spills for Each Cause Category

Year	Cause								Total
	Corrosion		Mechanical		Stuffing Box		Human Error		
1989	257	44 percent	184	32 percent	109	19 percent	30	5 percent	580
1990	294	45 percent	228	35 percent	105	16 percent	23	4 percent	650
1991	249	46 percent	159	29 percent	106	20 percent	29	5 percent	543
1992	224	43 percent	163	31 percent	84	16 percent	54	10 percent	525
1993	194	38 percent	199	39 percent	67	13 percent	52	10 percent	512
1994	156	37 percent	189	45 percent	55	13 percent	22	5 percent	422
1995[a]	180	40 percent	174	38 percent	59	13 percent	40	9 percent	453

Percentages may not add to 100 due to rounding.
[a] Oil spill data for 1995 taken from May 1996 Bechtel analysis.

3.10.2.2. Oil Spills at NPR-2

Approximately 72 spills have occurred on NPR-2 during the two years between March 1991 and March 1993, an average of six per month. Most of these involved much less than one barrel of oil and were caused by failures in pumps, valves, pipes or wellhead equipment. Only one of these spills was estimated to have exceeded one barrel. This spill consisted of 80 barrels (estimated) of an oil-and-water mixture that leaked from an aboveground, four-inch (10-cm) pipeline. The spill was cleaned up promptly and no permanent environmental damage occurred. Small spills are inevitable at oil production facilities because it is not possible to prevent all equipment failures.

3.10.2.3. Fires and Explosions at NPR-1

Only limited data exist on the occurrence of accidents involving fire or explosion in oil-field facilities. Since 1992, approximately 82 accidents involving fire or explosions occurred at NPR-1, representing a rate of approximately 0.173 fires or explosions per BCF of natural gas produced. A greater amount of information is available on well blowouts. Based on data taken from the 1979 EIS (DOE 1979), the calculated blowout rate for new wells is 0.8 blowouts per 1,000 wells drilled and the estimated blowout rate for remedial actions on wells is 0.3 blowouts per 1,000 actions. Between the mid-1970's and 1993, NPR-1 actually experienced six blow-outs (or similar conditions): one in connection with drilling approximately 1,100 wells (for an actual experience rate of .9 blowouts per 1,000 wells drilled); three performing 15,000 (estimate of .2 blowouts per 1,000) remedial and workover actions; and two related to day-to-day well operations that cannot be statistically correlated with industry experience. Since 1993, two additional blowouts have occurred at NPR-1. One was caused by a lack of proper fluid in the well during drill pipe removal. The cause of the most recent blowout was still under investigation when the analysis was performed. However, it is anticipated that current and future risks of blowouts would be relatively insignificant compared to the past risk because reservoir pressures have fallen significantly (and will continue to fall).

3.10.2.4. Fires and Explosions at NPR-2

No fires or explosions have occurred at NPR-2 since 1957. The risk of such occurrences is low because:

- The oil reservoir is 99 percent depleted, resulting in low reservoir pressure and decreased risk of blowouts; and
- The number of oil wells at NPR-2 (i.e., 200) is low compared to the reported frequency of failures (less than 1/1000 at NPR-1) (DOE, 1993).

3.10.3. Identification of Potential Hazards Associated with Operations at NPR-1 and NPR-2

Generally, hazards identified as those that either occur too frequently, even though the consequences are fairly minor, or those for which the magnitude of consequences is so great that occurrence can be tolerated only in terms of millennia are deemed unacceptable risks, which require risk reduction measures. The primary areas of concern are discussed below. The risk of these hazardous events have been reduced to an acceptable level.

3.10.3.1. Oil Spills

Facilities on NPR-1 and NPR-2 with the potential to release oil include:

- Petroleum storage tanks;
- Production wells and pipelines;
- Compressor stations;
- Product loading operations; and
- Vehicle refueling stations.

EPA's Facility Response Plan regulations at 40 CFR 112.20 and 21 require a facility to determine small, medium and worst case discharge amounts for the facility and develop plans to respond to such spills. NPR-1's facility response plan outlines small and medium discharge scenarios for various

components of the facility (BPOI 1995). Small spill scenarios are estimated at one barrel of oil released. Medium spill estimates range from five barrels at compressor stations to 100 barrels at vehicle refueling areas. Worst case discharge scenarios are presented for production storage tanks and production pipelines:

- The facility's worst case discharge for production storage tanks is the rupture of all tanks at the 18G lease automatic custody transfer (LACT) facility and is estimated at 316,800 barrels.
- The facility's worst case discharge scenario for production pipelines is the rupture or corrosion of the North or South flank pipelines on NPR-1 and is estimated at approximately 5,500 barrels.

Of the two worst case discharges presented, the production pipeline scenario is the more likely based on actual spill history at the site, for which corrosion has been the leading cause (see Table 3.10.2). Oil spill risks at NPR-2 are minimal at present and can be expected to decline even further as the number of wells and total oil production continue to decrease.

3.10.3.2. Accidents

Operation of compressor stations is one of the more hazardous operations at NPR-1. Closed spaces at these stations are locations where leaking gas potentially can accumulate to form explosive mixtures. Four explosions have occurred at enclosed compressor stations at NPR-1 since MER production began in the mid-1970's, the last of which was in 1985. No injuries resulted from these explosions. Portions of low temperature separation plant number one (LTS-1), LTS-2, HPI, 35R and 33S are enclosed, while 36R, 33R, 30R, 17R and 7R are all open. The enclosed stations and some open stations have fire and gas detection equipment installed. Most open compressor stations are not equipped with detection equipment.

About 440,000 gallons/day of natural gas liquid products (NGL) were produced at NPR-1 gas plants in 1996 (35 percent propane, 35 percent butane, and 25 percent natural gasoline, and five percent isobutane). This totals about 160 MMG/year. These NPR-1 products are transported to market in MC-330 and MC-331 tank trucks on public highways. Given that NGL's are highly flammable, this activity represents a potentially significant risk to the public. Hence, an analysis was undertaken to determine the number of vehicle accidents that might occur "off-site" while transporting NPR-1 NGL's.

On the basis of the analysis, it was estimated that approximately nine vehicle accidents per year could be expected based on an estimated 24,387 one-way tank truck shipments (0.00035 accidents per one-way trip). This estimate assumed approximately three times as many trips per day during the summer months as during the winter months. In addition, the estimate was based, in part, on an analysis reported in Appendix C of the 1979 EIS (DOE 1979) of 40 accidents involving tank trucks hauling products similar to NGL's (1.8 to 6.3 accidents per million miles for trucks depending on highway type). Although there are no known cases of spills associated with tank trucks transporting NPR-1 NGL's, based on a severe accident frequency of nine percent (Jones et al. 1973), one of the nine accidents could be severe (i.e., fuel-air detonation). Despite the heavy traffic at NPR-1, the "on-site" safety record is excellent; accidents have been few and very minor.

NPR-1 reported an average of 311 vehicles in use and 2,839,500 miles of travel during the period 1989-1995.[1] For this period, NPR-1 experienced an average of 2.95 reportable vehicle accidents per

[1] Figures were not available for 1988.

million vehicle miles driven. For 1994 and 1995, reportable vehicle accidents included 12 involving pickup trucks, three involving automobiles, and one involving a heavy truck.

3.10.3.3. Naturally Occurring Radioactive Materials

Wet gas, as taken from the wellhead, contains trace amounts of radioactive gas, primarily radon. During gas processing, radon can become concentrated in the gas plant in the ethane and propane fractions. Studies have shown that radon can produce slight, but possibly significant, short-term hazards to workers and consumers (DOE 1993). The radon level in California wet gas is well within the normal limits reported from other gas-producing areas in the nation. However, liquid petroleum gas (LPG) produced and sold in California has the highest radon content of any state, possibly due to the rapid movement of the produced LPG to market (radon-222 has a half-life of 3.8 days). In recognition of the risks, naturally occurring radioactive material (NORM) surveys, including radon, have been performed at NPR-1 to establish baseline conditions and identify areas of concern. This information is contained in NPR-1's Radiation Protection Plan.

3.10.3.4. Occupational Safety

Recordable occupational injury rates at NPR-1 (DOE, contractors and subcontractors) for the period 1982-1995 are provided by Table 3.10-3. Injuries per 200,000 man-hours worked during this period ranged from 1.88 in 1993 to 8.50 in 1982. During this same period the average injury rate experienced by the oil and gas extraction industry according to the Bureau of Labor Statistics (BLS) ranged from 5.2 in 1994 to 12.0 in 1982. The NPR-1 injury rate was below that reported by BLS in each year during the indicated period. The most hazardous activities at NPR-1 are those associated with drilling operations. There have been a total of five fatalities at NPR-1 since 1979, the last of which occurred in July 1988. Fatality incidents are reported to Cal-OSHA, Kern County, and DOE Emergency Operations Center.

Table 3.10-3
NPR-1 Recordable Occupational Injury Rates[a] Compared with Bureau of Labor Statistics (BLS) for Oil and Gas Extraction Industry

Year	NPR-1					BLS
	Drilling	Production	Gas Processing	Other[b]	Overall	
1982	12.86	6.66	5.70	5.61	8.50	12.0
1983	16.65	5.37	4.47	1.27	5.19	9.6
1984	6.40	4.38	7.58	.96	3.87	11.7
1985	4.50	2.23	3.09	1.79	2.55	10.0
1986	6.19	3.61	3.48	.80	2.48	8.0
1987	6.82	8.07	4.52	2.24	4.55	8.2
1988	10.35	6.75	7.12	.99	4.75	8.1
1989	5.39	4.38	7.59	1.03	3.42	7.5
1990	3.22	3.90	6.15	1.27	3.01	7.9
1991	5.80	3.90	8.38	3.09	4.30	6.3
1992	7.33	5.07	4.10	1.40	3.14	5.8
1993	3.51	0.00	2.02	1.85	1.88	5.9
1994	7.32	2.97	2.98	2.41	3.31	5.2
1995	2.09	4.65	4.46	1.44	2.43	N/A[c]

[a] Recordable accidents per 200,000 man hours worked.
[b] Engineering, Administrative, etc.
[c] Data not available.

3.10.3.5. NPR-2 Risks

Risks of fires, explosion and other accidents at NPR-2 are minimal at present and future risks are expected to be lower than current risk because of the continued depletion of the reservoirs and reduction in the total number of wells.

3.10.4. Overview of Existing Capabilities

3.10.4.1. On-Site Prevention and Emergency Response Capabilities

NPR-1 developed and implemented an SPCC Plan in 1989 that, among other things, provided for inspection procedures at NPR-1 and the installation/enhancement of prevention and containment facilities throughout the site. Table A.2-2 of Appendix A summarizes inspection procedures in the SPCC Plan. The SPCC Plan is periodically updated (most recently in October 1995) to reflect improvements in spill prevention and response, including upgrades to secondary containment. A project to enhance secondary containment at 25 tank settings was recently completed at NPR-1. Dikes and contingency catch basins are an important part of NPR-1's containment system for tanks. To mitigate oil spill risks from pipelines, NPR-1 has an ongoing corrosion control and pipeline monitoring/inspection/replacement program. NPR's Corrosion Control Program (CCP) seeks to identify and control corrosion at both pipelines and tanks. The CCP program is outlined in Figure A.2-2 of Appendix A.

In addition to the SPCC Plan, NPR-1 has a facility response plan to meet Federal requirements. The plan identifies potential spill sources and pathways, vulnerable receptors, and equipment, personnel and procedures to respond to a range of spill scenarios (i.e., small, medium, and worst case scenarios). Appendix A contains details on the facility response plan as well as an inventory of on-site response equipment.

NPR-2 employs prevention, preparedness and response techniques similar to those at NPR-1. NPR-2's activities include:

- Maintaining an SPCC Plan;
- Monitoring the site environment and facilities;
- Conducting routine equipment inspections;
- Training employees in equipment maintenance and operation to protect human health and the environment; and
- Providing secondary containment and corrosion protection where necessary.

3.10.4.2. Local and State Emergency Response Capabilities

This section summarizes the emergency response capabilities that currently exist in the vicinity of the NPRs. This information is important to demonstrate the ability of the local emergency response system to respond to a major oil spill or accident, should one occur. Response capabilities for land-based incidents exist within industry and the public agencies.

Kern County uses Hazardous Materials Emergency Response Area Plans (Area Plans) as a basis for planning and responding to oil spills and hazardous materials incidents. Primary responsibility for public agency oil spill response lies with the Fire Departments within each county and city jurisdiction. The Forest Service also has two fire stations in the area. Also, a number of oil spill emergency response contractors are available to assist with the clean-up of oil spills. Response agencies in Kern County use

the Incident Command System for managing response to oil spills. This allows effective integration of response personnel from multiple agencies and industry.

The mutual aid system used by Kern County is based on the California Disaster and Civil Defense Master Mutual Aid Agreement. The state Office of Emergency Services (OES) responds to mutual aid requests placed through the Operational Areas. The OES assists in locating and providing additional equipment or personnel by drawing on available state and local resources. Mutual aid agreements established within each county are outlined in the respective Area Plans.

At NPR-2, individual lessees maintain basic on site capabilities for responding to oil spills and other emergencies commensurate with the level of risk of individual sites. In summary, considerable equipment and human resources are in place to effect a large scale emergency response and/or clean-up operation on the NPRs.

3.10.5. References

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3.11. ENERGY CONSERVATION

This section describes energy requirements at NPR-1 and NPR-2. Section 3.11.1 discusses applicable energy regulations. Section 3.11.2 discusses energy used at NPR-1. Section 3.11.3 discusses the energy use at NPR-2. Section 3.11.4 provides a list of references for future information.

3.11.1. Applicable Regulations

NPR-1 oil and gas exploration and production activities are regulated by DOGGR under authority of the California Public Resources Code and Chapter 4 of Title 14 of the California Code of Regulations. The new private owner of NPR-1 (as well as any NPR-2 lessees) would be required to comply fully with all of these requirements. These requirements include financial responsibility, well activity approval and well closure approval.

The Conservation Committee of California Oil and Gas Producers (CCCOGP) is an industry-supported, tax exempt organization that was created in 1929 and that pursuant to state statute has administrated a voluntary hydrocarbon resource conservation program for the DOGGR since 1955. CCCOGP represents the oil and gas industry before the DOGGR on matters related to oil and gas conservation. Comprised of both majors and independents, membership accounts for over 80 percent of California production, excluding Elk Hills. It is funded by millage on production of large producers and by a fixed membership fee of $60 per year for very small producers.

The Committee's conservation efforts have been compared to the Texas Railroad Commission's production on proration program with the significant exception that it is operated by the industry rather than the state. The organization works through a technically qualified, industry-appointed Engineering Board supplemented by a small staff. Its charter is to monitor operations, calculate maximum efficient recovery (MER) rates, and assemble and evaluate production and reservoir data from onshore, state tidelands, and OCS areas. The Committee collects, prints, and distributes information on oil and gas operations in the state.

3.11.2. Energy Use at NPR-1

Energy consumption at NPR-1 is used to maintain in-house and outside working facilities for the staff, operate field vehicles, power instrumentation for all equipment, and operate the equipment necessary for oil and gas production, transportation, processing and sale. This includes: 60 internal combustion powered gas compressors with a combined horsepower of 105,000; 7 electric powered gas compressors with a combined horsepower of 11,500; a fleet of 350 vehicles; the instrumentation of all equipment; radio communication equipment; 1,049 pumping units on well sites; and the pumping and measurement equipment for the oil and gas pipelines and sales facilities. The highest percentage of electric power is used for general in-house consumption, operation of electronic instrumentation control equipment; and operation of electric motors for oil well pumping units, pumping units for waterflood injection, produced water disposal, and gas compressor motors. The highest use of natural gas, as a nonrenewable fuel, is for the operation of compressor engines.

3.11.3. Energy Use at NPR-2

Energy consumption at NPR-2 is primarily limited to the requirements of operating pump jacks. Because NPR-2 contains few facilities and has geared down production, impact on energy conservation is minimal.

3.11.4. References

U.S. Department of Energy, 1993, Supplemental to the 1979 Final Environmental Impact Statement, DOE/EIS-0158, March.

U.S. Department of Energy, Chevron U.S.A. and Bechtel, 1995, Naval Petroleum Reserves in California, FY 1995 Long Range Plan, Vol. 1 & 2.

U.S. Department of Energy, Chevron U.S.A. and Bechtel, 1997, Naval Petroleum Reserves in California FY 1997 Annual Operating Plan.

3.12. ENVIRONMENTAL JUSTICE

This section addresses the Executive Branch's concern for the potential impacts that proposed Federal actions may have on minority and low-income populations. This concern was originally addressed under a 1994 Executive Order (EO) that required all Federal agencies to promote non-discriminatory practices in Federal programs that substantially affect human health or the environment. Section 3.12.1 presents an overview of the main requirements of the EO. Section 3.12.2 presents both the racial and income characteristics of the resident population surrounding the site. Section 3.12.3 lists the references used for this section.

3.12.1. Applicable Requirements

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," and an accompanying Presidential memorandum to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities. The EO requires each Federal agency to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations in the United States. The general purpose of the EO is to:

- Focus the attention of Federal agencies on the human health and environmental conditions in minority and low-income communities with the goal of achieving environmental justice (EJ);
- Foster non-discrimination in Federal programs that substantially affect human health or the environment; and
- Give minority communities and low-income communities greater opportunities for public participation in, and access to public information on, matters relating to human health and the environment.

3.12.2. Demographics

Table 3.12-1 presents the racial composition surrounding the Elk Hills oil field for a one-, five-, and ten-mile radius. Based on the population estimate for Kern County of about 624,700 individuals, less than two percent of the county's population lives within a ten-mile radius of the site. The table also shows that the population residing within a ten-mile radius is composed of proportionately fewer Black, Asians and other minorities than are found in the composition of these races within the entire county or state. The table also shows that slightly more Native Americans are found within a ten-mile radius of the site than are found within the county or state as a whole.

Table 3.12-2 presents the distribution of income for households surrounding the Elk Hills Oil Field. The distributions are presented for household incomes corresponding to the State of California's household income quartile distributions. For example, in the State of California, approximately 25 percent of households have an annual income of less than $20,000, while another 25 percent have an annual income between $20,000 to $37,500. The exhibit shows that Kern County households are slightly less well off than a typical household in the State. While approximately 25 percent of California households earn less than $20,000, almost 40 percent of the households in Kern County earn less than $20,000. While Kern

County has a larger percentage of households in the State's lowest household income quartile, a smaller percentage of these county households are found surrounding the site than would be expected based on the county's overall distribution. The exhibit shows that about 33 percent of the households within a ten mile radius of the site earn below $20,000, while almost 40 percent of all households in the county earn less than this amount.

Table 3.12-1
Racial/Ethnic Mix of Populations Surrounding the Elk Hills Oil Field

Radius	Population/ Percent	White	Black	Native American	Asian	Other	Total	Hispanic *
1-mile	Population	4	0	0	0	0	4	0
	Percent	100%	0%	0%	0%	0%	100%	0.%
5-mile	Population	111	0	1	0	0	112	9
	Percent	99%	0%	1%	0%	0%	100%	8%
10-mile	Population	10,941	241	197	162	1,026	12,567	1,578
	Percent	87%	2%	2%	1%	8%	100%	13%
County	Percent	70%	6%	1%	3%	20%	100%	8%
State	Percent	69%	7%	1%	10%	13%	100%	26%

*The U.S. Census counts Hispanic populations separately from other ethnic groups which results in double counting of Hispanic populations (i.e., Hispanics are also counted as white, black, Native American, Asian, or other.) For this reason, Hispanic populations are presented separately.

Source: ICF Analysis

Table 3.12-2
Household Income of Populations Surrounding the Elk Hills Oil Field

Radius	Population/ Percent	less than $20,000	$20,000 to $37,500	$37,500 to $60,000	greater than or equal to $60,000	Total
1-mile	Population	1	1	1	0	3
	Percent	33%	33%	33%	0%	100%
5-mile	Population	31	24	19	10	84
	Percent	37%	29%	23%	12%	100%
10-mile	Population	1,357	1,354	1,039	375	4,125
	Percent	33%	33%	25%	9%	100%
County	Percent	39%	20%	25%	16%	100%
State	Percent	25%	25%	25%	25%	100%

Source: ICF analysis based on 1990 U.S Census data.

3.12.3. References

"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," Executive Order 12898, February 11, 1994.

U.S. Department of Commerce, Bureau of the Census.

U.S. Environmental Protection Agency, 1997, "Presidential Executive Order 12898 - Environmental Justice," http: /les.incl.gov/program/exec/eo-12898.html.

Slater, Courtenay M. and Hall, George E., 1997, "1996 County and City Extra, Annual Metro, City and County Data Book," Bernan Press, Lanham, Maryland.

4. ENVIRONMENTAL CONSEQUENCES

4.1. GEOLOGY AND SOILS

4.1.1. Summary of Impacts for NPR-1

This section analyzes the potential impacts related to geology and soils. The Notice of Preparation of a Draft Program Environmental Impact Report by Kern County Planning Department identifies six impacts in this area that could be potentially significant. These impacts are:

- Fault rupture;
- Seismic ground shaking;
- Seismic ground failure, including liquefaction;
- Landslides or mudflows;
- Erosion; and
- Subsidence.

The potential for each impact is assessed and defined in terms of one of four categories: no impact, less than significant impact, potentially significant impact unless mitigation is incorporated (when the incorporation of mitigation measures reduces an effect from potentially significant impact to a less than significant impact), and potentially significant impact (even with mitigation measures, the effect cannot be reduced to a less than significant impact).

The additional structures and the larger number of wells in the Proposed Action and the Alternative to the Proposed Action -- compared to the Reference Case -- would increase the potential for impacts due to possible fault rupture, seismic events and landslides. However, the construction of structures taking into consideration standard industry practices (including the Uniform Building Code) should reduce potential impacts to levels below significance.

The Proposed Action and the Alternative to the Proposed Action are expected to result in larger areas disturbed in the producing zone of NPR-1 than the corresponding areas disturbed under the Reference Case. Therefore, there would be a higher potential for erosion impacts. Common erosion control, revegetation and soil rehabilitation practices should make the residual effects of this increased erosion short-lived and localized. However, the residual effects in the Proposed Action and the Alternative to the Proposed Action would be, nevertheless, slightly higher than in the Reference Case.

Because of uncertainties associated with the prediction of subsidence, the occurrence of subsidence cannot be discounted, and the larger oil, gas and withdrawal rates in the Proposed Action may increase the potential for subsidence. However, the greatest potential for subsidence at NPR-1 has already passed with the peak production period. Proper construction and monitoring of subsidence effects on structures would reduce the effects to levels below significance in all the alternatives considered.

4.1.2. Methodology

The analysis of potential fault ruptures, seismicity and subsidence is based on geologic information from various geotechnical, earthquake engineering and geologic studies, as well as data

related to these issues obtained during previous NPR-1 oil field development activities. The impact analysis examines the potential effects of oil and gas development activities on seismicity and uses the California Uniform Building Code to define the need for additional mitigation measures to prevent impacts from seismicity. The analysis of potential landslides and mudflows is based on soil and topography information from Elk Hills. It also uses rainfall information for the region. The analysis of erosion potential focuses on a variety of factors, such as area of soil disturbed, duration of disturbance and other variables used in the U.S. Department of Agriculture (USDA) Universal Soil Loss Equation (USLE). Erosion impacts are analyzed by calculating areas disturbed by new development and compares the effects across alternatives. The impact analysis also examines erosion control and soil rehabilitation practices to make recommendations for mitigation measures.

According to Appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will:

- Cause substantial flooding, erosion, or siltation; or
- Expose people or structures to major geologic hazards.

These guidelines are used to assess the significance of potential impacts.

Many of the activities that cause environmental effects analyzed in this section are regulated in the No Action Alternative by several DOE orders, to be described in the corresponding analyses. All activities (and the required mitigation measures) are also regulated under the California Laws for Conservation of Petroleum and Gas (commonly called the "Public Resources Code"), as well as other specific regulations related to mitigation of impacts on geology and soils, which would apply to both government and commercial development as discussed below.

4.1.3. NPR-1 Impacts

This section analyzes potential impacts at NPR-1 related to geology and soils caused by the No Action Alternative (Section 4.1.3.1), the Proposed Action (Section 4.1.3.2) and the Alternative to the Proposed Action (Section 4.1.3.3). Each of these sections starts with a review of the potential impacts followed by a summary of recommended mitigation measures. Section 4.1.3.4 presents a brief comparison of the impacts analyzed.

4.1.3.1. No Action

The No Action Alternative corresponds to continued DOE ownership and operation of NPR-1. The analysis of impacts related to geology and soils in this section considers the potential effects caused by the expected range of activities between the lower and upper bounds of the Government Development Case. It should be noted that these upper and lower bounds of Government Development encompass the level of activities associated with the Reference Case.

Impacts

Fault rupture, seismic ground shaking and seismic ground failure. The Government Development Case, with the development of 252 to 490 wells (lower and upper bound, respectively) over the period 1997 to 2034, would introduce additional structures and facilities that may experience ground shaking during a seismic event. Also, oil field development activities may induce seismic events that could impact structures at NPR-1.

Though NPR-1 is in a seismically active region, no historically active faults have been identified (see Section 3.1.2 for a more detailed description of seismic conditions in the region). Some non-active faults can be observed in a direction perpendicular to the 29R and 31S structures, most noticeably the Tupman fault in the northeast flank of NPR-1 (Milliken 1993). The nearest active faults are the San Andreas, White Wolf, Pond Posso and Buena Vista (located at 12, 25, 22 and five miles from NPR-1, respectively). The maximum estimated earthquake magnitude for a fault near NPR-1 is 7.5-8.0 on the San Andreas Fault (Woodward-Clyde Consultants 1991). The existence of active faults in the region indicates the potential for earthquake activity at NPR-1.

The potential effects of earthquake events on structures, facilities and personnel for the No Action Alternative are affected by two factors. First, the potential for damage due to an earthquake tends to be greatest for facilities located on the alluvial fan and the Buena Vista Valley, where ground cracking, densification and liquefaction are most likely to occur (DOE SEIS 1993). Second, the elevated portions of Elk Hills would be affected less by an earthquake along the nearby active faults. Considering the somewhat higher earthquake risk when designing structures in the lower areas would reduce potential impacts.

Although oil and gas production activities have been related to seismic events, the magnitude of these events has been at the most 4.6 on the Richter scale (DOE SEIS 1993). These induced seismic events are caused by changes in the pressure field of existing faults, especially those that are active. The magnitude of seismic events induced by oil and gas production would not significantly affect structures properly designed according to the California Uniform Building Code.

The California Uniform Building Code (Section 2312) defines the area where NPR-1 is located as a seismic Zone 4 area (highest potential in a scale from 0 to 4). This category has design implications intended to protect structures from earthquake effects. All critical structures at NPR-1 have been upgraded to conform to design standards. Any new structures constructed under the No Action Alternative would be built following the standards of the Uniform Building Code, so the effects of fault ruptures, seismic ground shaking and seismic ground failure would be significantly reduced.

Landslides or mudflows. The potential for landslides in a given area depends on a variety of factors, including soil properties and slopes. A soil survey of NPR-1 (SCS undated) indicates that 35.2 percent of the area contains soil with 30 percent or higher slopes; the survey does not report, however, a high risk of landslides, but it does emphasize the potential for erosion and gully formation. The selection of new drilling sites takes into consideration stability factors to minimize the potential risk of landslides. Also, as torrential rains from summer thunderstorms are rare in Elk Hills and winter rains are usually gentle (Maher et al. 1975) with a total annual precipitation of about 5 inches, the potential for mudflows is small.

Erosion. The potential for fluvial erosion in certain areas of NPR-1 is considered to be high (SCS undated). The salts in certain areas have become concentrated as they have been deposited by runoff from upslope areas, and the deposited salts have not been leached because of the low permeability of the underlying soil layers and the low levels of precipitation. Plant growth is reduced in areas with excessive amounts of salt is reduced, and if slopes are high, the potential for fluvial erosion may be high. The soil survey of NPR-1 (SCS undated) indicates a high erosion potential for soils covering approximately 16,360 acres (or 35 percent of the total area). The erosion potential is not the only variable that affects the actual volumes of eroded material. Other important variables include precipitation (which is low in the area of analysis), the area of disturbance and the duration of construction (i.e., time during which soil is disturbed).

The development activity that is expected to cause the majority of soil disturbance at NPR-1 is the drilling of new wells, as most of the other facilities needed for the operation of the oil field already exist. Remedial activities of existing wells are not expected to cause significant erosion because no earth moving activities are involved. A review of past practices at NPR-1 indicates that a conservative value for the total area disturbed for a new well is, on average, 1.2 acres. This value includes 1.0 acre for installation of the actual well pad and maintenance area, and 0.2 acres for the right-of-way of new flowlines that connect the new well and the main collection pipelines to accommodate new wells. In addition, temporary disturbance is expected to occur. However, that temporary disturbance would be primarily noise and dust and would not sufficiently remove the ground cover so as to increase the risk of erosion. Additionally, it is necessary to extend the main pipelines. Data on past practices at NPR-1 indicate that, on average, the area disturbed for the right of way of extended main pipelines is equal to approximately 8.6 percent of the area required for new wells and flowlines. Areas disturbed by new wells, combined with the projected number of new wells for the various cases and scenarios analyzed, are the basis for calculating acreage disturbed by construction activities. These areas are the most susceptible to increased erosion.

There are two ways of analyzing areas disturbed for the purpose of comparing alternatives. One way is to multiply the area disturbed per new well times the total number of wells expected to be constructed over the remaining useful life of the oil field. However, as revegetation activities would proceed shortly after well drilling activities are completed, the area disturbed in a given year would be a more reasonable parameter for erosion impact analysis. The projections for the number of new wells that would be drilled under the No Action Alternative are presented in Appendix B. These projections show a generally downward trend. The maximum number of wells in a given year for the Reference Case and the lower and upper bound of the Government Development Case corresponds to 1997 levels, with 74 wells in all three cases. These 74 wells would imply a disturbance of 96.4 acres in total within the areas under development at NPR-1. Since the exact location of the new wells is not known, it is not possible quantitatively to assess the potential for sediment removal and transport from particular sites.

Over the entire 1997 to 2034 period, the areas disturbed by the development of new wells differ between the lower and upper bounds of the Government Development Case. Table 4.1-1 presents the total disturbed area for the possible range of activities considered under the No Action Alternative. The largest possible area disturbed by oil and gas development activities over the 1997 to 2034 period corresponds to the upper bound of the Government Development Case, with 600 acres (less than 1.4 percent of the total area of NPR-1).

Table 4.1-1
Total Areas Disturbed (in Acres) by New Development (1997 to 2034)

Reference Case	Government Development Case	
	Lower Bound	Upper Bound
535	303	600

The areas to be disturbed for the construction of new facilities is expected to be much smaller than the area required for new well development. Over the period 1997 to 2034, an estimated four new acres would be required for new facilities in the Reference Case and twelve acres for the upper bound of the Government Development Case. No new facilities are expected for the lower bound of the Government Development Case.

Given the erosion potential of the soils and the areas to be cleared, there is a significant potential for erosion impacts and related indirect impacts (e.g., water quality impacts in nearby streams, effects on terrestrial and aquatic biota). Therefore, appropriate erosion-control and site-rehabilitation measures should continue to be implemented as they have been in the past. Applying these measures should reduce the effects to a less than significant impact, with the duration of impacts limited to the duration of construction activities. The measures that would be applied correspond to well-known best management practices to reduce erosion in construction projects, such as those presented by Amimoto (1977), and the Soil Conservation Service (1985). Some of these measures include: conservation and stockpiling of topsoil for use in future reclamation efforts; minimization of impacts to natural drainageways and rapid re-establishment of their natural conditions and course after construction, if affected; revegetation of areas not needed permanently after construction; and rehabilitation of areas abandoned (including access roads, pipelines and well pads).

No erosion impacts are expected under the No Action Alternative from non-producing areas, because no significant infrastructure development activities would occur in these areas.

Subsidence. The withdrawal of oil, gas and water at NPR-1 has the potential to induce subsidence. However, the greatest potential for subsidence immediately followed the peak production period, which was in 1982. No significant land surface subsidence has been reported at NPR-1.

Among the individual reservoirs at NPR-1, the Stevens and Carneros Zone have favorable conditions for self-support (i.e., their geologic conditions are such that even after removal of fluids such as oil and gas, the structure is able to support itself), reducing the potential for subsidence. The Shallow Oil Zone (SOZ) and the Dry Gas Zone (DGZ) may offer less support and some level of subsidence may be caused as a result of oil and gas extraction. However, the waterflood and injection projects to be developed for the SOZ may reduce the potential for subsidence as water and gas fill the voids in the geologic structure. Table 4.1-2 presents the projected oil and gas production, along with gas and water injection volumes for the SOZ and the DGZ, for the Reference Case and the upper bound of the Government Development Case.

Uncertainties associated with prediction of subsidence make it impossible to rule out this phenomenon. Monitoring of structures at NPR-1 and rapid response to any subsidence observed would reduce the potential for significant damage to existing or future critical structures at NPR-1.

Table 4.1-2
Total Oil and Gas Production, Total Gas and Water Injection, Period 1997 to 2034
Shallow Oil Zone (SOZ) and Dry Gas Zone (DGZ)
Reference Case and Upper Bound Government Development Case (GDC)

Fluid	SOZ		DGZ	
	Reference Case	Upper Bound GDC	Reference Case	Upper Bound GDC
Production				
Oil (MMB)	164.84	283.23	0	0
Gas (BCF)	84.24	103.95	73.88	77.93
Injection				
Oil (BCF)	61.83	61.83	0	0
Water MMB)	17.52	17.52	0	0

Mitigation

To mitigate the potential for damage caused by fault rupture and seismic events, any new structure at NPR-1 would have to be properly designed and constructed following the standards of the California Uniform Building Code, as is presently required. Special attention to building design is recommended for any new structures on lower (non-elevated) areas of the reserve near active fault lines, which have a somewhat higher risk of earthquake potential and damage.

No mitigation is needed to address impacts from landslides and mudflows, because the potential for these events is not significant across the reserve as a whole. Selecting new drilling sites taking into account site-specific soil stability should avoid impacts at any particular location.

Common industry best management practices should be employed to reduce the potential for erosion and subsequent impacts at new construction sites. Some of these measures include conservation and reuse of topsoil, avoiding or (at least) minimizing disturbances to natural drainageways, rapid stabilization (e.g., revegetation) of disturbed slopes after construction and rehabilitation of abandoned areas. These and other standard practices are presented in Amimoto (1977) and the Soil Conservation Service (1985), among other references. Note that, as discussed elsewhere in this chapter, some of these practices might be mandatory requirements under permits for activities affecting other parts of the NPR-1 environment.

Monitoring of critical structures at NPR-1 and rapid response to any observed erosion subsidence would reduce the potential for any significant damage to existing or future structures on the reserve.

4.1.3.2. Proposed Action

This section analyzes potential impacts related to geology and soils that may be caused by activities associated with the sale of all of the Federal government's interests in NPR-1, as directed by

P.L. 104-106. For the purposes of characterizing the potential impacts, the range of development activities expected under the Proposed Action is considered to be limited by the lower and upper bounds of the Commercial Development Case, as defined in Chapter 2. The reader is referred to Appendix B for detailed information on annual projected activities for the Proposed Action. As discussed in Chapter 2, the potential production range for the Commercial Development Case overlaps with the range for the Government Development Case (see Figure 2.2-4). The impacts analyzed in this section parallel those evaluated in Section 4.1.3.1 (No Action). Under each heading, the impact that may be caused by each of the three proposed action scenarios considered under the Proposed Action are compared. Mitigation measures are summarized following the discussion of impacts.

Impacts

Fault rupture, seismic ground shaking and seismic ground failure; landslides and mudflows. The consideration of appropriate design and construction standards in the Proposed Action, as described in Section 4.1.3.1, would reduce the potential effects due to fault rupture, seismic activity, or landslides and mudflows to levels below significance. The larger number of structures (wells) to be constructed in the Proposed Action would increase the risks slightly, but the protection measures incorporated in the DOGGR regulations should make this difference negligible. There are no differences in this impact category across the divestiture scenarios considered under the Proposed Action.

Erosion. Most of the factors that influence the significance of erosion impacts under the Proposed Action are identical to the No Action Alternative (i.e., precipitation, soil properties, slopes). The main difference between the Proposed Action and the No Action Alternative and the Reference Case corresponds to the total areas disturbed during well development activities, as a larger number of wells (both annually and for the period 1997 to 2034) is expected for some range of options of the Commercial Development Case. The area to be disturbed per new well for the Proposed Action is expected to be the same, on average, as the area assumed for the No Action analysis. The larger area disturbed during well development activities under the Proposed Action would imply a larger potential for erosion impacts, relative to the No Action Alternative or the Reference Case.

As discussed in Section 4.1.3.1, a key factor in the evaluation of the magnitude of potential erosion impacts is the area disturbed in a given year. Table 4.1-3 compares the maximum annual values of disturbed areas due to new well development activities, over the period 1997 to 2034, for the Reference Case and the lower and upper bounds of the Commercial Development Case. The maximum annual disturbed area for the upper bound of the Commercial Development Case is expected to be 15 percent larger than the corresponding value for the Reference Case.

Table 4.1-3
Maximum Annual Disturbed Area (in Acres) by New Well Development Activities

Reference Case		Commercial Development Case			
		Lower Bound		Upper Bound	
Year	Area	Year	Area	Year	Area
1997	96.4	1997	96.4	1999	110.8

Table 4.1-4 presents the total areas that would be disturbed by new well development over the period 1997 to 2034, for the range of activities considered under the Proposed Action. The total area that would be disturbed for the construction of new wells under the Proposed Action is approximately 2.3-3.2 percent (lower and upper bound, respectively) of the total area of NPR-1.

Table 4.1-4
Total Areas Disturbed (in Acres) by New Well Development (1997 to 2034)

Reference Case	Commercial Development Case	
	Lower Bound	Upper Bound
535	555	766

The areas that would be disturbed for the construction of new facilities (in addition to new wells) is expected to be only 12 acres for both the lower and upper bounds of the Commercial Development Case.

Due to the soil erosion potential in the NPR-1 region and the size of the areas that would be disturbed for new well development, there is a significant potential for erosion impacts and indirect impacts if no erosion control and environmental restoration measures are implemented. These measures are well-known best management practices in construction projects and are described in Section 4.1.3.1.

Even with the application of corrective measures and rehabilitation plans, the residual effect of erosion impacts would be larger for the upper bound of the Commercial Development Case than for the No Action Alternative. However, there is a range of possibilities where the area to be disturbed by new development activities for the Proposed Action and for the No Action overlap. In any case, if mitigation measures are implemented, the potential impacts would be short-lived and not concentrated in a single area of NPR-1, thereby reducing the significance of the residual impacts after protection measures are taken.

The potential erosion impacts in producing areas of NPR-1 would be identical for all three sale scenarios considered under the Proposed Action, as the range of oil and gas production (as well as the expected number of new wells) is the same. However, the potential erosion impacts in non-producing areas differ with the sale scenario considered. For Scenario 1 (sale of all government interests in NPR-1 to two or more commercial entities) and Scenario 2 (sale to a single commercial entity), the commercial entities may develop the non-producing areas in the future not otherwise required to be set aside (see section 4.5) and additional erosion impacts may occur. This situation would not occur under Scenario 3, where non-producing areas would be sold to a conservation entity. Because the nature of future commercial activities in non-producing areas under Scenarios 1 and 2 cannot be predicted at this time, there is some uncertainty about the significance of potential erosion impacts. Nevertheless, the implementation of erosion control and environmental restoration measures is expected for most development activities in these areas, thereby reducing the potential for significant erosion impacts.

Subsidence. As noted in Section 4.1.3.1, the greatest potential for subsidence at NPR-1 followed the peak production period in 1982. No significant land surface subsidence has been reported at NPR-1. The larger oil and gas production levels from the Shallow Oil and Dry Gas Zones (the structures that may offer less support) for the upper bound of the Commercial Development Case, compared to the No

Action levels, may generate different subsidence rates over the production period (1997 to 2034). Table 4.1-5 compares the projected production and injection volumes for the Reference Case and the upper bound of the Commercial Development Case. The uncertainties in predicting potential subsidence effects preclude a quantitative prediction of the increase in subsidence impacts. The implementation of response and mitigation measures similar to those described in Section 4.1.3.1 for the No Action Alternative are expected to reduce any potential damages to critical structures of NPR-1. There are no differences in expected subsidence potential across the sales scenarios considered under the Proposed Action.

Table 4.1-5
Total Oil and Gas Production, Total Gas and Water Injection, Period 1997-2034
Shallow Oil Zone (SOZ) and Dry Gas Zone (DGZ)
Reference Case and Upper Bound Commercial Development Case (CDC)

Fluid	SOZ		DGZ	
	Reference Case	Upper Bound CDC	Reference Case	Upper Bound CDC
Production				
Oil (MMB)	164.84	413.12	0	0
Gas (BCF)	84.24	120.79	73.88	84.12
Injection				
Oil (BCF)	61.83	61.83	0	0
Water (MMB)	17.52	17.52	0	0

Mitigation

The nature of mitigation measures needed for the Proposed Action is identical to those described for the No Action alternative in Section 4.1.3.1; however, the magnitude or extent to which those measures would need to be implemented would be slightly greater under the Proposed Action. These measures include: (1) design and construction of new structures following the standards of the California Uniform Building Code; (2) selection of new drilling sites taking into account site-specific soil stability to avoid any impacts associated with landslides or mudflows; (3) use of common best management practices to reduce the potential for erosion and subsequent impacts at new construction sites; and (4) monitoring of critical structures and rapid response to any erosion or subsidence observed.

4.1.3.3. Alternative to the Proposed Action

As the expected production range for the Alternative to the Proposed Action is the same as the range for the Proposed Action (the Commercial Development Case in both cases), potential impacts related to fault rupture, seismic ground shaking, seismic ground failure and subsidence would be identical. If erosion control and environmental restoration measures are effectively implemented, there would be no difference in the temporary and localized erosion impacts in the producing areas of NPR-1 between the Proposed Action and the Alternative to the Proposed Action. Because no development

activities are expected to occur in non-producing areas under the Alternative to the Proposed Action, there would be no erosion impacts as in Sale Scenario 3 of the Proposed Action.

4.1.3.4. Comparison of Impacts

The additional structures and the larger number of wells in the Proposed Action and the Alternative to the Proposed Action (both Commercial Development Cases), compared to the No Action Alternative (Government Development Case) and the Reference Case, would result in a larger potential for impacts due to possible fault rupture, seismic events and landslides. However, the construction of structures taking into consideration recommended practices (including the Uniform Building Code) should reduce potential impacts to levels below significance.

Under the Proposed Action and the Alternative to the Proposed Action, commercial development is expected to result in larger areas disturbed in the producing zone of NPR-1 than the corresponding areas disturbed under government development (No Action Alternative) or the Reference Case. Therefore, there would be a higher potential for erosion impacts in the former. Common erosion control, revegetation and soil rehabilitation practices should make any residual effects from increased erosion short-lived and localized. The residual effects in the Proposed Action and the Alternative to the Proposed Action would be, nevertheless, slightly higher than government development in the No Action Alternative or the Reference Case.

Because of the uncertainties associated with the prediction of subsidence, the occurrence of subsidence cannot be discarded, and the larger oil, gas, and withdrawal rates in the Proposed Action and the Alternative to the Proposed Action may increase the potential for subsidence. However, the greatest potential for subsidence at NPR-1 has already passed with the peak production period. Proper construction and monitoring of subsidence effects on structures would reduce the effects to levels below significance in all the alternatives considered.

4.1.4. NPR-2 Impacts

This section analyzes potential impacts at NPR-2 related to geology and soils caused by the No Action Alternative (Section 4.1.4.1), the Recommended Action (Section 4.1.4.2) and the Alternative to the Recommended Action (Section 4.1.4.3).

As NPR-2 is near the end of its useful life, the level of production activities would be much lower than at NPR-1 for all alternatives considered. For example, the upper bound estimate for Commercial Development of NPR-1 corresponds to a total of 932,220 MB of oil, compared to 5,114 MB of oil for NPR-2. Therefore, although the nature of production activities at NPR-2 and the associated impacts related to geology and soils would be similar to those at NPR-1, the magnitude and significance of these impacts would be much smaller.

4.1.4.1. No Action

This section analyzes potential impacts related to geology and soils for the No Action Alternative for NPR-2 (continued DOE leasing for private operations).

Fault rupture, seismic ground shaking and seismic ground failure. As described in more detail in Section 3.1, three potentially active thrust faults have been identified in the southern portion of NPR-2, and the State of California Department of Conservation, Division of Mines and Geology (CDMG) has

designated two special study zones that encompass these three faults. As oil production is reduced with time under the No Action Alternative, the potential for seismic impacts is reduced. Furthermore, before construction of structures that would be occupied 2,000 hours annually in the special study zones, a detailed study of geologic features indicating active faulting and displacement is required. The expected impacts in this category are not expected to be significant.

Landslides and mudflows. Given the similarities in climate, topography and surface soils at NPR-2 and NPR-1, the potential for landslides and mudflows is small, as previously discussed in Section 4.1.3.1.

Erosion. The drilling of new wells at NPR-2 and other construction activities have the potential to cause erosion impacts. The factors that influence erosion at NPR-2 are the same as those discussed for NPR-1 in Section 4.1.3. However, the areas expected to be disturbed over the remaining useful life of NPR-2 until 2017 encompass only 185.5 acres (less than 0.57 percent of the NPR-2 area and less than 1.8 percent of the portion owned by DOE). The total area expected to be disturbed at NPR-2 by new construction activities is distributed as follows: 98 acres for drilling of 75 new wells; 75 acres for construction of 22.5 miles of new pipelines; 7.5 acres for construction of 2.25 miles of new roads; and five acres for new tank settings.

As part of the No Action Alternative, erosion control measures (e.g., establishing temporary drainage controls, compacting work areas, revegetating) would be implemented to minimize the potential erosion effects. Soil erosion would be, as a result of these measures, relatively localized in extent and short-term in nature. Furthermore, the area currently used by several support facilities, roadways and pipelines would be reclaimed, minimizing the potential for long-term erosion impacts.

Subsidence. The continued withdrawal of oil, gas and water from producing zones has the potential to result in surface subsidence. However, the greatest potential for subsidence immediately follows the peak production period, which was in the early 1900s. For this reason, it is expected that no new subsidence areas would occur, and the existing affected area will continue to subside at a decreasing rate (DOE EA 1994).

4.1.4.2. Recommended Action

Under the Recommended Action (transfer of NPR-2 to BLM for management under current BLM programs), there would be no changes in the expected production levels. Development activities and associated impacts related to geology and soils would be identical. Ownership and control of surface soil would be transferred to BLM, and erosion control and environmental restoration measures would continue to be implemented.

4.1.4.3. Alternative to the Recommended Action

Under the Alternative to the Recommended Action, there would be no changes in the expected production levels. Development activities and associated impacts related to geology and soils would be identical. As surface rights would be owned by a commercial entity in the Alternative to the Recommended Action, other non-oil development activities might take place in non-producing areas, as well as in producing areas after depletion of oil resources and decommissioning of existing facilities. The nature and extent of these commercial activities and their associated erosion impacts cannot be predicted at this time. Regular erosion control practices used in most development activities would reduce the significance of any additional impacts.

4.1.5. Cumulative Impacts

This section analyzes cumulative impacts from the various alternative actions for NPR-1 in conjunction with other past, present, and reasonably foreseeable future actions that could have impacts on geology and soils in the affected environment, such as production activities at NPR-2 and other oil fields in Kern County, as presented in the Notice of Preparation by Kern County Planning Department for this environmental study. These oil fields are described in Section 2.4.

A key source of information for the cumulative analysis presented in this section is the Final Environmental Impact Statement for the Caliente Range Management Plan recently prepared by the Bureau of Land Management (BLM 1996). The Range Management Plan analyzes the future management of three distinct geographical areas: the Coast, South Sierra and Valley Management Areas of the Caliente Region of southern California. The Valley Management Area encompasses NPR-1 and 2, as well as the other cumulative projects.

The Valley Management area includes the southern San Joaquin Valley and Carrizo Plain. The total acreage of the area is 4,761,520 acres, 50 percent of which (2,393,000 acres) is located in Kern County. Private lands in the management area are predominantly devoted to agriculture, livestock, grazing and oil and gas development. The management area contains several of the nation's largest oil and gas production fields, and is characterized by extensive oil development. The Valley Management Area contains a total of 397,300 acres of mineral estate, of which a total of 136,000 acres are currently leased. There are 395 federal leases in the management area covering 136,000 acres with 5,177 wells. In the Kern County portion of the Valley Management Area, 102,000 of the acres are leased and contain 5,065 producing federal oil wells. Exploration success peaked in the 1950s and has steadily declined since then. The annual total of new wells within existing fields are roughly equal to the total number of wells being abandoned annually (BLM 1996). The potential for increased production from the Proposed Action or the implementation of the Alternative Action at NPR-1 is not expected to affect this overall regional trend.

The subsidence that may be caused by oil and gas development activities at NPR-1 is only the third type of subsidence in order of importance in the San Joaquin Valley (DOE EA 1994). Most of the subsiding area in the San Joaquin Valley is the result of pumping water from an underlying confined aquifer system which is unrelated to oil and gas activities. The second most common type of subsidence in the area is related to hydrocompaction of soils above the water table, usually as a result of surface irrigation and weak soil structure also unrelated to oil and gas activities. No cumulative impacts are expected from any of the alternatives analyzed for NPR-1 for two reasons. First, for the most part, the type of subsidence that may be induced by oil and gas development activities is restricted to local areas. Second, the greatest potential for subsidence at NPR-1 has already passed after the peak production period. All of the other cumulative projects, including NPR-2, have also passed their peak production (see Section 2.4 for additional information on these projects).

If the erosion control and environmental restoration measures discussed in Section 4.1.3 are implemented, residual soil erosion impacts will be localized in extent and short-term in nature for any of the alternatives considered for NPR-1. At a regional level, between 150 and 260 new wells are forecast to be drilled per year (BLM 1996). The low precipitation levels and the lack of a dense hydrological network of perennial streams in the region makes it highly unlikely that sediment eroded from different new wells in the region can be accumulated into a single water body. Furthermore, BLM (1996) states that cumulative effects to water quality (including erosion effects) in the San Joaquin Valley associated with oil and gas production from federal leases is incrementally insignificant.

4.1.6. References

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4.2. HAZARDOUS MATERIALS AND WASTE MANAGEMENT

4.2.1. Summary of Impacts for NPR-1

This section analyzes the potential environmental impacts caused by the generation and management of hazardous materials and wastes. Oil and gas production activities normally use a variety of hazardous materials and generate hazardous wastes that are managed under a variety of Federal, state and local regulations, as described in Section 3.2.1.

This section reviews existing and planned actions for reporting, disposing and recycling of hazardous materials, waste minimization and management of PCBs, radiation, herbicides and asbestos. Sections 4.2.3 and 4.2.4 analyze the potential impacts for NPR-1 and NPR-2, respectively.

The comprehensive regulatory framework at the Federal, state and local levels related to the management and disposal of hazardous materials and wastes applies to all three alternatives analyzed. The No Action Alternative requires the use and disposal of smaller volumes and quantities of hazardous materials and waste than the Proposed Action and the Alternative to the Proposed Action. As there is enough regional capacity to handle the volume of the fairly conventional hazardous waste generated under any of the three alternatives, the potential impacts caused by the disposal or recycling of these wastes would be less than significant.

Some programs required by DOE to be implemented under the No Action Alternative (e.g., the RadCon program and environmental training program) may or may not continue on the same level under the Proposed or Alternative to Proposed Action, depending on the environmental practices of the proposed purchaser that ultimately operate the oil and gas production at NPR-1. The waste minimization/pollution prevention program currently implemented by DOE in accordance with DOE Order 0440.1, or some comparable program, is expected to be implemented by the new owner in accordance with the California Hazardous Waste Source Reduction and Management Review Act (California Health and Safety Code Section 25244 et seq.).

4.2.2. Methodology

As a starting point, the impact analysis in this section uses the inventory data of hazardous materials and wastes for current operations at NPR-1, as presented in Section 3.2. From that point, the volume and quantities of hazardous materials and wastes used and generated are expected to approximate the pattern of future oil and gas production levels. This section reviews projected levels for the various alternatives, and discusses the management programs currently implemented at NPR-1 and potential changes for the various alternatives. Finally, the analysis includes a review of existing regional capacity for hazardous waste management of the types expected to be generated to evaluate potential impacts.

According to Appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will create a potential public health hazard or involve the use, production or disposal of materials that pose a hazard to people or animal or plant populations in the area affected.

4.2.3. NPR-1 Impacts

4.2.3.1. No Action Alternative

Impacts

Under the No Action Alternative, current practices for hazardous materials and waste management and disposal would continue for production levels between the estimated lower and upper bounds of the Government Development Case. The volume of hazardous materials and wastes used and generated in future operations under the No Action Alternative is expected to follow the pattern of oil and gas production levels. It is important to note that peak production for NPR-1 already occurred in 1982 and the future trend is generally downward. Table 4.2-1 presents 1997 and relative peak production levels (for the period 1997 to 2034) for the Reference Case and the lower and upper bounds of the Commercial and Government Development Cases. As shown in this table, oil production is expected to decrease continuously in all cases. Gas production will increase by about 20 percent in 2001 compared to 1997 levels in all cases. The volumes of hazardous materials and waste managed and generated at these production levels are expected to remain constant or increase only slightly until 2001. After that, a downward trend is expected with slight increases in certain years when facilities are decommissioned.

Table 3.2-2 presents a 1996 inventory of hazardous materials at NPR-1, as submitted to the Kern County Fire Department. This inventory presents the types and amounts of hazardous materials used at NPR-1. These materials would continue to be used under the No Action Alternative in volumes and quantities that would follow production patterns (i.e., in a downward trend). These materials may cause environmental impacts when managed improperly or spilled. The potential for such impacts would be expected to decline along with production patterns.

Reporting chemical discharge that exceeds the threshold criteria for reporting under Toxic Release Inventory (TRI) regulations (40 CFR 372.25) would continue under the No Action Alternative. TRI information is submitted to EPA and Cal-EPA. Additionally, following Proposition 65 (otherwise known as the Safe Drinking Water and Toxic Enforcement Act of 1986), signs would be posted at entry gates and notices would continue to be distributed, as in the past, to all NPR employees to increase awareness of harmful chemicals that may be present in the workplace. Material Safety Data Sheets (MSDS) would be made available to workers handling chemicals either through their supervisors or at specific locations (BPOI 1994).

Hazardous waste would continue to be sent off-site for disposal or recycling at a permitted facility. There are three active hazardous waste transfer areas at NPR-1 where wastes are stored before being sent offsite. As part of the regular operations of NPR-1, all Federal and/or California hazardous wastes sent off NPR-1 would be monitored and reported on a monthly basis to the Cal-EPA, Division of Toxic Substances Control (DTSC). In 1994, 49,518 lbs of hazardous waste were transported off-site (BPOI 1994), of which 43.7 percent was attributed to tank cleaning projects. The generation of hazardous waste for both the lower and upper bounds of the Government Development Case is not expected to increase significantly above this level. There is currently enough capacity to dispose and/or recycle these wastes in permitted, off-site facilities as shown later in Section 4.2.5.

Table 4.2-1
1997 and Relative Peak (1997 to 2034) Oil and Gas Production

	1997 Oil Production (MB)	Relative Peak Year Oil Prod.	Relative Peak Oil Prod. (MB)	1997 Gas Production (BCF)	Relative Peak Year Gas Prod.	Relative Peak Gas Prod. (BCF)	1997 NGL Production (MGal)	Relative Peak Year NGL Prod.	Relative Peak Year NGL Prod.
Reference Case	29,673	1997	29,673	143	2001	171	209,919	2001	226,620
Lower Bound Government Development Case	24,332	1997	24,332	117	2001	140	172,134	2001	185,828
Upper Bound Government Development Case	29,673	1997	29,673	143	2001	171	209,919	2001	226,620
Lower Bound Commercial Development Case	29,673	1997	29,673	143	2001	171	209,919	2001	226,620
Upper Bound Commercial Development Case	29,673	2001	40,750	143	2001	190	209,919	2001	264,033

The TSCA regulations provide a comprehensive framework for actions to be taken under the No Action Alternative for the control of PCBs in liquids, such as waste oil, hydraulic fluids, heat transfer fluids and dielectric fluids, or in transformers, capacitors and light ballast.[1] Transformers account for the majority of the PCB waste generated by NPR-1 activities. The 2B Yard PCB Storage Area is used for transformer sampling to determine the presence of PCBs; if levels exceed the 5 ppm criterion, the transformer is fully encapsulated prior to off-site disposal (BPOI 1994). These practices would continue under the No Action Alternative, minimizing any potential impact.

Efforts to minimize the use of herbicides would continue at NPR-1 under the No Action Alternative. Storage containers and applicators used by subcontractors to apply the herbicides are considered hazardous and are disposed off-site. Though EPA classified the 65 abandoned waste sites and unpermitted discharges identified at NPR-1 as involving "no further remedial action planned," work continues on two of the sites to address state and DOE Order 5400.4 requirements. Preliminary risk assessments have been completed for the 23S sumps and the 1A-6M well pad. Remedial actions, would be implemented if determined to be needed.

The current asbestos program, which involves the phased removal of all asbestos-containing insulation from NPR-1 facilities and equipment, would continue as removal projects disturb existing asbestos.

Under the No Action Alternative, the current NPR-1 Waste Minimization/Pollution Prevention program would continue to perform waste minimization audits, review material safety data sheets for chemicals proposed for use at NPR-1 and conduct general awareness training. Environmental training also would continue under the No Action Alternative, covering topics such as hazardous waste generation, waste minimization, PCB management and basic fundamentals of radiation.

The Radiological Control (RadCon) program currently in place at NPR-1 would continue, including safety issues, emergency response and subcontractor activities (BPOI 1994). RadCon addresses concerns associated with Naturally Occurring Radioactive Materials (NORM) released in oil production and gas processing activities.

Mitigation

No mitigation measures over and above current management practices would be required under the No Action Alternative. These current practices include proper management and disposal of hazardous materials and wastes in accordance with applicable Federal, state and local requirements. Ongoing monitoring and reporting as required by applicable laws and regulations also would continue, as would those programs currently implemented in accordance with DOE orders addressing asbestos management, waste minimization/pollution prevention, environmental training and radiological control. Prompt containment and cleanup would be required in the event of any accidental release of hazardous constituents. If determined to be needed at existing or possible future contaminated sites, remedial actions would have to be implemented.

[1] "Although DOE intends to conduct all necessary remedial action on federally owned lands prior to the transfer date, the State Department of Toxic Substances Control has asked DOE to assess particular areas of the site for possible hazardous substance contamination and that process may extend beyond the transfer date. As a result, in accordance with applicable laws, DOE may submit a request to the Governor to defer the requirement that all necessary remedial action be taken prior to the transfer." Any deferral is not expected to have a significant impact to the environment, since assessment and remediation would eventually occur under any of the alternatives.

4.2.3.2. Proposed Action

Impacts

Private operation of NPR-1 activities would be regulated by nearly the same set of Federal, state and local regulations and guidance. Hazardous material and waste management practices (including reporting, disposal and recycling) would be implemented under the Proposed Action similar to the No Action Alternative. The only difference that may occur corresponds to programs promoted by DOE orders that go beyond Federal and state requirements, such as the waste minimization/pollution prevention program, the RadCon program and environmental training. These programs may or may not continue with the same scope, as some of their components are not required by regulations. However, some private operators follow similar if not more aggressive programs, as they have found economic benefits from waste minimization/pollution prevention and environmental awareness programs. The protection offered by the Federal, state and local regulations described in Section 4.2.3.1 would reduce the potential impacts caused by the management and generation of hazardous materials and wastes under the Proposed Action to less than significant levels.

The overall production trends for both the lower and upper bounds of the Commercial Development Case under the Proposed Action are generally downward, after peak production in 2001 in some cases (the NPR-1 absolute peak production already occurred in 1982). The use of hazardous materials and the generation of hazardous wastes is expected to follow this same downward trend. Table 4.2-1 shows the expected range of production levels for the lower and upper bounds of the Commercial Development Case. The Reference Case and the lower bound of the Commercial Development Case are expected to have the same level of hazardous materials and waste management. The upper bound of the Commercial Development Case, with a peak oil production 37 percent larger than the corresponding value for the Reference Case, would use and generate larger volumes of hazardous materials and wastes. Section 4.2.5 discusses the regional hazardous waste management capacity. The capacity and demand data in the region indicate that there is enough capacity in the region to handle the potentially larger off-site shipments of hazardous waste from NPR-1. Therefore, the potential impacts of disposal and/or recycling of these wastes would be minimal.

The larger volumes of hazardous materials and wastes managed at NPR-1 for the upper bound of the Commercial Development Case would imply a higher probability of spills at NPR-1. Good management and spill response practices that could be implemented in both the high and low commercial cases would keep the volumes and number of spills under control and minimize their potential environmental impacts. Section 4.10 discusses the issue of potential spills in more detail.

The above considerations do not change for any of the three sale scenarios analyzed under the Proposed Action. Therefore, the significance of potential impacts related to the management of hazardous materials and wastes used and generated by oil and gas production would be the same for all three. However, under Sale Scenarios 1 and 2, the commercial entities that would acquire NPR-1 may consider an alternative commercial use of non-producing areas that are not otherwise required to be set aside by other environmental requirements (see section 4.5). Depending on the nature of future activities at these areas, the use and generation of hazardous materials and wastes may increase. Federal, state and local regulations would apply to the management of these hazardous materials and wastes. Under Sale Scenario 3, the conservation entity that would own non-producing areas at NPR-1 would not undertake such commercial activities, decreasing any threats posed by hazardous materials and wastes.

Mitigation

Hazardous waste management and disposal by a commercial entity would be governed by the same Federal, state and local requirements as those that currently apply to DOE. The new owner must have a hazardous substance spill prevention and response plan for addressing accidental releases that may occur. However, a commercial entity would not be held to the programs promoted by DOE orders that go beyond Federal and state requirements. Therefore, to maintain the same level of protection in the Proposed Action as provided in the No Action Alternative, the new owner would have to follow programs at least as effective as those currently implemented by DOE for asbestos management, waste minimization, environmental training and radiological control. However, should the new owner choose not to adopt equivalent programs, the impact to the environment from these programs as a result of the loss of affirmative federal obligation to protect the environment is still expected to be less than significant.

4.2.3.3. Alternative to the Proposed Action

Impacts

The oil and gas production range for the Alternative to the Proposed Action (commercial operation but retention of some ownership by the Federal Government) would be identical to that of the Proposed Action. Because the entities in charge of oil and gas production in the Alternative to the Proposed Action would manage hazardous materials and wastes as commercial entities, the potential impacts of oil and gas development activities would be the same as those for the Proposed Action. As the Federal Government would retain an ownership interest at NPR-1 under the alternative to the Proposal Action, the overall impacts for both divestiture scenarios of the Alternative to the Proposed Action (transfer to BLM, or creation of a Federally-owned corporation) would be identical to those of the No Action Alternative.

Mitigation

Mitigation measures for the Alternative to the Proposed Action would be similar to those discussed under the mitigation section for the Proposed Action.

4.2.4. NPR-2 Impacts

4.2.4.1. No Action Alternative

Under the No Action Alternative, current activities for the management of hazardous materials and wastes would continue. Because the field at NPR-2 is near the end of its useful life, the volumes of hazardous materials and wastes managed and generated should remain constant or decrease. At the end of the field's useful life, there may be some increase in the amount of wastes generated at the site due to remediation and closure activities. Volumes of hazardous materials handled at NPR-2 would remain constant or decrease. NPR-2 lessees would continue complying with State of California and Federal regulations governing hazardous materials and waste management, including compliance with RCRA, TSCA, TRI, CERCLA and Proposition 65. Voluntary waste minimization programs would also likely continue under the No Action Alternative.

4.2.4.2. Recommended Action

Transfer of DOE's interests in NPR-2 to BLM for management would have very little to no impact on the management of hazardous materials and wastes at NPR-2. As expected under the No

Action Alternative, waste generation should remain constant or decrease because oil production activities are expected to remain the same or decrease as the useful life of the field comes to an end. The current lease holders would continue to be responsible for complying with state and Federal regulations governing hazardous materials and waste management at their facilities.

4.2.4.3. Alternative to the Recommended Action

In the short term, the sale of government interests in NPR-2 would not likely affect the management of hazardous materials and wastes at NPR-2. Short-term impacts would likely be similar to those discussed for the No Action Alternative. However, once the NPR-2 oil field comes to the end of its useful life, the commercial owner could sell or develop the property for uses consistent with local zoning laws. The nature of the potential further uses for the property under this scenario cannot be characterized. Hazardous materials handling and waste generation could increase or decrease depending on the new use.

4.2.5. Cumulative Impacts

This section analyzes the impact from the Proposed Action and past, present, and reasonably foreseeable actions in the region that involve hazardous material use and hazardous waste management. The data presented in this section indicates ample capacity in the region to manage off-site shipments of hazardous waste generated by future oil and gas production at NPR-1 under any of the alternatives analyzed. The largest expected volumes of hazardous waste would occur under commercial development. The relative peak oil production for the upper bound of the Commercial Development Case is expected to be 37 percent larger than the corresponding level for the Reference Case. Volumes of hazardous wastes are expected to follow the increasing trend in oil production, although a certain amount of variability could be expected due to decommissioning and remediation activities. NPR-1 generated approximately 878, 25 and 151 tons of hazardous waste in 1993, 1994 and 1995, respectively (DOE 1994, 1995, 1997). In 1993, 94 percent of the hazardous waste generated at NPR-1 was attributed to demolition projects (DOE 1994). In 1995, 75 percent of the hazardous waste generated was attributed to remediation activities (DOE 1997). The average annual volume of hazardous waste generated by NPR-1 was 351 tons per year, based on the 1993, 1994 and 1995 figures. Assuming a 37 percent increase in hazardous waste generation as a result of the NPR-1 proposed action, an additional 130 tons of hazardous waste could be generated annually. This volume would be sent to disposal, treatment and recycling facilities in the region.

To determine whether adequate hazardous waste management capacity exists for the region surrounding NPR-1, State Capacity Assurance Plan data can be used. Under CERCLA, states are required to submit Capacity Assurance Plans to U.S. EPA to assure that adequate capacity exists to treat and dispose of hazardous wastes generated in the States. Table 4.2-2 presents the western States' (including California, Nevada, Arizona, Utah, Colorado and 12 others) estimated hazardous waste management demand in 1993 for landfill disposal, organics recovery and hazardous waste water and sludge treatment according to U.S. EPA's *National Capacity Assessment Report* (1995). The future total hazardous waste management capacity for these three waste management options exceeds current demand by 96 percent. As inferred from the data presented in Table 4.2-2, the additional 130 tons of hazardous waste that might be generated as a result of the proposed actions for NPR-1 constitutes a very small increase in the western States' annual demand. Thus, hazardous waste management capacity for the NPR-1 region should be adequate to meet the increased demand generated by the proposed actions.

Table 4.2-2
Western States' Estimated Hazardous Waste Management Demand and Capacity (U.S. EPA, 1995)

Waste Management Option	Estimated Demand in 1993 (tons)	Estimated Maximum Commercial Management Capacity in 2013 (tons)
Landfill disposal	483,082	21,558,462
Organics recovery	143,759	320,263
Hazardous waste water and sludge treatment	211,484	1,274,524

As discussed in Section 4.2.4, none of the actions considered for NPR-2 would significantly change the rate of hazardous waste generation, which is on a downward trend. Furthermore, at a regional level, oil and gas production is past its peak and the overall level of production is in decline with a corresponding decrease in hazardous waste generation. The slight expected increase in hazardous waste at NPR-1 under any of the alternatives will not change this downward trend.

In addition, the proposed activities on NPR-1 (and NPR-2) would be expected to generate fairly conventional wastestreams (e.g., spent acids, solvents, herbicides/pesticides, oil-contaminated soil, used oil), and the disposal, treatment and recycling methods and technologies for these wastes (e.g., stabilization/chemical fixation, combustion, soil vapor extraction, carbon absorption) are also conventional and well established. Therefore, if hazardous waste management demand increased beyond current regional capacities due to the proposed actions, it would be expected that commercial management facilities could readily be developed or modified to meet this increased demand.

4.2.6. References

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4.3. AIR IMPACTS

This section analyzes the potential environmental impacts caused by the emissions of atmospheric pollutants from oil production activities at NPR-1. Section 4.3.2 describes the methodology used to estimate emissions under the Proposed Action and Alternatives. Section 4.3.3 presents the projected levels of atmospheric emissions and the resulting concentration estimates for the NPR-1 Proposed Action and Alternatives. Section 4.3.4 discusses the air impacts at NPR-2. Section 4.3.5 discusses cumulative impacts.

4.3.1. Summary of Impacts for NPR-1

This section compares atmospheric emissions under the Reference Case with the upper bound of the Proposed Action's Commercial Development Case to determine if elevated ground level concentrations of pollutants would result from the Proposed Action. These activities include drilling and extraction of oil and gas, handling and production of oil and gas products, and the operation of motor vehicles. Emissions of atmospheric pollutants result from oil and gas handling (drilling, tanks, ground disturbance) and from equipment (engines, flares, boilers, heaters, motor vehicles). These activities are managed under a variety of Federal, state and local air quality regulations, as described in Section 3.3.1.

At NPR-1, levels of atmospheric emissions under the highest production year of the Proposed Action (2001) would--relative to levels under the lowest production year since production peaked for the Reference Case (1995)--increase for most emissions sources (surface disturbances and stationary sources) and most pollutants (CO, NO_x, SO_2, Reactive Organic Gases (ROG)), due to the higher levels of production expected under commercial development.[1] Emissions of mobile sources, however, would decrease as the number of workers declined under commercial management. For the two years analyzed, no violations of Federal or state ambient air quality standards were predicted in the areas surrounding NPR-1 with one exception: off-site particulate concentrations (PM_{10}) under all cases are estimated to exceed the state ambient air quality standards for both years. 2001 NO_x emission concentrations on-site are also expected to exceed Federal ambient air quality standards; while 2001 SO_2 concentrations and PM_{10} concentrations for both years on-site are estimated to exceed state standards. Note that the 2001 projected exceedances are based on maximum emission levels for NPR-1 sources, which may be far greater than actual emissions from those sources. The on-site exceedances are expected to occur where the public does not have access. These results are discussed in more detail in Appendix D.

In comparison to the Reference Case, the emission levels and concentrations at NPR-1 would remain approximately the same under the lower bound of the Government Development Case. Under the upper bound of the Government Development Case and the lower bound of the Commercial Development Case, the emission levels associated with stationary sources would be about the same, both slightly higher than the Reference Case. However, the mobile source emissions under the upper bound of the Government Development Case are estimated to be higher than under the lower bound of the Commercial Development Case. The upper bound of the Commercial Development Case is estimated to result in the largest increase in emissions from stationary sources. Again, the mobile source emissions would decrease from the Reference Case.

The upper bound of the Commercial Development Case would result in the greatest increase in emission levels and concentrations. For any alternative where the permitted emission levels would need to be expanded to accommodate increased production levels or the installation of new equipment, air quality regulations require the owner(s) or operator(s) to obtain a new or revised construction and operating permit. During the permitting process, specific measures for avoiding and mitigating air quality impacts would be determined by the regional air quality regulatory agency, the San Joaquin

[1] The basis for selecting these two years is discussed in Section 4.3.2.

Valley Unified Air Pollution Control District (SJUAPCD) and required to be implemented by the owner(s) and operator(s). These measures would take into consideration local as well as regional air quality impacts.

4.3.2. Methodology

As production levels are projected first to increase and then decrease, future air emissions at NPR-1 would vary over time. However, modeling emissions for each year under both government and commercial development would not significantly assist in identifying the potential impacts of the Proposed Action and Alternatives. Instead, emissions for two years, one based on past actual emissions and one on future production, were modeled to provide the quantitative analysis in support of the determination of the significance of future impacts to air quality by the proposed actions and alternatives.

To estimate the emissions for the Reference Case, the estimated emissions from one year of actual operation as reported to the SJVUAPCD were chosen. The existing (1995) levels of emissions served as the baseline for analysis as these represented the lowest oil and gas production levels since peak production occurred at NPR-1. These 1995 figures are used for the Reference Case and are also representative of future emissions under continued government development. For the Proposed Action, the analysis projected emissions data for the highest commercial production year (2001). The use of actual (1995) emissions as the Reference Case and maximum potential or allowable commercial emissions in 2001 as the Proposed Action, generated maximum (i.e., most conservative) estimates for determining the impacts from the Proposed Action because: (1) these two years had the biggest difference in projected oil and gas production and (2) maximum potential or allowable emissions generally far exceed actual emissions. Estimates of impacts for the other alternatives are based on these two models.

As with the existing emission estimates (see Section 3.3.3), 2001 emissions were calculated by multiplying a unit of activity (such as hours of operation) by an emission factor (an estimate of the rate at which a pollutant is being produced). Equipment emission estimates for 1995 (Reference Case) are based on the actual operating conditions but do exclude some ongoing mitigation measures; emission estimates for the Proposed Action in 2001 are based on the maximum potential operating conditions or the maximum allowable emissions from permit limits. To account for proposed new facilities that could be operating under the Proposed Action in 2001,[2] additional equipment is included in the calculations. Most estimates for the Proposed Action in 2001, however, are based on pollutant permit limits for specific equipment. These assumptions result in conservative emissions estimates because of the notable differences in actual, rather than potential, or allowable, emission assumptions. For example, to estimate emissions from an internal combustion engine in the Reference Case, the calculations include actual hours of operation and an emission factor based on engine stack tests. In contrast, the emissions for the Proposed Action in 2001 are based on the maximum permitted emission limits (which can be significantly higher than actual emission rates).

Emission sources at NPR-1 include stationary combustion sources, remedial and development drilling, evaporate emissions (tanks) and mobile sources. One example of a combustion source is an internal combustion engine used for a variety of purposes, such as gas compression engines, well pumps and drill rigs. Internal combustion engines are required to have an air permit by the SJVUAPCD if they are rated at greater than 50 horsepower (maximum output). In 1995, a total of 237 engines rated at 50 horsepower or greater operated on site. About sixty of these engines are as large as 5,500 horsepower each; these gas compression engines are referred to as the "K units" by the facility and District. The remaining engines are smaller (about 100 horsepower) and are used primarily as well pumps.

[2] The proposed new facilities/operations for the commercial operations are described in Appendix A.

Both remedial and development drilling are normal operations at a petroleum production facility. Appendix B provides further details about the past and present well drillings associated with the facility. To determine the emissions for these operations, the number of drilling operations on a typical day was estimated under the Reference Case and under the Proposed Action in 2001. For 1995, under typical operating conditions, four development wells and five remedial wells were drilled; in 2001 seven development and seven remedial wells are projected to be drilled. The emissions associated with each drilling were estimated and multiplied by the number of wells to yield emission totals.

The EPA computer program TANKS (version 3.0) (EPA 1996) estimated evaporative emissions from tanks, which involve two types of emissions: storage and working losses. Storage loss is the release of vapor from the tank resulting from changes in temperature and barometric pressure. Emissions produced from evaporation of gases during filling and emptying of tanks are called working losses. As the liquid level increases, the pressure inside the tank increases, and vapors are expelled from the tank. Evaporative losses occur when air drawn into the tank becomes saturated with organic vapors and expands, exceeding the capacity of the vapor space. It should be noted that most of the tanks at NPR-1 are equipped with a vapor recovery system[3] to capture emissions. The vapor recovery system reduces pollutant emissions by 99.9 percent. The 1995 and Proposed Action (2001) emissions were adjusted for the production rates under 1995 actual and the upper bound of the Commercial Development Cases, respectively.

Emissions from mobile sources at the NPR facility (and in surrounding areas) were also estimated for the Reference Case and the Proposed Action (2001). Emissions were estimated by multiplying a unit of activity (such as vehicle miles traveled, or VMT) by an emission factor, an estimate of the rate at which a pollutant is being emitted. Two computer models (EMFAC7 and PART5) (CARB 1995 and EPA 1995) helped develop the emission factors for this study. Emissions of fine particles (PM_{10}) were predicted using EPA's PART5 model, which calculates particulate emission rates in grams per mile (g/mi) for automobiles, trucks and motorcycles. Emissions of dust from vehicle exhaust, brake wear, tire wear and roadway shoulders, which are required for PM_{10} emission estimates, are all included in the emission rates produced by PART5.

As discussed in section 3.3.4, air quality dispersion modeling determined the air quality impacts of current and future pollutant emissions from the NPR-1 site. The EPA computer model, Industrial Source Complex Short Term (ISC3ST) (EPA 1987), was used to simulate dispersion of emissions from sources to ground level locations within NPR-1 and in surrounding areas. The ISC3ST model is recommended in the *Guidelines on Air Quality Models* (EPA 1987) for dispersion modeling of complex industrial source facilities. ISC3ST accepts hourly emission rates and meteorological data (temperature, wind speed and wind direction) and was used to predict hourly, 8-hour, 24-hour and annual average concentrations of pollutants. This modeling analysis did not take into consideration ozone (with NO_x and ROG as precursors) because photochemical modeling is required to determine the effect of these emissions. This type of analysis is beyond the scope of this study but the potential impacts are discussed qualitatively under the cumulative impacts section (Section 4.3.5). The CALINE4 (Benson 1994) model was also used to determine the impacts of motor vehicle operations on ambient air quality levels.

The results of these modeling analyses were then compared to the state and Federal ambient air quality standards to determine the significance of the impacts. According to Appendix G of the state CEQA Guidelines, a project will normally have a significant effect on the environment if it will violate any air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentration.

[3] SJVUAPCD Rule 4623 - Storage of Organic Liquids.

4.3.3. NPR-1 Impacts

4.3.3.1. No Action Alternative

Impacts

Under the No Action Alternative, activities that produce atmospheric emissions would be very similar to those currently underway at the NPR-1 facility. As discussed in Section 3.3.3, emission sources would include surface disturbances, stationary sources and mobile sources. Emission estimates for each source were developed for the year 1995 based on actual operating conditions. This baseline emission inventory used emission estimates submitted by NPR-1 to the SJVUAPCD for 1995. Future year emissions under the No Action Alternative would result from production at levels near those in 1995 (under the lower bound of government development) or at slightly higher production levels (associated with the upper bound of government development), with both declining over time to well below the 1995 level. Therefore, 1995 serves as a conservative model of future emissions under government development.

As discussed in Section 4.3.2, future year emission estimates are based on maximum emission assumptions. Making these assumptions allows for development of maximum potential or allowable emission projections to estimate air emissions conservatively. However, for 1995 maximum potential emissions were not estimated; rather, actual results were used but without fully taking into account all ongoing mitigation measures. Tables 4.3-1 and 4.3-2 contain the 1995 actual emission estimates. These results would likely represent the maximum emissions that would occur under the lower bound of the Government Development Case. Maximum potential emissions, under the upper bound of the Government Development Case, would likely increase from 1995 levels for most emissions sources (surface disturbances and stationary sources) and most pollutants (CO, NO_x, SO_2, ROG) for no more than a few years, then fall below the 1995 levels as production declines. Emissions of mobile sources would likely continue near 1995 levels. Increases in vehicle activity in future years would be offset by decreases in vehicle emissions for most pollutants (CO, NO_x, SO_2, ROG). Emissions of particulates, however, would increase with growth in vehicle activity. This growth (both in off and on-site traffic) would result in elevated levels of PM_{10} above California standards within the NPR-1 facility without the use of presently employed mitigation measures at NPR-1. (Refer to Table 3.3-5 for the 1995 actual pollutant concentrations.)

Mitigation

A new or revised construction and operating permit would be required to accommodate the increased emissions likely to be caused by the upper bound Government Development Case. During the permitting process, specific measures for avoiding and mitigating air quality impacts through the application of the most stringent control technology or emission reduction requirement under the appropriate regulations would be determined by the SJVUAPCD in consultation with DOE and included in the terms of the permit. Depending on the specific pollutants involved and target emission limits, these measures may include electrifying additional generators on-site (many have already been electrified), equipping tanks with fixed or floating roofs with VOC recovery systems, continuing and perhaps expanding existing VOC leak detection activities, limiting the size of disturbed areas for the purpose of dust control, and continuing or expanding measures included in DOE's dust control plan (such as road paving), among others. If a new cogeneration facility is needed to supply power for the increased level of production, that facility would have to be designed and constructed to comply with emission limits specified in SJVUAPCD standards.

Table 4.3-1
Summary of Stationary Source Emissions at NPR-1

Source Type	1995 Emissions (lb/hr) - Reference Case					2001 Emissions - Proposed Action (lb/hr)				
	PM_{10}	CO	SO_X	NO_X	ROG	PM_{10}	CO	SO_X	NO_X	ROG
Stationary Combustion Sources										
Compressors Engines	3.68	384.77	0.35	169.36	45.86	24.73	925.48	42.08	581.03	648.57
Boilers and Heaters	0.68	3.04	0.09	15.22	0.35	5.57	13.88	4.24	55.63	3.91
Cogenerators	0.02	3.46	1.48	5.17	0.92	4.22	45.38	1.51	20.48	4.28
Flares	0.19	0.84	0.03	4.21	0.11	0.32	1.42	0.04	7.08	0.41
Pump Engines	0.15	9.83	0.01	5.55	2.37	3.87	36.31	11.62	252.30	10.40
Diesel Fired Engines	0.04	0.12	0.04	0.55	0.03	0.22	2.05	0.68	14.88	0.59
Subtotal	*4.76*	*402.06*	*1.99*	*200.06*	*49.64*	*38.92*	*1,024.52*	*60.18*	*931.39*	*668.16*
Drilling and Construction										
New Development Drilling	17.90	31.44	3.65	131.02	12.70	31.33	55.03	6.38	229.28	22.23
Remedial Drilling	14.00	29.21	3.33	122.36	12.00	19.60	40.90	4.67	171.31	16.80
Fugitive Dust - New Construction	0	0	0	0	0	16	0	0	0	0
Subtotal	*31.90*	*60.65*	*6.98*	*253.38*	*24.70*	*66.93*	*95.92*	*11.05*	*400.59*	*39.03*
Evaporative Emissions										
Tanks	0	0	0	0	117.05	0	0	0	0	196.64
Fugitive Emissions										
Valves, Connectors, etc.	0	0	0	0	92.53	0	0	0	0	92.53
Well Heads and Cellars	0	0	0	0	226.61	0	0	0	0	207.5
Stack Vent Releases	0	0	0	0	63.64	0	0	0	0	106.91
Oil-Spill related Emissions	0	0	0	0	1.53	0	0	0	0	2.57
Percolation Ponds	0	0	0	0	5.52	0	0	0	0	9.27
Subtotal	*0*	*0*	*0*	*0*	*506.87*	*0*	*0*	*0*	*0*	*615.41*
Total	36.66	462.72	8.97	453.44	581.22	105.85	1,120.44	71.23	1,331.98	1,322.60

Table 4.3-2
NPR-1 Mobile Source Emissions Estimates

Source Category	1995 Emissions (lbs/day) - Reference Case				2001 Emissions - Proposed Action (lbs/day)			
	PM_{10}	CO	NOx	ROG	PM_{10}	CO	NOx	ROG
On-Site								
Light-duty autos	249.94	297.43	14.91	15.12	186.61	172.78	7.47	7.42
Light-duty trucks	1510.92	391.09	36.65	22.95	1133.95	180.44	16.17	8.48
Heavy-duty trucks	10.75	22.01	40.87	5.24	15.41	34.24	39.13	5.42
Subtotal	*1,771.61*	*710.53*	*92.43*	*43.31*	*1,335.97*	*387.46*	*62.77*	*21.32*
Off-Site								
Light-duty autos	13.74	150.19	11.22	6.93	10.26	101.31	5.30	4.06
Light-duty trucks	8.35	112.55	10.07	4.88	6.30	75.86	4.83	2.79
Heavy-duty trucks	64.56	108.57	373.02	21.59	92.45	160.80	321.07	22.13
Subtotal	*86.65*	*371.31*	*788.75*	*33.40*	*109.01*	*337.97*	*331.20*	*28.98*
Total	1,858.26	1,081.84	881.18	76.71	1,444.98	*719.43*	*393.97*	50.30

4.3.3.2. Proposed Action

Impacts

Table 4.3-1 includes estimates of emissions during the peak production year, 2001, for stationary sources at NPR-1 under the Proposed Action. Emissions are reported for three categories of sources: 1) stationary combustion sources; 2) drilling and construction; and 3) evaporative sources. Table 4.3-2 presents the estimated total emissions from mobile sources for 2001 for all pollutants evaluated. Emissions for stationary sources, especially sulfur oxides, increase significantly under the maximum potential or allowable assumptions and higher productions levels associated with commercial operation under both the lower and upper bound of commercial development. Mobile source emissions, however, decrease with declining numbers of employees under commercial operations.

The air quality dispersion modeling indicates that concentrations of some pollutants (SO_2 and CO) would be well below national and California ambient standards, both within the facility boundaries and outside the borders of NPR-1 in 1995 and 2001. Concentrations of particulates and NO_x, however, under commercial development, could be elevated at certain areas within the NPR-1 boundaries. Particulate concentrations are also estimated to exceed state standards in off-site areas. Concentrations of all other pollutants in public access areas outside of the NPR-1 boundaries would be below state and Federal standards. The maximum predicted concentrations for all pollutants under commercial development are shown in Table 4.3-3 and discussed in more detail in Appendix D. The values shown in this table do not reflect the impact of the mitigation measures presently employed at NPR-1 or additional mitigation that a new private owner may choose to employ.

To estimate the impact of current motor vehicle operations at NPR-1 for 1995 and 2001, the CALINE4 model was applied to the intersection of the two major roads crossing near the center of NPR-1, Elk Hills Road and Skyline Boulevard. In 1995 and 2001, the highest predicted one-hour CO concentrations were 200 $\mu g/m^3$ and 100 $\mu g/m,^3$ respectively, at locations approximately ten meters from the roadway. Since these concentrations were predicted near the roadway, which is also near the maximum on-site modeled ISC3ST concentration, the maximum total predicted concentration for CO is 2,400 $\mu g/m^3$ in 1995 and 8500 $\mu g/m^3$ in 2001, well below the state and national standards of 23,000 $\mu g/m^3$ and 40,000 $\mu g/m^3$, respectively.

Mitigation

The new owner or operator would be required to obtain a new or revised construction and operating permit to accommodate the increased emissions predicted to occur in the Commercial Development Case. During the permitting process, specific measures for avoiding and mitigating air quality impacts through the application of the most stringent control technology or emission reduction requirement specified by the appropriate regulations would be determined by the SJVUAPCD and the owner or operator and included in the terms and conditions of the permits. Any such permits would only be issued after a clear demonstration of consistency with the State Implementation Plan. Based on the air quality modeling results presented above, it is likely that these measures would be specifically geared to control particulate, NO_x and SO_x emissions. To control particulate emissions, the new owner or operator may limit the size of disturbed areas, and would likely have to implement a dust control plan, similar to the plan that DOE has adopted voluntarily, which could include such measures as paving dirt roads and perhaps wetting construction or exposed sites susceptible to wind erosion. To control NO_x and SO_x emissions, new generators and perhaps additional existing generators would have to be electrified. In addition, if a new cogeneration facility is needed to supply power for the increased level of production,

its design and construction would have to comply with emission limits specified by the SJVUAPCD regulations.

4.3.3.3. Alternative to the Proposed Action

Impacts

The Alternative to the Proposed Action involves operation of the facility by a commercial entity, but some retention of government ownership of NPR-1 by another government agency (such as BLM). Activities that would occur at the NPR-1 facility under this alternative would be very similar to those under commercial development. As discussed in Section 2.2.4, the government agency would not participate actively in the operation of the facility and would only control the operations at a minimum level. Production levels would be essentially the same as those presented for the upper and lower bounds of the Commercial Development Case. Hence, levels of atmospheric emissions and ambient concentrations would be the same as discussed under the Proposed Action (Section 4.3.3.2).

Mitigation

Mitigation measures for the Alternative to the Proposed Action would be similar to those outlined for the Proposed Action due to the similarity of the impacts.

4.3.3.4. Comparison of Impacts

Maximum emissions under the Proposed Action would increase for most emissions sources (surface disturbances and stationary sources) and most pollutants (CO, NO_x, SO_2, ROG), from levels estimated under the No Action alternative due to growth in levels of production. Emissions of mobile sources, however, would decrease as the number of workers employed under commercial management falls. Tables 4.3-1 and 4.3-2 present emission estimates for the Reference Case (and are similar for the No Action Alternative) and the Proposed Action in 2001 (from the upper bound of commercial development) alternatives. As a conservative comparison, 1995 actual emissions and air quality concentrations (at production levels near the lower bound of government development) were estimated for comparison with maximum emissions and air quality concentrations associated with the upper bound of commercial development. Table 4.3-4 compares the results of ambient air quality modeling completed for the two alternatives without the incorporation of mitigation measures presently employed at NPR-1 or those which may be employed by a new private developer.

Table 4.3-3
Maximum Predicted Total Concentrations of Air Pollutants
Under the Proposed Action ($\mu g/m^3$)
(Without Existing Mitigation)

Pollutant	Averaging Period	Maximum On-site	Maximum Off-site	California Standard	National Standard
NOx	Annual	515.8	1.00	n/a	100
SO_2	24 hr	150.2	0.66	131	365
	Annual	32.0	0.10	n/a	80
CO	1 hr	8393	107.3	23,000	40,000
	8 hr	5428	22.7	10,000	10,000
PM_{10}	24 hr	133.38	102.82	50	150
	Annual	36.64	33.18	30	50

Note: Total concentration includes background concentrations of 32 $\mu g/m^3$ for the annual and 93 $\mu g/m^3$ for the 24-hour standard for PM_{10}.

Table 4.3-4
Maximum Predicted Total Concentrations of Air Pollutants ($\mu g/m^3$)
(Without Existing Mitigation)

		1995 Actual		Proposed Action			
Pollutant	Averaging Period	Maximum On-site	Maximum Off-site	Maximum On-site	Maximum Off-site	California Standard	National Standard
NO_x	Annual	69.8	0.45	515.8	1.00	n/a	100
SO_2	24 hr	3.14	0.26	150.2	0.66	131	365
	Annual	0.30	0.02	32.0	0.10	n/a	80
CO	1 hr	2,230	39.1	8393	107.3	23,000	40,000
	8 hr	1,513	7.4	5428	22.7	10,000	10,000
PM_{10}	24 hr	139.08	105.95	133.38	102.82	50	150
	Annual	36.21	33.38	36.64	33.18	30	50

Note: Total concentration includes background concentrations of 32 $\mu g/m^3$ for the annual and 93 $\mu g/m^3$ for the 24-hour standard.

Under both the No Action Alternative and the Proposed Action, no violations of any Federal ambient air quality standards were predicted off-site; however, particulate emissions are estimated to exceed the state standards both on and off-site without the use of mitigation measures presently employed at NPR-1 which reduce PM_{10} emissions to less than the state standard. NO_x emission concentrations on-site are expected to exceed Federal standards; while SO_2 concentrations on-site are estimated to exceed the state standards. It should be noted that under the upper bound of the Government Development Case, production for the year 2001 is estimated to be approximately 160% of 1995 production. However, using maximum potential or allowable emissions produces much greater increases in emissions for 2001 compared to 1995, except for PM_{10}, which is predicted to decrease slightly (and would still exceed the standard without mitigation). Therefore, it is likely that actual NO_x and SO_x emissions will not exceed these standards.

4.3.4. NPR-2 Impacts

Emission sources at NPR-2 include surface disturbances, stationary sources and mobile sources. Surface disturbances include earth working, drilling activity and traffic-generated PM_{10} in the form of fugitive dust. Stationary sources include compressor engines, electrical generators, boilers, heaters, flares, pump engines and miscellaneous field engines (DOE 1993b). Mobile sources include cars, trucks and heavy equipment. Because oil and gas production levels are expected to be much lower at NPR-2 than at NPR-1, the expected emissions from NPR-2 are much less than those from NPR-1. (Approximately 1,000 BPD compared to NPR-1, with potential production levels close to 80,000 BPD.) Accordingly, the number of actual emission sources at NPR-2 is much less than those at NPR-1.

Future emissions and source types are not expected to change under the Proposed Action. Continued production and development of known reserves at NPR-2 would require drilling and installation of new reserve wells, as well as remediation of existing wells. However, because of declining oil production in the field and decommissioning of existing facilities, these operations are not expected to increase overall under the Proposed Action.

4.3.5. Cumulative Impacts

Cumulative impacts can occur as the result of increased environmental impacts associated with the Proposed Action and other existing or reasonably foreseeable emission sources in the air basin. Emissions from NPR-1 currently contribute significantly to emissions in Kern County and the San Joaquin Valley Air Basin (SJVAB). Table 4.3-5 indicates the percent of total county and total air basin (SJVAB) emissions that NPR-1 sources contribute. NPR-1 contributed over one percent of the pollutant emissions in the county in 1995 and close to one percent in the air basin for ozone precursors (NO_x and ROG). Therefore, since NPR-1 contributes significantly to air basin totals, future increases in emissions, especially for ozone precursors and particulates, could have significant cumulative impacts.

Table 4.3-5
Comparison of NPR-1 Emission Estimates to County and Air Basin Totals[1]

	1995			
	PM_{10}	CO	NOx	ROG
Stationary Sources				
% of Total County	0.55%	1.47%	2.99%	4.19%
Mobile Sources				
% of Total County	1.16%	0.14%	0.24%	0.02%
Total NPR	1.37	6.09	5.89	7.01
% of Total County	1.71%	1.61%	3.23%	4.21%
% of Total Basin	0.30%	0.24%	1.05%	1.30%

[1]County and air basin totals are for 1993 and provided by the CARB Stationary Source Inventory (5/08/97) and ARB EMFAC7G/BURDEN

Unlike the other pollutants included in the air quality modeling, ozone is not directly emitted into the atmosphere but is formed by the reaction of oxides to nitrogen and reactive organic gases in the presence of sunlight. Therefore, to model ozone impacts, regional photochemical modeling would need to be completed, including all sources of NO_x and ROG in the air basin. Completion of such a full-scale photochemical modeling analysis is beyond the needs of this analysis; however, an examination of trends in emissions of ozone precursors can help in understanding the cumulative impacts associated with the proposed action and alternatives.

To accurately compare future year emission impacts associated with NPR-1 operations and other existing or reasonably foreseeable sources in the air basin, projected total production levels for NPR-1 out to the year 2033 (see Figure 2.1-2) for all three development cases were analyzed. Examination of this figure shows that the difference in production estimates for the three cases in 2001 is considerably larger than in other years. Production under all alternatives assumes peak operations in the year 2001 with significant decreases thereafter. Hence, impacts from NPR-1 will decrease after that time, especially due to changes in permitted emission limits, below existing impacts.

To determine whether changes in emissions levels at NPR-1 and NPR-2 will have a significant cumulative air quality effect, it is illustrative to examine emission trends in the entire SJVAB. Figure 4.3-1 shows projected emission levels of ozone precursors in the air basin from the year 1993 to 2006.

These emission estimates were prepared by the California Air Resources Board and are used for air quality planning. While emissions at NPR-1 under the Proposed Action or upper bound of the Government Development Case will increase between 1995 and 2001 (emissions at NPR-2 declining slightly), the figures show that overall basin-wide emissions of ozone precursors will decrease during this period. Furthermore, the long-term emissions to 2033 both within the basin and from NPR-1 should also fall, because emissions from oil and gas production in the air basin, which are a predominant source of ozone precursors in Kern County, are expected to scale back as oil and gas production decreases throughout the area (see Table 2.4.2). Similarly, Figure 4.3-2 shows the same trend for CO emissions.

While emission trends for ozone precursors and CO indicate decreasing levels of pollutants, trends of particulate emissions do not show clear decreases in emission levels for the next ten years, as illustrated in Figure 4.3-3. While emissions of particulates have been decreasing since 1993, emissions will begin to increase between 2001 and 2006 due to growth in stationary sources. The SJVUAPCD has recently put together an air quality plan for reaching attainment of PM_{10} air quality standards in the air basin, which includes NPR-1 emissions (SJVUAPCD 1997). This plan indicates that the Federal annual standard will be attained in the years 2001 and 2006. As indicated in Table 4.3-4, PM_{10} emissions are predicted to decrease under the Proposed Action, primarily due to a decrease in vehicle traffic. Decreases in particulate emissions at NPR-1 should help meet the annual standard. The plan does not show attainment of the 24-hour standard by December 31, 2001. Thus the SJVUAPCD has committed to pursue and implement additional control strategies.

Figure 4.3-1
Emission Trends for Ozone Precursors in the SJVAB

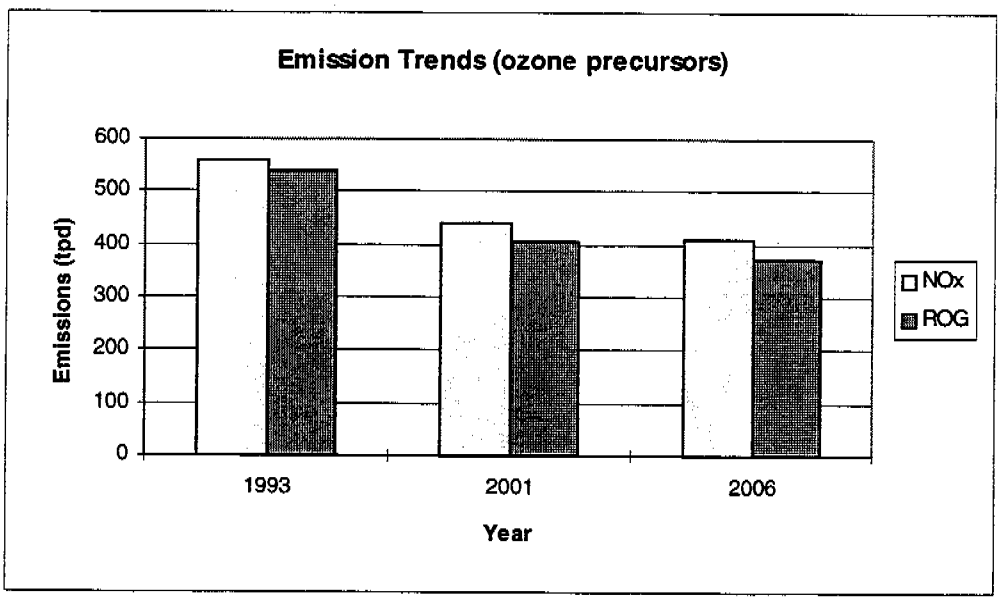


Figure 4.3-2
Emission Trends for CO in the SJVAB

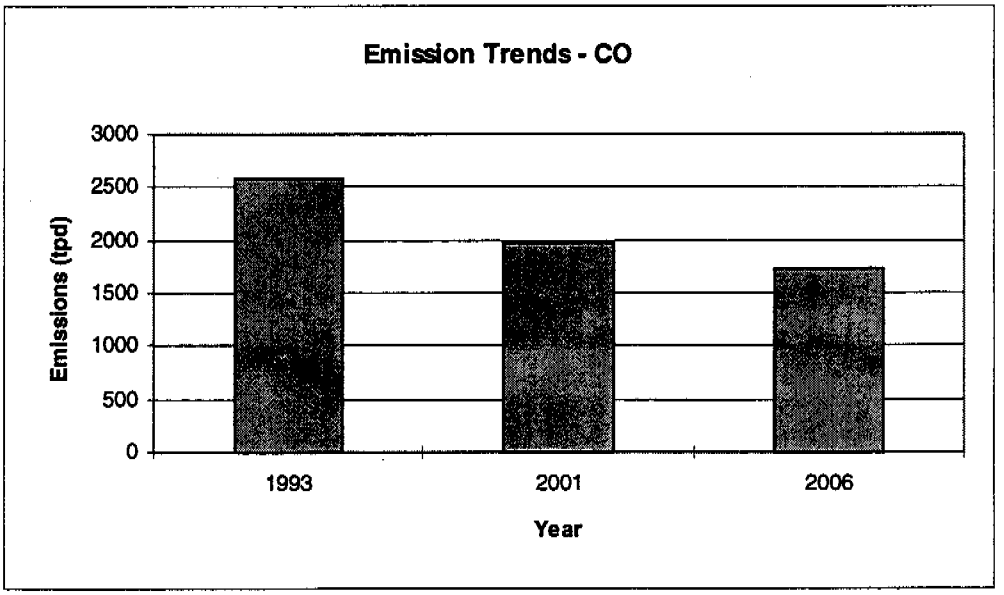
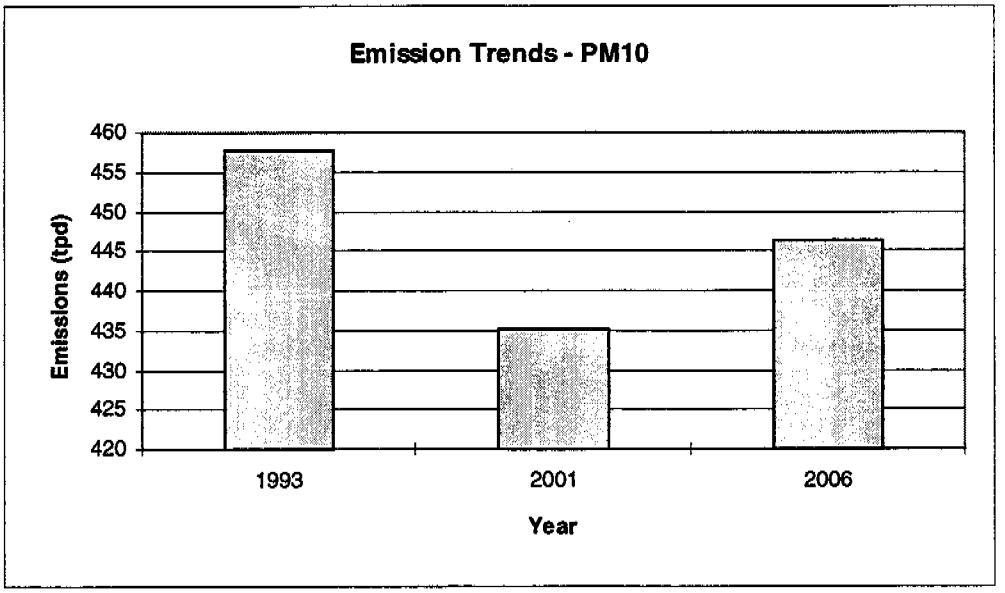


Figure 4.3-3
Emission Trends for PM_{10} in the SJVAB



4.3.6. References

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4.4. WATER RESOURCES

The analysis of potential impacts on water resources is subdivided into two topics; issues related to surface water in Section 4.4.1; and issues related to groundwater in Section 4.4.2. Cumulative impacts are discussed in Section 4.4.3.

4.4.1. Surface Water

4.4.1.1. Summary Of Impacts

This section analyzes the potential impacts related to surface water, including wetlands and floodplains. The Notice of Preparation of a Draft Program Environmental Impact Report by Kern County Planning Department identifies three impacts in this area that could be potentially significant. These are:

- Changes in absorption rates, drainage patterns and rate and amount of surface runoff;
- Exposure of people or property to water related hazards such as flooding; and
- Discharge into surface waters or other alteration of surface water quality.

Water is rarely observed in streams at NPR-1 due to low rainfall in the area of study. Most of the facilities needed for future operation of NPR-1 under any of the alternatives have already been built. Because the construction of new facilities with impervious areas would require less than 12 acres, few changes in the rate and amount of surface runoff at NPR-1 are expected. The Proposed Action and the Alternative to the Proposed Action would have a larger number of wells drilled than the No Action Alternative. However, only a small portion of the well pads would actually be impervious and the well pads would be dispersed, reducing the potential for surface runoff changes. Design considerations commonly used in the selection of pipeline routes would minimize impacts to drainage patterns. As no significant differences are expected in the rate and amount of surface runoff, and no major changes to topography are expected, flooding potential would not change significantly. Impacts to surface water quality due to potential erosion effects are analyzed in more detail in Section 4.1. Impacts to surface water quality due to spills of hazardous materials and wastes are analyzed in Sections 4.2 and 4.10. The considerations above apply only to oil and gas activities in producing areas. Under Sale Scenarios 1 and 2 of the Proposed Action, other commercial activities may be developed in non-producing areas although the possibility is believed to be remote. Since the nature of these activities is difficult to predict at this time, the significance of potential impacts to surface water in non-producing areas cannot be estimated.

In addition to being an SEIS/PEIR, this document is also a floodplains/wetlands assessment as required by the DOE Floodplains/Wetlands regulation, 10 CFR 1022. With respect to wetlands, there would be no impacts under any action because no areas on NPR-1 have been found to meet wetland designation criteria. Given the isolated extent of floodplains on NPR-1, direct impacts to floodplains caused by new development activities are very unlikely and can be easily avoided by siting new development away from the immediate banks of drainage channels. Any floodplain impacts caused by the placement of new dredged material or fill in natural drainages would be mitigated by a Corps of Engineers dredge and fill permit under Section 404 of the Clean Water Act.

4.4.1.2. Methodology

One key consideration in the analysis of potential impacts to surface water resources is the fact that water is rarely observed in streams at NPR-1 due to low precipitation levels. The impact analysis considers the areas required for new facilities under each alternative, as these would affect the rate and amount of surface runoff. The number of new well pads are also considered, but the impervious portion

of these pads is small. For the analysis of flooding and floodplain impacts, existing information on floodplains and expected changes to topography and construction of new facilities were taken into consideration to determine the potential to changes in floodplain boundaries or construction activities on floodplains. The analysis of impacts due to discharges to surface waters or other alteration of surface water quality combines the analysis of potential erosion impacts of Section 4.1, and the analysis of hazardous materials and waste management of Section 4.2, along with information on the hydrologic system at NPR-1 and the categories and importance of streams in the area.

According to Appendix G of the State CEQA Guidelines, a project will have a significant effect on the environment if it will:

1. Substantially degrade water quality;
2. Contaminate a public water supply; or
3. Cause substantial flooding, erosion, or siltation.

4.4.1.3. NPR-1 Impacts

This section analyzes potential impacts at NPR-1 related to surface water, caused by the No Action, the Proposed Action, and the Alternatives to the Proposed Action. A brief comparison of the impacts is also analyzed.

No Action Alternative

Impacts

Changes in absorption rates, drainage patterns, and rate and amount of surface runoff. The absorption rates, and hence the rate and amount of surface runoff, may be affected by the construction of large new impervious areas, such as roads, parking lots, buildings, equipment storage and portions of well pads. Compacted areas of well pads may also influence infiltraton and runoff rates. However, total annual average rainfall in the region is only 5.72 inches, 90 percent of which falls during the months of October through April. Monthly precipitation ranges from 0.01 inches in July to 1.07 inches in February. As a result, water is rarely observed in streams at NPR-1 and, except for a few days each year, stream channels draining the flanks of the hills do not carry natural runoff (DOE SEIS 1993).

New facilities planned at NPR-1 under the No Action Alternative vary between zero acres (for the lower bound of the Government Development Case), to four acres (for the Reference Case), to 12 acres (for the upper bound of the Government Development Case). These would be the areas changed to be substantially impervious. The small size of these areas, low precipitation rates, and surface runoff drainage management incorporated in the design of the new facilities would reduce the runoff impacts to less than significant levels. No new primary or secondary roads are planned; however, unpaved access roads would be needed for new wells not currently served by roads. Abandoned roadways would be reseeded and reclaimed as part of the ongoing restoration program.

Over the period 1997 to 2034, a total of 252 to 490 new wells would be developed for the lower and upper bounds of the Government Development Case, respectively, compared to 446 new wells under the Reference Case. Additional facilities permanently distrubing another 12 acres would also be required under the upper bound. These wells would require a total permanent disturbance of 303 to 600 acres, respectively. This permanently disturbed area corresponds to the well pad and the surrounding surface

that is compacted and used for well operations. The total permanent disturbed area for the range of possible options under the No Action Alternative would be only about 0.53 to 1.24 percent of the total area of NPR-1. Furthermore, only a small portion of these areas would actually be impervious. The rest of the area would just be compacted. Additionally, as old wells are closed and decommissioned, restoration activities would decrease the total impervious areas at NPR-1. All these considerations, combined with the very low rainfall levels at NPR-1, indicate that few, if any, significant adverse impacts would occur to the rate and amount of surface runoff under the No Action Alternative.

The potential for impacts to drainage patterns would be minimized with good construction practices, with special consideration to new pipeline sections connecting new wells to the pipeline distribution network. Careful consideration of drainage patterns in the design of these pipelines would minimize any negative effects. In addition, a drainage reclamation program for drilling sumps that may have been abandoned in natural drainages would continue as a mitigative measure.

Wetland impacts. Because no areas on NPR-1 have been found to meet wetland designation criteria, there would not be any impacts to wetlands under the Government Development Case.

Flooding potential and floodplain impacts. Because no significant differences are expected in the rate and amount of surface runoff, and no significant changes to topography would occur under the No Action Alternative, there would not be significant changes in flooding potential, or significant impacts to floodplains. Direct impacts to floodplains would occur only if new well pads or other new structures are constructed either within or very near existing drainage channels, which fall within the boundaries of 100-year floodplains.

New construction in such areas is considered very unlikely and could be easily avoided by careful siting of new wells and structures. Only a limited number of new structures is expected to be developed, mostly well pads and associated structures. Since well pads require approximately an acre of relatively flat surface and since well pads can readily be relocated and still still achieve their purpose, there would be little advantage to locating a well pad in the gully that constitute most of the floodplains area on NPR-1 requiring substantial earth moving before drilling and restoration after abandoment of the well. Therefore, there is unlikely to be any need to place a well pad in a NPR-1 floodplain. Further, such structure are so minimal as to not impede any natural flood patterns or the movement of water.

Floodplains also could be altered if dredge or fill material from new construction activities were placed directly in floodplains. However, any such disruptions would be mitigated by the requirement to obtain a Corps of Engineers permit under Section 404 of the Clean Water Act prior to placing fill material into a water of the United States. The Sacramento District of the Corps has noted that it considers any natural drainage with a bed and a bank -- including those on NPR-1 -- to be a water of the United States.

Discharge into surface waters or other alteration of surface water quality. The provisions of the Clean Water Act are set to prevent the discharge of pollutants into the nation's waters. Smaller volumes of produced water (7,000 to 8,000 barrels per day) are disposed in four active surface sumps, in accordance with waste discharge requirements issued by the Regional Water Quality Control Board. These waterways are monitored during storm events, but water is rarely observed in them (BPOI 1994).

Produced water (water produced with the oil) is not discharged into surface water bodies. Instead, it is injected into groundwaters in accordance with applicable regulations, as described in Section 4.4.2. The only waterbody on NPR-1 that has been classified as a navigable waterway under the Clean Water Act is Buena Vista Creek. Although NPR-1 has been exempted from the Act's stormwater

permit requirements, facility personnel (as a best management practice) monitor the quality of stormwater entering Buena Vista Creek during heavy precipitation events. No pollution incidents have been observed since this monitoring was initiated in 1992.

Spills of oil, hazardous materials or wastes might pollute surface waters in the unlikely case the spill occurred during a major runoff-producing storm. There are several systems in place designed to contain such spills. (See Section 4.10 for additional details.) For example, emergency overflow containment basins have been constructed at each of the three Lease Automatic Custody Transfer (LACT) facilities for spill containment purposes during emergency or accidental overflow condition (BPOI 1994).

Even if a spill were to occur at a time when surface water were present in water bodies, and if such a spill were not contained, there are several measures in place to prevent any runoff from entering the California Aqueduct, located along the northern and northeastern perimeter of Elk Hills. The western side of the aqueduct has been constructed with a high berm to divert runoff (DOE SEIS 1993). The spill prevention measures and the maintenance programs would minimize any potential impacts caused by spills on surface waters, especially off-site impacts.

During land-clearing activities for construction of new facilities, especially for new wells and pipeline connections, the range of development activities under the No Action Alternative has the potential to impact surface water quality. However, the hydrologic system at NPR-1 does not have the capacity to carry sediments a large distance. Even if a major runoff-producing storm were to occur during the period when surface disturbance was at a maximum, the potential for significant long-term impacts is minimal (DOE SEIS 1993).

Mitigation

The kinds of measures currently being implemented at NPR-1 would likely be sufficient to prevent significant surface water impacts under the No Action Alternative. In particular, efforts could be made to minimize the areal extent of new impervious areas. New pipelines, road routes, or other structures could be selected so as to minimize disruptions to existing drainageways and floodplains. The topography in disturbed areas could be restored to natural or similar contours. Abandoned drilling sumps would continue to be reclaimed to restore normal drainage patterns. The berm protecting the California Aqueduct must be maintained and new activities would be located safe distances away from the aqueduct. Existing emergency overflow catchment basins would be maintained and new basins constructed as needed to serve new areas of development. The hazardous material spill response plan would continue to be followed and adapted to accommodate any increased levels of production. A permit from the Corps of Engineers under Section 404 of the Clean Water Act would be required prior to placing any fill material into onsite drainage channels. And new construction sites would be quickly stabilized (revegetated) and contoured so as to minimize erosion. Moreover, continued compliance with underground injection control regulations and prohibition of direct discharges of produced water to nearby waterways would ensure surface water protection. No wetland mitigation would be required because no jurisdictional wetlands have been identified on NPR-1.

Proposed Action

Impacts

Changes in absorption rates, drainage patterns, rate, and amount of surface runoff. For both the lower and upper bounds of the Commercial Development Case considered in the Proposed Action, the new facilities planned would cover twelve acres, as in the upper bound of the Government Development Case considered in the No Action Alternative. No primary or secondary roads are planned in the Proposed Action. Even though the total area to be permanently disturbed by new wells and additional facilities in the period 1997 to 2034 is projected to be larger than for the No Action Alternative (555 and 766 acres, for the lower and upper bounds of the Commercial Development Case, respectively), the very low rainfall levels and the mitigation measures described in Section 4.4.1.3 would reduce the magnitude of the potential impacts to levels below significance in producing areas of NPR-1. Under Sale Scenarios 1 and 2, other commercial activities different from oil and gas production may be developed by the new private owners in non-producing areas although such an event is considered remote. Depending on the nature of these activities, there could be some impacts to drainage patterns and the surface runoff regime.

Wetland impacts. Because no jurisdictional wetlands have been identified on NPR-1, there would not be any impacts to wetlands under the Commercial Development Case.

Flooding potential and floodplain impacts. As no significant differences are expected in the rate and amount of surface runoff, and significant changes to topography are not expected under the Proposed Action, adequate management of the floodplain is expected to continue and there would not be a significant potential for floodplain impacts. For the reasons discussed above there are no expected to be any direct or indirect, long-term or short-term effects of the propsed actions on floodplains. As there are not expected to be any floodplain impacts, there are not expected to be any effects on lives or property, or on natural beneficial values of floodplains, which would be expected to be minimal in the arid climate of NPR-1.

Discharge into surface waters or other alteration of surface water quality. The monitoring, spill prevention and erosion minimization activities described above. would also apply for the Proposed Action. Despite the larger volumes of hazardous materials and wastes and the areas cleared during drilling of new wells and construction of pipeline connections to them, the very low levels of precipitation indicate that the potential impacts would not be significant.

Under Sale Scenarios 1 and 2 of the Proposed Action, the commercial entities that would own the land surface rights of NPR-1 could develop commercial activities in non-producing areas. Depending on the nature of these activities, the level of impacts analyzed in this section may vary. As the nature of the commercial activities in the non-producing areas cannot be predicted, the significance of impacts cannot be evaluated at this time.

Mitigation

The same mitigation measures discussed above for the No Action Alternative also would need to be implemented for the Proposed Action. In addition to these measures, however, other controls may be needed to protect surface water from other commercial (non-oil and gas production) activities that are possible under Sale Scenarios 1 and 2. These could include limits on the nature and location of activities to ensure protection of the aqueduct and other nearby waterways, as well as limits and controls on wastewater discharge limits and controls in accordance with the Federal Clean Water Act and other applicable state or local requirements.

Alternative to the Proposed Action

Impacts

All the scenarios considered under the Alternative to the Proposed Action would result in identical potential impacts on surface water resources in producing areas of NPR-1, as the corresponding lower and upper bounds of development activities are identical to those of the Proposed Action. The impacts in non-producing areas would be identical to those of Scenario 3 of the Proposed Action, as no commercial activities would be develop in these areas.

Mitigation

Mitigation measures for Alternatives to the Proposed Action would be similar to those for the Proposed Action.

Comparison of Impacts

The annual rainfall in Kern County is approximately five inches per year, and water is rarely observed in streams at NPR-1. This feature of the hydrologic system indicates that the potential impacts to the surface water system caused by future activities under the No Action, Proposed Action and Alternative to the Proposed Action would not be significant, if the mitigation and prevention measures (e.g., minimization of disturbed areas, no discharge of produced water to surface water bodies, oil and hazardous material spill prevention and response capabilities and erosion minimization measures previously described in this and other related sections) are applied. Furthermore, the impacts to surface water bodies could be significant only if the cause of the impact (e.g., sediment eroded, or spilled materials) occurred at the same time a storm generated enough runoff in streams at NPR-1 and no response action were taken. The residual effects after mitigation measures would be very similar for the three alternatives, despite the larger areas to be disturbed and the slightly higher probability of spills in the Proposed Action and the Alternative to the Proposed Action.

There may be some differences between Sale Scenario 1 and 2 of the Proposed Action and the other alternatives in non-producing areas if commercial activities are developed in the future by the private owners. The significance of these differences would depend on the scope and intensity of these commercial activities.

4.4.1.4. NPR-2 Impacts

This section analyzes potential impacts at NPR-2 related to surface water, caused by the No Action, the Recommended Action and the Alternatives to the Proposed Action. NPR-2 receives very little precipitation, and streams are ephemeral. Also, the level of development activities for all alternatives considered at NPR-2 is much smaller than those expected at NPR-1, as NPR-2 is near the end of its useful life.

No Action Alternative

Changes in absorption rates, drainage patterns, and rate and amount of surface runoff. The absorption rates, and hence the rate and amount of surface runoff, may be affected by the construction of new impervious areas, such as roads, facilities, equipment storage and portions of well pads. New facilities at NPR-2 under the No Action alternative would only cover five acres for new tank settings. Construction of 2.5 miles of new roads is expected to occur under the proposed action, disturbing 7.5

acres. Over the period 1993 to 2017, 75 new wells are expected to be developed, requiring the permanent disturbance of approximately 90 acres. However, only a small portion of these areas would actually be impervious and the rest would just be compacted. Additionally, as old wells are closed and abandoned, restoration activities would decrease the total impervious areas at NPR-2. All these considerations, combined with the very low rainfall levels at NPR-2, indicate that few, if any, adverse impacts would occur to the rate and amount of surface runoff under the Proposed Action, none of which are expected to be significant.

The potential for impacts to drainage patterns would be minimized with good construction practices, with special consideration to new pipeline sections connecting new wells to the distribution network. Approximately 22.5 miles of new pipelines would be constructed in the period 1993 to 2017.

Flooding Potential. Some of the levees in old drainages that were designed and built to contain small accidental spills and pipeline leaks have a high probability of failure during 100-year rain storm events. Flooding of tank settings and wells currently existing in 100-year floodplains potentially would be inundated if secondary containments surrounding those facilities are breached. This may cause downstream spread of contaminants. New tank settings, pipelines, wells and other facilities to be constructed may be located within 100-year floodplains. These new facilities have a limited potential to alter floodplain boundaries and flood flows.

The potential effects described above would be minimal. The water depth of 100-year floods outside of drainage channels would be shallow. New facilities would be small and dispersed throughout NPR-2. At most, about 1.4 acres per year would be disturbed in the 100-year floodplain for new construction activities. In addition, several actions would minimize potential negative effects to 100-year floodplains. All projects would be reviewed to determine if they are in a floodplain and relocated or redesigned whenever possible. If a proposed action is located in an identified floodplain with no alternative site location, a Floodplain Statement of Findings for the proposed action would be prepared in accordance with 10 CFR 1022. Also, secondary containments of existing and new facilities within 100-year floodplains would be reviewed for proper design, construction and maintenance to ensure that inundation of the facility is eliminated or minimized.

Discharge into surface waters or other alteration of surface water quality. The volumes of hydrocarbons and other hazardous materials and wastes handled at NPR-2 would be much smaller than those at NPR-1. As similar mitigation and prevention measures would be implemented to minimize spills of equipment lubricants, hydrocarbons, fuels and tank sediments on the ground surface, the potential effects on standing surface waters and ephemeral streams would not be significant. Potential effects from spills would be minimized by existing secondary containment, immediate clean-up of spilled materials and adherence to existing SPCC plans.

Recommended Action

As the expected level of development activities for the Recommended Action at NPR-2 is identical to that of the No Action alternative, and the mitigation and spill prevention measures would also be implemented, the potential effects on surface waters are identical. The mitigation activities currently implemented by the lessees are expected to continue in the case of transfer to BLM (Recommended Action). As a result, no difference in impacts to surface waters are expected.

Alternative to the Recommended Action

As the expected level of development activities for the Alternative to the Recommended Action at NPR-2 is identical to that of the No Action alternative, and the mitigation and spill prevention measures would also be implemented, the potential effects on surface waters are identical. The mitigation activities currently implemented by the lessees are expected to continue in the case of a sale to commercial entities. As a result, no difference in impacts to surface waters are expected during the remaining producing years. As oil and gas production declines and facilities are decommissioned, the private owners of NPR-2 under the Alternative to the Recommended Action may develop other commercial activities that could cause surface water impacts with a level of significance different than those caused by oil and gas activities. As the nature of these commercial activities cannot be predicted at this time, the significance of impacts is difficult to estimate.

4.4.2. Groundwater

4.4.2.1. Summary Of Impacts

This section analyzes potential impacts to groundwater. These impacts are classified into two major categories: impacts related to groundwater quantity and impacts related to groundwater quality. Section 4.4.2.2 describes the methodology for impact analyses. Sections 4.4.2.3 and 4.4.2.4 analyze impacts at NPR-1 and NPR-2, respectively.

The upper bounds of the Government and Commercial Development Cases are expected to have a continuous decrease of annual water requirements for their injection programs after 1999 and 2004, respectively. Existing and planned sources of water are expected to be able to cover water needs related to oil and gas development activities. The development of commercial activities in non-producing areas in Sale Scenarios 1 and 2 of the Proposed Action may require additional water.

The implementation of industry practices and stringent regulations of the California Division of Oil, Gas and Geothermal Resources (DOGGR) would reduce the significance of potential impacts to groundwater quality by well and pipeline construction. The geologic conditions of NPR-1 indicate that the potential for significant migration of contaminants off-site is small. Most produced water on NPR-1 is injected into the Tulare Zone, portions of which have been designated as an exempt aquifer for the purpose of Class II underground injection (meaning that Class II injection can occur without having to protect the Tulare Zone as an underground source of drinking water). The existing groundwater monitoring program would continue under any alternative to detect any potential migration off-site and determine response measures.

4.4.2.2. Methodology

The analysis of potential impacts to groundwater quantity is based on the projected consumption of fresh water (of which the most important component is the injection program for enhanced production) and the sources of water (including outside sources, groundwater extraction, and an on-site filtration plant). This information formed the basis for evaluating whether the availability of fresh water were sufficient to cover projected future needs.

The analysis of potential impacts to groundwater quality is divided into five categories of activities. First, pipeline construction, well drilling and the management of residues associated with these activities are analyzed for their potential effect on groundwater quality. Second, impacts related to the disposal of produced water are analyzed by evaluating projected injection levels and expected

injection practices. Third, impacts of fluid injection activities associated with hydrocarbon recovery and potential risks of leaking injection wells are analyzed. Fourth, impacts associated with spills of hydrocarbons and other hazardous materials are briefly examined in this section and additional details are presented in Section 4.10. Fifth, the components of the current groundwater management protection plan are evaluated to make recommendations for implementation in the alternatives evaluated.

According to Appendix G of the State CEQA Guidelines, a project will have a significant effect on the environment if it will:

- Contaminate a public water supply;
- Substantially degrade or deplete groundwater resources; or
- Interfere substantially with groundwater recharge.

4.4.2.3. NPR-1 Impacts

This section analyzes potential impacts to groundwater that could be caused by future activities at NPR-1 under the various alternatives: the No Action Alternative, the Proposed Action, and the Alternative to the Proposed Action. Each section is subdivided into potential impacts to groundwater quantity and potential impacts to groundwater quality.

No Action

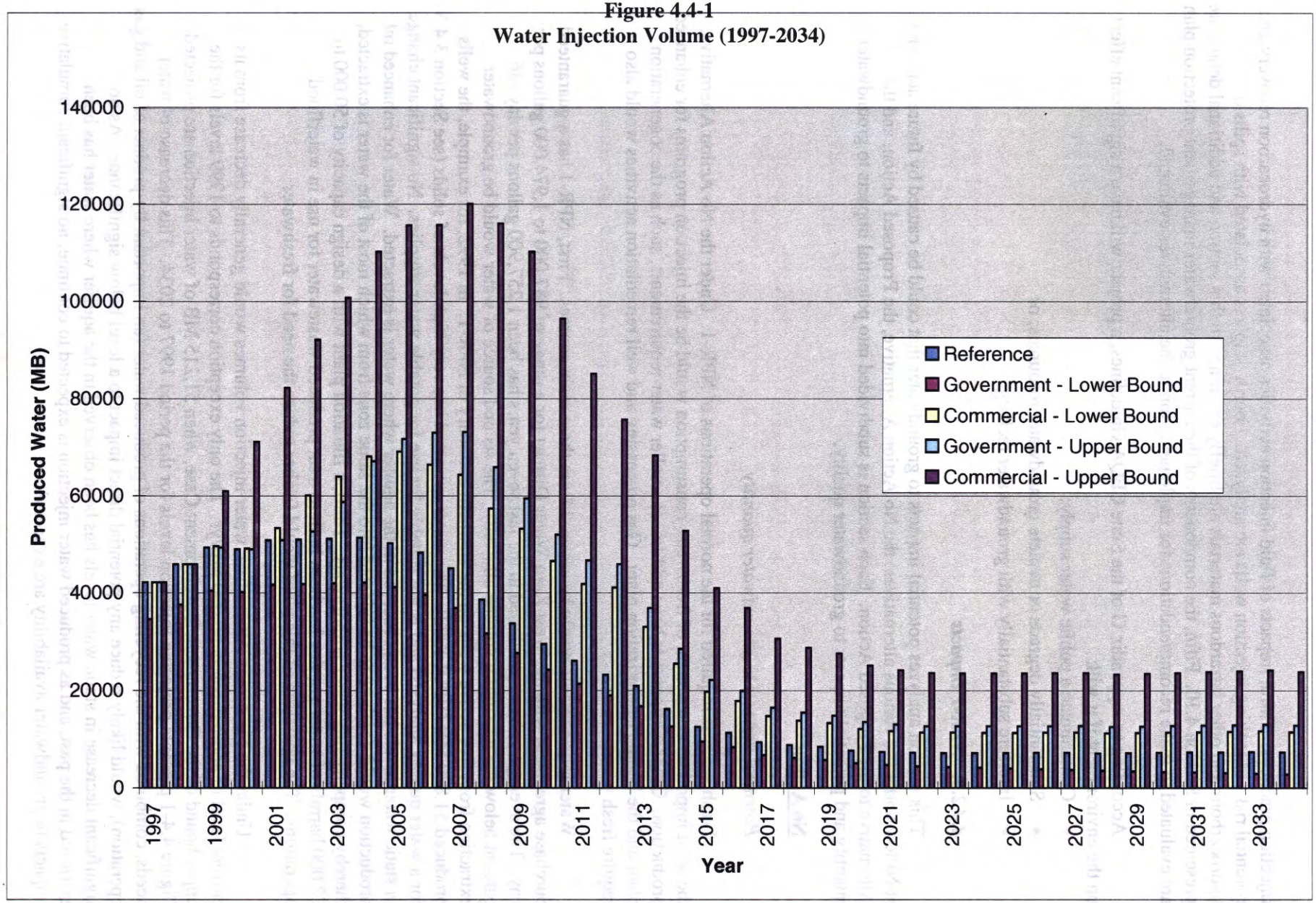
Potential impacts to groundwater quantity

Fresh water is required for the normal operations of NPR-1. Under the No Action Alternative, the most important component of freshwater consumption would be the injection programs for enhanced production. Other components have additional smaller water requirements, such as the cogeneration plant and the butane isomerization plant. Gas processing and well remediation activities would also require fresh water.

Water requirements would be covered from three main sources. First, NPR-1 has a guaranteed purchase agreement with the West Kern Water District for a range of 987,000 to 1,974,000 gallons per day. The average volume purchased in the last seven years has been 1,257,900 gallons per day (36 percent below the maximum volume allowed). The second source of water would be groundwater extraction from five active wells on the southern boundary of NPR-1. In 1992, for example, the wells produced 51,830 MB (BPOI 1992). The water extracted has very high levels of solids (see Section 3.4.3 for a water quality analysis) and is not suitable for use for potable water supplies. No significant change in static water levels has been observed in the aquifer where water is extracted. Water for enhanced oil production would continue to be injected into the same zone from which most of the water is extracted, thereby compensating water withdrawals. Third, a filtration plant with a design capacity of 50,000 to 72,000 barrels of water per day has been built to treat produced wastewater for use in waterflood operations. The operation of this plant would further reduce the need for freshwater.

Under the No Action Alternative, water injection volumes would generally decrease from its current level of approximately 50,000 MB/yr. The only exception corresponds to 1999 levels for the upper bound of the Government Development Case, when 51,215 MB of water injection are projected. Figure 4.4-1 presents projected injection levels for the period 1997 to 2034. This decrease of water needs, combined with the recycling operations of produced water (an important by-product of oil and gas operation), would likely reduce any potential direct impact to a level below significance. As no significant decrease in static water levels has been observed in the aquifer where water has been extracted in the past, and as produced water injection is expected to continue, no significant cumulative impacts in groundwater availability are expected.

Figure 4.4-1
Water Injection Volume (1997-2034)



Potential impacts to groundwater quality

A variety of activities related to oil and gas production have the potential to impact groundwater quality. The rest of this section analyzes the practices and mitigation activities planned to minimize potential impacts to groundwater. The section has been divided in five areas: wells and pipelines, produced water, fluid injection activities, spills and groundwater protection management plan.

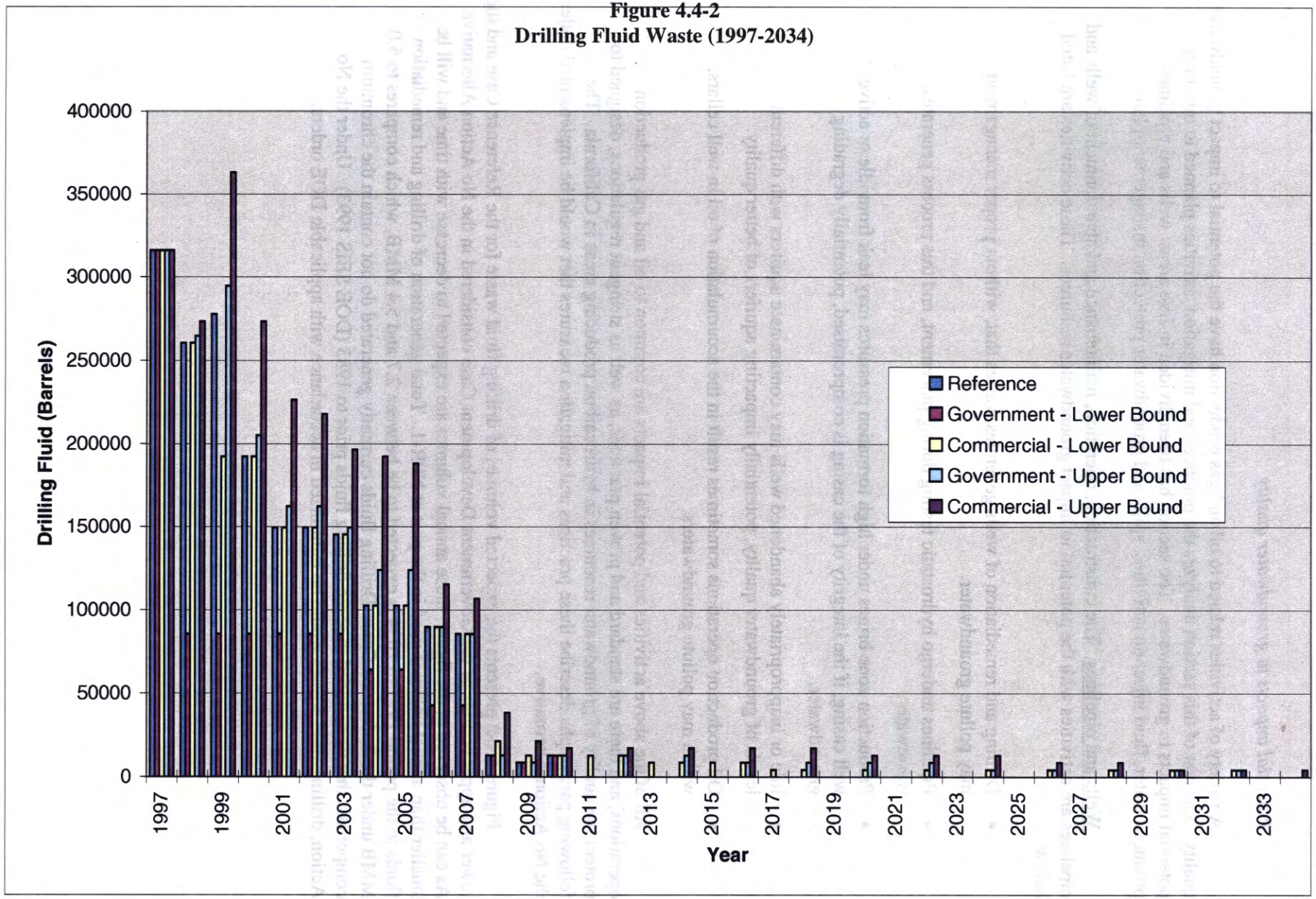
Wells and pipelines. The construction, operation, maintenance and abandonment of wells and pipelines are activities with the potential to impact groundwater resources. These activities are listed below.

- Drilling and remediation of wells generates wastes that, without proper management, may pollute groundwater.
- Pipelines undergo hydrostatic testing during placement, and this process generates wastewater.
- Production zone brines under high formation pressures may leak from idle or active well casing, if the integrity of the casing is compromised, potentially degrading groundwater.
- Idle or inappropriately abandoned wells may contaminate aquifers with different levels of groundwater quality, potentially impacting aquifers of better quality.
- Oil production operations sometimes result in the accumulation of oil in well cellars, which may pollute groundwaters.

All of the above activities and potential impacts are common to oil and gas production operations, and there are standard and proven practices, as well as stringent regulations, designed to protect the quality of groundwater resources in hydrocarbon producing areas in California. The following paragraphs describe these practices and mitigation measures that would be implemented under the No Action Alternative.

Figure 4.4-2 presents the expected volumes of drilling fluid waste for the Reference Case and the lower and upper bounds of the Government Development Case considered in the No Action Alternative. As can be observed in the figure, these annual volumes are expected to decrease with time and will be smaller than annual volumes used in the past at NPR-1. Total generation of drilling and remediation fluids in the period 1997 to 2034 is expected to be between 2.7 and 5.4 MMB, which compares to 5.0 MMB under the Reference Case. Drilling fluids currently generated do not contain the chromium compounds that were added to some drilling fluids prior to 1983 (DOE SEIS 1993). Under the No Action, drilling fluid wastes would be minimized in accordance with applicable DOE orders.

Figure 4.4-2
Drilling Fluid Waste (1997-2034)



Drilling fluids should be nonhazardous, and they would be tested to confirm this after use and before disposal. Fluids that are confirmed to be nonhazardous would be disposed of on-site at permitted 10G and 27R landfarms in accordance with Waste Discharge Requirements. The volumes of materials discharged at these landfarms will continue to be reported to the California Regional Water Quality Control Board (BPOI 1994). In the rare instances when drilling fluids could test hazardous, they would be disposed of off-site at permitted facilities.

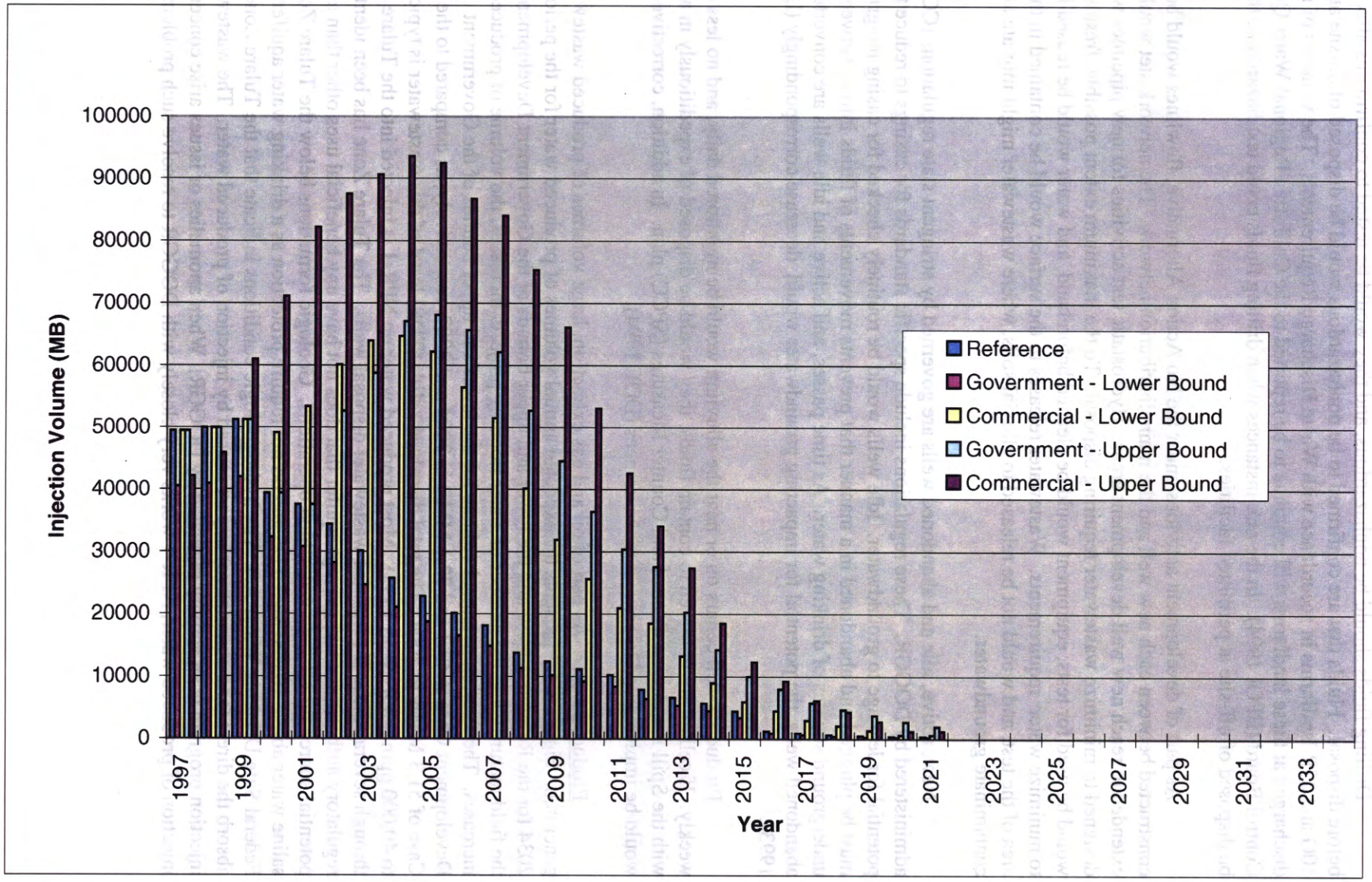
As part of development activities under the No Action Alternative, flowlines would be constructed between each new well and the main distribution network. The network stet would be extended to reach new well development areas. Hydrostatic test activities for new pipelines would be designed to minimize wastewater requiring disposal. To the maximum extent possible, fresh water would be used for tests, equipment would be cleaned beforehand, and water would be reused in each unit to minimize water requirements. Wastewater releases to the surface would be contained in the general area of the test, and would not be released to alluvial soils, where wastewater might migrate and contaminate groundwater.

New, active, idle and abandoned wells are governed by stringent state regulations (CCR Title 14) administered by DOGGR. These regulations include specific standards for casings to reduce the potential for leakage to groundwater. Idle wells would be routinely checked for casing integrity. Wells must be plugged and abandoned in a manner that prevents movements of fluids into or between underground sources of drinking water. As time passes, and active and idle wells are converted into abandoned wells, the potential for impacting groundwater would decrease correspondingly (DOE SEIS 1993).

Producing well cellars on or near the alluvium would be monitored daily, and no less often than weekly. If cellars are observed to contain fluids, they would be disposed of expeditiously in accordance with the Spill Prevention Control and Counter Measures (SPCC) plan. In addition, corrective actions would be implemented to prevent reoccurrences (DOE 1994).

Produced water. As part of oil and gas extraction, large volumes of produced wastewater are generated. Figure 4.4-3 presents the expected annual volumes of produced water for the period 1997 to 2034 for the Reference Case and the lower and upper bounds of the Government Development Case. As the field matures, and the number of water flooding projects increases, the volume of produced water increases. The maximum annual volume for the lower and upper bounds of the Government Development Case is 42.1 and 73.1 MMB in 2004 and 2007, respectively, as compared to the Reference Case of 51.3 MMB in 2004. The total dissolved solids (TDS) level of this wastewater is typically 20,000 to 40,000 ppm (DOE SEIS 1993). Most produced water on NPR-1 is injected into the Tulare Zone through several Class II permitted wastewater disposal wells. The Tulare Zone has been identified by the regulatory authorities as an exempt aquifer that does not have any beneficial uses other than as a potential source for oil-field waterflood operations. Geologic formations below the Tulare Zone contain saline water above 10,000 mg/l TDS and do not require protection as a drinking water aquifer under the Federal Safe Drinking Water Act. The hydrogeologic conditions indicate that the Tulare Zone is able to absorb the direct (and cumulative) impact caused by injection of produced water. The wastewater injection program is an activity regulated by DOGGR. When anomalies or issues arise concerning injection of produced water, NPR-1 works very closely with DOGGR to resolve such problems.

Figure 4.4-3
Produced Water (1997-2034)



Monitoring of injection well pressures, volume of liquid injected, and mechanical integrity testing of disposal wells are performed regularly per DOGGR requirements. Leaking injection wells could contaminate surrounding groundwaters. This risk is greater for injection wells than producing wells because operating pressures are greater. However, if an injection well leaks or fails mechanically, the impact on drinking water should not be significant because the Tulare Zone is an exempt aquifer for Class II underground injection (meaning that it is not protected as an underground source of drinking water). In addition, available data indicate that local groundwater is typically nonpotable due to high total dissolved solids levels.

One concern related to the wastewater injection program is the potential impact on off-site groundwater resources used for agriculture. The alluvium of Buena Vista Valley, from which agriculture water production is obtained, is near the south flank of NPR-1, where injection wells are located. However, recent work performed to support the 1993 SEIS hydrogeologic discussions has shown that the Tulare clay forms a barrier to groundwater migration between the Tulare Zone, where produced water is injected, and the alluvium (see Figure 3.2-5, taken from Milliken (1992)). In addition, Phillips (1992) and Milliken (1992) present water quality and resistivity data indicating that the Amnicola clay acts as an aquiclude separating the Tulare Formation groundwater above and below this clay (see Section 3.4.3 for additional details). All this evidence indicates that the alluvium is geohydrologically isolated from the Tulare Formation, and potential groundwater quality impacts outside NPR-1, due to injection of produced water, would likely be minimal.

In addition, produced water quantities would be minimized under the No Action Alternative, pursuant to the requirements of applicable DOE orders. Also, to the extent technically and economically feasible, future plans call for recycling produced water for use as source water for waterflood operations. For example, a filtration plant has been built to treat produced wastewater.

Monitoring of surface seeps would continue under the No Action Alternative in areas where produced water is injected. These seeps are sometimes linked to high injection rates and/or pressure, and operational changes or abandonment of wells are necessary. Close coordination with DOGGR would be maintained if such surface seeps were to occur.

There are five active sumps used to dispose of produced water at NPR-1. Four sumps, all located in Section 10G, are in regular use and receive a total of 7,000 to 8,000 barrels of produced water per day. The other active sump, located in Section 26Z, is used only in emergency or abnormal situations, when produced waters cannot be disposed of through normal means (e.g., during injection well system shutdowns). Overall, continued use of these sumps should not cause significant environmental impacts. As it has in the past, the amount of produced water disposed of in sumps is expected to decline, as oil and water production levels continue to trend downward and more of the produced water is recycled for waterflooding purposes. There are no new sumps planned for the site. In addition, the active sumps are permitted by the Regional Water Quality Control Board and designed to avoid impacts to drinking water supplies. For example, the one active sump located in an alluvial area where produced water could percolate and potentially contaminate a drinking water aquifer (the emergency sump in Section 26Z) is equipped with a liner.

Although there are several other sumps on-site in Sections 9G and 18G, they are all inactive. Closure and remediation activities of old sumps are summarized in Section 3.2.3.

Fluid injection activities. Under the No Action Alternative, injection of fluids associated with enhanced hydrocarbon recovery would continue. Figure 4.4-1 presents the expected injection volumes of water for the lower and upper bounds of the Government Development Case. The maximum annual

volumes of injected water for the lower and upper bounds of the Government Development Case are 42.0 MMB (1999 level) and 68.1 MMB (2005 level), respectively, compared to a maximum volume of 51.2 MMB in 1999 for the Reference Case. There is a potential risk of groundwater contamination if an injection well were to fail mechanically or leak into surrounding waters. This risk is greater for injection wells than producing wells because operating pressures are greater. This risk, however, is minimal because injection wells are completed, tested and monitored according to state regulations. For example, injection pressures are kept at a safe level to protect the producing injection formations from fracturing and potentially providing a flow path to overlying groundwaters (DOE SEIS 1993). Furthermore, the groundwater aquifers penetrated by the injection wells are in UIC-exempt aquifers not suitable for drinking water.

Spills. Some spills of hydrocarbons and other hazardous materials may occur as part of the operations at NPR-1. Section 4.10 presents a detailed risk analysis of spills. If these spills were to remain undetected and no response were taken, the spilled substances would impact groundwater resources. However, NPR-1 has an approved SPCC plan. Spills of hydrocarbons from pumping stations and leaking valves, as well as other hazardous materials, would be managed and cleaned up promptly in accordance with the specific procedures described in the SPCC plan. Furthermore, secondary containment facilities have been enhanced sitewide at NPR-1. For example, emergency overflow containment basins have been constructed at each of the three LACT facilities for spill containment purposes during emergency or accidental overflow conditions. One of the basins is lined due to its location on the alluvium (BPOI 1994). The enhanced secondary containment would provide additional protection for groundwater resources and reduce the significance of any potential impact.

Groundwater management protection plan. In response to the environmental monitoring requirements of DOE Order 0440.1, a Groundwater Protection Management Plan for NPR-1 has been developed. The plan was finished in April, 1994, and revised in February, 1995. It includes a review of remediation activities needed at the time for potentially impacted areas at NPR-1, and a groundwater monitoring plan. As part of this monitoring program, monthly samples of the Tulare Formation water source wells are taken to measure the water quality of the formation downgradient from the produced wastewater disposal well system. The plan recommends active pursuit of alternate wastewater disposal zones, and building new wastewater disposal wells to handle excess volumes when existing wells are shut-in due to mechanical problems. Under the No Action Alternative, the groundwater management protection plan would continue to be implemented. The monitoring of groundwater in the south flank would reduce the potential for off-site impacts, as any water quality decrease below standards can be detected early, and the appropriate remediation measures can be taken promptly.

Mitigation

Under the No Action Alternative, numerous engineering and administrative controls would continue to be implemented at NPR-1 to ensure the protection of groundwater quantity and quality. To mitigate potential impacts to groundwater quantity, these measures would include:

- Continued compliance with water purchase agreements with the West Kern Water District;
- Periodic monitoring of static groundwater levels; and
- Filtration and recycling (reinjection for waterflooding) of produced water.

Measures designed to mitigate impacts to groundwater quality would include:

- Prohibition of the use of chromium compounds in drilling fluids;
- Monitoring the quality of drilling fluids, and managing and disposing of them properly in accordance with applicable laws and regulations depending on their quality and regulatory status;
- Designing hydrostatic test activities for new pipelines to minimize the generation of wastewater that requires disposal;
- Compliance with UIC and other control regulations administered by DOGGR for produced water management and disposal;
- Compliance with the site's SPCC plan, including requirements for secondary containment structures and for monitoring of well cellars and proper disposal of any fluids observed;
- Obtaining permits and complying with waste discharge requirements issued by the Regional Water Quality Control Board for the disposal of produced water in surface sumps; and
- Continued implementation of the site's Groundwater Management Protection Plan, including routine monitoring of groundwater quality and prompt remedial actions in response to detected problems.

Proposed Action

Impacts

The hydrocarbon operations under the Proposed Action alternative would be subject to the same set of Federal, state, and local regulations that protect groundwater resources. The higher production rates expected for the Proposed Action alternative may cause potentially larger impacts on groundwater resources and may increase the risk of hydrocarbon and hazardous material spills. This section analyzes the relative differences of the Proposed Action compared to the No Action. This section is divided into impacts to groundwater quantity and impacts to groundwater quality.

Potential impacts to groundwater quantity. Figure 4.4-1 presents expected injection levels for the period 1997 to 2034 for the lower and upper bounds of the Commercial Development Case considered in the Proposed Action. Waterflooding is the operation that would require the largest volume of water in the Proposed Action. Other activities, such as gas processing and well remediation, may also increase in the Proposed Action, when compared to the No Action, but their contribution to total water requirements is much smaller than that of the injection program. The upper bound of the Commercial Development Case is expected to require 1,191 MMB of water in the period 1997 to 2034, which corresponds to an increase of 38 percent with respect to the upper bound of the Government Development Case considered in the No Action Alternative, which requires 864 MMB (or an increase of 162 percent with respect to the Reference Case, which requires 455 MMB).

The maximum annual water requirement for the injection program in the upper bound of the Commercial Development Case is 93.6 MMB in 2004. This volume may be covered by current production of extraction wells on the southern boundary of NPR-1 (which has produced no significant drawdown of groundwater levels, extracts water not suitable for potable water supplies, and does not compete with any other uses), water purchased from the West Kern Water District, and potentially from recycled produced water. If during the period 1997 to 2034, monitoring of the aquifer where groundwater is extracted indicates a significant drawdown caused by the cumulative extraction of water,

other measures would have to be considered, such as additional capacity for recycling of produced water for use in waterflood operations.

Potential impacts to groundwater quality

Wells and pipelines. Figure 4.4-2 presents the expected volumes of drilling fluid waste for the lower and upper bounds of the Commercial Development Case. These annual volumes would decrease starting in 1997 and 1999, for the lower and upper bounds, respectively. Total production of drilling fluids in the period 1997 to 2034 is expected to be 5.1 and 6.1 MMB for the lower and upper bounds, respectively. Compared to the expected volume of drilling fluids for the Reference Case (5.0 MMB) same period, this represent a decrease of 0.1 MMB for the lower bound and an increase of 1.1 MMB for the upper bound. Compared to the expected volume of drilling fluids for the upper bound of the Government Development Case (2.7 to 5.3 MMB) for the same period, this represents an increase of 2.3 MMB for the lower bound and 0.7 MMB for the upper bound. The management and disposal practices under the Proposed Action are identical to those described for the No Action. As discussed previously, the environmental protection offered by these measures would preclude any potential significant impact to groundwater quality caused by management of drilling fluid waste.

As part of development activities under the Proposed Action, flowlines would be constructed between each new well and the main distribution network. Also, the main pipelines would be extended to reach new well development areas. The standard management practices for wastewater generated during hydrostatic pressure of the pipes before installation would preclude any potential significant impact.

The same stringent state regulations described in the No Action Alternative for new, active, idle and abandoned wells, would apply and be administered and enforced by DOGGR under the Proposed Action. Though a larger number of wells would be drilled (see Section 4.1 for a detailed comparison on the number of new wells), thereby increasing the risk of leaking, the protection offered by compliance with the standards and regulations, would reduce the potential impacts to levels below significance. Monitoring of well cellars and prompt disposal of any fluids observed would be performed in the Proposed Action with the same regularity.

Produced water. Produced water is one of the most important wastes generated in the operation of NPR-1. Figure 4.4-3 presents the expected annual volumes of produced water for the period 1997 to 2034, for the lower and upper bounds of the Commercial Development Case. The largest volumes are expected to occur in 2007 for the upper bound (120 MMB). This value is 166 percent larger than the maximum annual volume expected for Reference Case for 2007 and 64 percent larger than the upper bound of the Government Development Case.

In the Proposed Action, produced water would continue to be injected into the Tulare Zone, as in the No Action. The Tulare Zone, as explained in the discussion of produced waters under the No Action Alternatives, has been identified as an exempt aquifer to be used for this purpose, and the injection program would continue to be regulated by DOGGR. Monitoring of injection well operations and surface seeps would continue in the Proposed Action.

As discussed previously under the No Action Alternatives, the information presented in recent hydrogeologic reports on NPR-1 indicates that the alluvium is isolated from the Tulare Formation, and the potential groundwater quality impacts outside NPR-1 would be minimum. As a preventive and protective measure, the groundwater monitoring activities currently being performed as part of the groundwater management protection plan would continue. If the monitoring indicates the potential for

groundwater impacts outside the exempt aquifer, then prompt actions would be taken, including the use of alternate produced water disposal areas in NPR-1, and potentially the installation of additional filtration capacity to treat produced water.

The sumps currently being used for disposal of produced water during off-normal would continue to be used under the Proposed Action. Off-normal disposal situations would be minimized through continuous improvement in contingency initiatives and better operation practices.

Fluid injection activities. Figure 4.4-1 presents the expected injection volumes of water for the lower and upper bound of the Commercial Development Case, respectively. The maximum annual volumes of injected water for the lower and upper bounds of the Commercial Development Case are expected to be 64.7 and 93.6 MMB (in 2004), respectively. The volume for the lower bound is 151 percent higher than for the Reference Case, while the total volume for the upper bound of the Commercial Development Case is 264 percent higher, due to the more aggressive enhanced recovery program.

The regulations applied to the injection program in the No Action Alternative would also apply in the Proposed Action. As the groundwater aquifers penetrated by the injection wells are in UIC exempt aquifers not suitable for drinking water, the environmental risks posed by the injection program would not be significant.

Spills. The expected frequency of spills would be different for the Proposed Action. See Section 4.10 for a detailed analysis of spill risks. If unattended, spills of hydrocarbons and hazardous materials have the potential to impact groundwater resources. However, under the Proposed Action, the SPCC plan (or an equivalent plan set up by the private operator) would be in place to respond and clean up spills promptly, thereby minimizing any potential impact to groundwater resources. The secondary containment enhancement program described in the previous section provides additional protection.

Groundwater management protection plan. Some components of the Groundwater Protection Management Plan developed for NPR-1 would continue to be applied. Specifically, the monitoring of groundwater in the south flank of NPR-1 should continue, given the importance of early detection of any potential migration of groundwater impacts off-site, so that appropriate remediation measures can be taken promptly. Also, alternate wastewater disposal zones would be explored, if needed, and new wastewater disposal wells would be built to handle excess volumes when existing wells are shut-in, thereby reducing the need to use surface sumps.

Mitigation

The same mitigation measures described for the No Action Alternative would continue to be implemented under the Proposed Action to assure the same level of groundwater protection. Most of the measures currently implemented by DOE would naturally extend to the new owner, because they are driven by Federal, state and/or local requirements that would apply the same to a commercial entity as they do to DOE. Two potential exceptions, however, are the continued implementation of the SPCC Plan and Groundwater Management Protection Plan currently implemented by DOE. Under the Proposed Action, an equivalent SPCC plan would adopted by the new owner. Some components of the Groundwater Management Protection Plan also would continue to be applied by the new owner. This includes monitoring of groundwater quality in the south flank of NPR-1 and remediation of detected problems, exploration of alternate wastewater disposal zones (if needed), and construction of new wastewater disposal wells to handle excess volumes.

Alternative to the Proposed Action

Impacts

The two scenarios considered under the Alternative to the Proposed Action would result in impacts to groundwater caused by oil and gas activity that are identical to those analyzed for the Proposed Action, as the production levels are the same. Therefore, the impact analysis is not repeated in this section. As no commercial activities are expected to be developed in non-producing areas, there would be no impact to groundwater resources as in the No Action and Sale Scenarios 3 of the Proposed Action.

Mitigation

Mitigation measures for Alternatives to the Proposed Action would be similar to those for the Proposed Action.

Comparison of Impacts

There is a variety of activities in hydrocarbon production at NPR-1 that could impact groundwater resources. These activities are common to oil producing fields and not specific to NPR-1. For this reason, a set of stringent Federal, state and local regulations have been set in place to protect the environment, specifically from hydrocarbon production activities like those expected at NPR-1. These regulations apply to the No Action, the Proposed Action and the Alternative to the Proposed Action.

The higher production levels expected in the upper bound of the Commercial Development Case, compared to the Reference Case and the upper bound of the Government Development Case, would result in a need for larger volumes of fresh water, a larger number of wells, and larger volumes of produced water and fluid injection. These increased volumes also would imply an increased risk of spills, although an increased availability and commitment of capital toward system maintenance and improvements by commercial entities could act to offset this increased risk. Furthermore, there is a range of potential development scenarios in which the Commercial and the Government Development Cases overlap, resulting in identical potential impacts to groundwater.

Expected fresh water requirements can be covered with the purchase agreement with the West Kern Water District and extraction wells in the southern flank of NPR-1. Other options, such as filtration and treatment of produced water for fresh water uses, would be considered if water supply constraints occur in any of the three alternatives. Management and disposal of drilling fluids, water used for hydrostatic testing, and other wastewaters would be conducted according to existing standards and regulations, reducing the significance of potential impacts to groundwater. New, idle and abandoned wells would be managed and monitored in accordance to DOGGR regulations.

The increase in produced water volumes for the No Action Alternative, and the larger volumes of the upper bound of the Proposed Action, compared to the No Action Alternative, would require careful monitoring of environmental conditions and may require consideration of additional options for disposal. Most of the produced water would continue to be injected in the Tulare Zone. The injection of produced water in this UIC-exempt aquifer has not caused significant impacts in NPR-1 water extraction wells located downgradient. Hydrogeologic information available indicates isolation of the alluvium used for extraction of water for agriculture in areas near NPR-1, from the Tulare Zone where disposal of produced water is done. Monitoring of groundwater quality and surface seeps would continue to detect any changes that may be caused by the injection of produced water. Finally, production water may be

recycled, up to a certain level, for use as source water for waterflood operations. Given these considerations, the potential for significant impacts to groundwater resources outside NPR-1 appears to be below significance.

The use of surface sumps for disposal of produced water during off-normal situations would continue, but the frequency of these occurrences would be minimized through contingency initiatives, and other actions that may include drilling of new disposal wells. No wastewater is planned to be discharged to unlined sumps located in alluvial areas, where it could percolate and potentially impact drinking water aquifers.

The injection program for enhanced hydrocarbon extraction would be regulated by the same set of standards for all three alternatives, and the potential for significant impacts to groundwater resources would be minimal.

The spill response and cleanup activities would continue to be performed according to the SCPP plan, under the No Action alternative. The same plan (or an equivalent one developed by the private operator(s)) would be in place in the Proposed Action and the Alternative to the Proposed Action. Prompt response and cleanup of hydrocarbon and hazardous material spills would reduce any potential impact to groundwater resources to levels below significance.

Finally, the groundwater monitoring activities currently developed at NPR-1 should continue under all three alternatives, as a precautionary measure for early detection of impacts to groundwater resources that migrate off-site, outside the portion of the Tulare Zone designated as an exempt aquifer for the purpose of Class II underground injection.

4.4.2.4. NPR-2 Impacts

No Action

Potential impacts to groundwater quantity

Fresh water is required for normal operations at NPR-2. As production declines, fresh water requirements at NPR-2 are reduced. As water needs decrease with time, potential impacts to groundwater quantity would continue to be at levels below significance.

Potential impacts to groundwater quality

As described for the impact analysis for NPR-1, there is a variety of activities related to oil and gas production that have the potential to impact groundwater quality. As production at NPR-2 declines, the magnitude of potential impacts to groundwater quality is reduced.

Wells and pipelines. It is projected that the No Action Alternative would include drilling and installing 75 new infill, offset and exploratory wells. The spent drilling fluids resulting from drilling operations have the potential to affect groundwater. However, measures would be taken to minimize the risk of such an occurrence. For instance, as each well is drilled, a temporary sump used to contain the drilling fluids and muds is constructed adjacent to the well. Upon completion of the well, the sump is reclaimed as explained in the waste generation and management section (see Section 3.5.1).

In addition, future development activities at NPR-2 are estimated to require the construction of approximately 22.5 miles of new pipelines. Hydrostatic test activities for new pipelines would be performed to minimize wastewater requiring disposal.

The withdrawal of oil, gas, and water from production wells has the potential to affect overlying aquifers because production-zone brines can migrate up an active well's casing if the casing has been compromised. By providing a vertical conduit between the production zone and overlying aquifers, a compromised well casing can lead to the degradation of valley aquifers or other usable groundwaters. The likelihood of this occurring would not increase under the proposed action, because the number of active wells is expected to decrease gradually over time. Such occurrences are further minimized by adherence to all regulations covering the completion of new wells and the operation and monitoring of active wells (DOE EA 1994).

Under the No Action Alternative, 175 existing wells would be shut-in or abandoned. Shut-in wells are those placed on inactive status and have the potential to allow communication of fluids between production zones if the well casing is compromised. Proper procedures for well shutdown/abandonment would be followed as stipulated by California DOGGR regulations. Abandonment involves the permanent closing of a well by "plugging" the well with a cement slurry to prevent any transport of fluids between formations. The risk posed by abandoned wells is decreased relative to the risk associated with shut-in wells. With time, more of the shut-in wells would be converted to abandoned wells and the risk of degradation to groundwater would therefore decrease (DOE EA 1994).

Produced water. Produced water is disposed of by injection into the Tulare Formation both on and off the Federally-owned portions of the NPR-2 site. The rate of disposal is approximately two to three MMB/year. This rate would decrease with lower production. The disposal of produced water in injection wells is in compliance with applicable laws, regulations and applicable DOE orders. The disposal is expected to continue in an exempt aquifer that has no other known beneficial uses. There is a remote possibility of migration of injected waters to non-exempt aquifers if formation fractures developed due to the injection pressure. However, the regulations governing injection activities are designed to monitor, identify, and correct such migration of injection fluids outside of the intended zones of disposal. The potential for off-site migration of injected produced water is therefore minimal.

Fluid injection activities. No injection is planned as part of the future activities at NPR-2.

Spills. Some spills and overflows of hydrocarbons and other hazardous materials may occur as part of the operations at NPR-2. Two examples include overflows and leaks at dehydration/LACT facilities and pipeline leaks. However, as oil production declines at NPR-2 due to maturation of the oil field, the potential impact to groundwater quality caused by spills and overflows would be reduced with the decreased usage of these facilities. The SPCC plans would continue to be applied and prompt responses and remediation of spills would continue to be implemented.

Recommended Action and Alternative to the Recommended Action

Future development activities at NPR-2 under the Recommended Action and the Alternative to the Recommended Action would be identical to those of the No Action Alternative. Management and protection of groundwater resources would also be the same. Use of groundwater to supply water needs at NPR-2 would continue at similar levels for all three alternatives. Potential impacts to groundwater quality due to construction and operation of wells and pipelines, disposal of produced water, fluid injection activities, and accidental spills, would be identical for all three alternatives. The mitigation and response measures described for the No Action Alternative would also be implemented for the

Recommended Action and the Alternative to the Recommended Action, thereby reducing potential impacts to groundwater quality to levels below significance.

4.4.3. Cumulative Impacts

As required by NEPA and CEQA, this section describes and analyzes the potential incremental in cumulative environmental impacts associated with water resources (surface water and groundwater) in the region. Cumulative impacts are defined in Section 2.5.

4.4.3.1. Regional Description

The geographical region considered for the analysis of cumulative impacts is the Tulare Lake Region, shown in Figure 4.4-4. Data for the cumulative impact analysis come from the California Department of Water Resources that analyzed water resources in this specific region as part of the California Water Plan Update (CA Department of Water Resources 1994). The Tulare Lake Region includes the southern San Joaquin Valley from the southern limit of the San Joaquin watershed to the crest of the Tehachapi Mountains. It stretches from the Sierra Nevada Crest in the east to the Coast Range in the west.

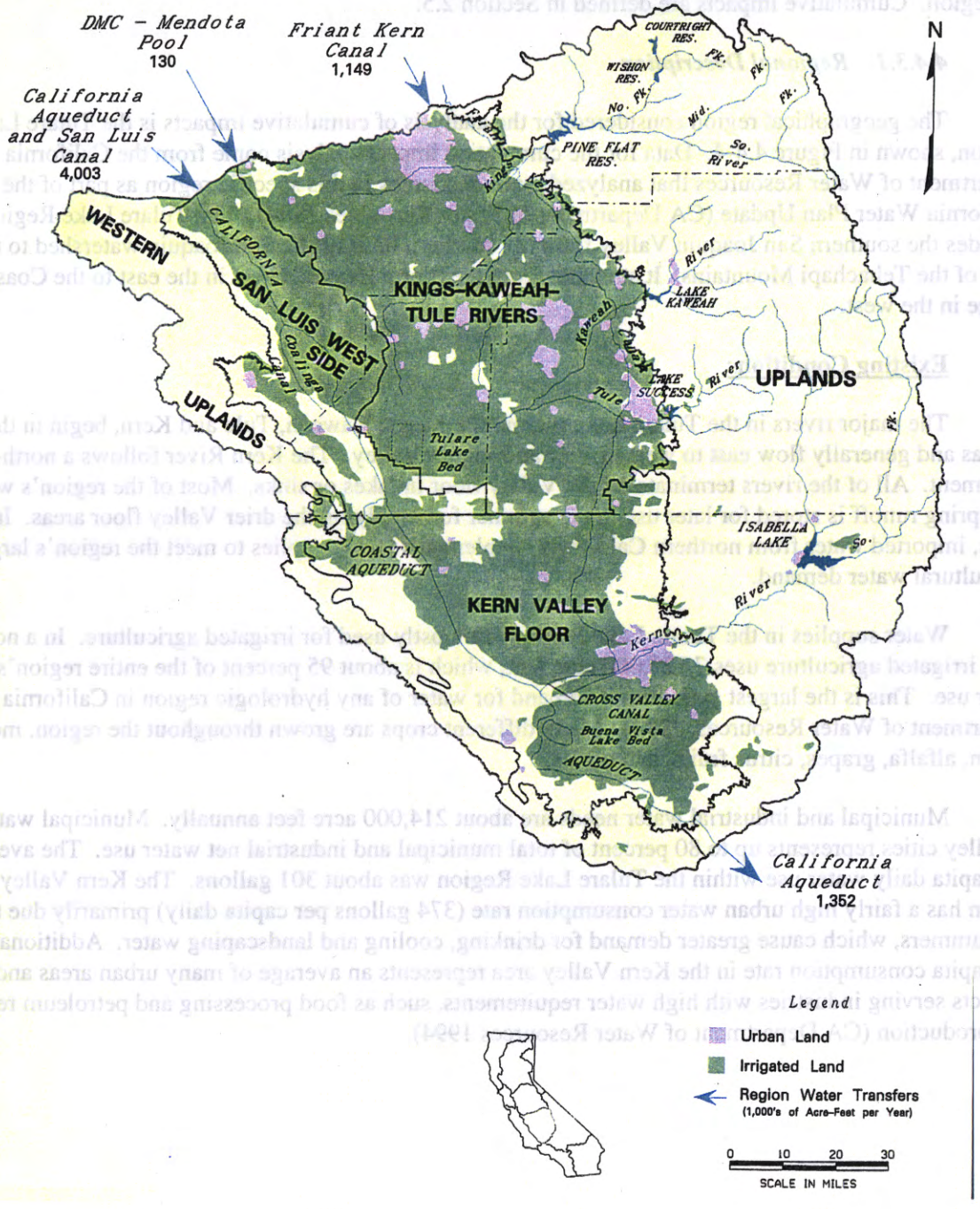
Existing Conditions

The major rivers in the Tulare Lake region, the Kings, Kaweah, Tule and Kern, begin in the Sierras and generally flow east to west in the San Joaquin Valley. The Kern River follows a north-south alignment. All of the rivers terminate on the Valley floor in lakes or sinks. Most of the region's winter and spring runoff is stored for later use in the summer for supplying the drier Valley floor areas. In most years, imported water from northern California supplements local supplies to meet the region's large agricultural water demand.

Water supplies in the Tulare Lake Region are mostly used for irrigated agriculture. In a normal year, irrigated agriculture uses 7,723,000 acre feet, which is about 95 percent of the entire region's total water use. This is the largest agricultural demand for water of any hydrologic region in California (CA Department of Water Resources, 1994). Many different crops are grown throughout the region, mostly cotton, alfalfa, grapes, citrus fruits, and olives.

Municipal and industrial water needs are about 214,000 acre feet annually. Municipal water use in valley cities represents up to 80 percent of total municipal and industrial net water use. The average per capita daily water use within the Tulare Lake Region was about 301 gallons. The Kern Valley floor region has a fairly high urban water consumption rate (374 gallons per capita daily) primarily due to its hot summers, which cause greater demand for drinking, cooling and landscaping water. Additionally, the per capita consumption rate in the Kern Valley area represents an average of many urban areas and water districts serving industries with high water requirements, such as food processing and petroleum refining and production (CA Department of Water Resources 1994).

Figure 4.4-4
Tulare Lake Region



Foreseeable Future Actions

Agriculture is expected to continue as a major water user in the Tulare Lake region in the future. However, improved farm irrigation efficiencies, urbanization and retirement of agricultural land are expected to decrease net water use for agriculture by 554,000 acre feet, or seven percent. Municipal and industrial net water use is expected to increase 112 percent by 2020 due to large population increases throughout the region, primarily Fresno and Bakersfield. The total net water use for the region is projected to decrease by 292,000 acre feet, or four percent, by 2020.

The California Department of Water Resources has developed a water budget for the Tulare Lake Region that compares existing and future water demand forecasts with the forecasted availability of supply. Table 4.4-1 presents 1990 and 2020 water supply and demand for the Tulare Lake Region. The Regional net water demands for the 1990 level of development totaled 8,136,000 and 8,308,000 acre feet for average and drought years, respectively. Those demands are forecasted to decrease to 7,844,000 and 7,995,000 acre feet, respectively, for the year 2020. The forecasted decrease in net demand will come from several sources, a 20,000 acre feet reduction in urban water demand resulting from implementation of long-term conservation measures; a 90,000 acre feet reduction in agricultural demand resulting from additional long-term agricultural water conservation measures; and a 120,000 acre feet reduction due to land retirement on the west side of the region.

Table 4.4-1
Tulare Lake Region Water Budget
(thousands of acre feet)

Water Demand/Supply	1990		2020	
	Average	Drought	Average	Drought
Net Demand				
Urban	214	214	474	474
Agricultural	7,723	7,895	7,379	7,530
Other	199	199	221	221
Total Net Demand	***8,136***	***8,308***	***7,844***	***7.995***
Water Supplies				
Surface Water	6,571	3,373	6,333	3,140
Ground Water	915	3,773	926	3,758
Ground Water Overdraft	650	650	--	--
Total Water Supplies	***8,136***	***7,796***	***7,259***	***6,898***
Demand/Supply Balance	**0**	**-512**	**-585**	**-1,097**

Potential for Cumulative Impacts

The water required for production activities at NPR-1 is derived from three main sources, the most important of which is on-site groundwater extraction. Other sources include off-site purchases and treatment of produced water. NPR-1 has a guaranteed purchase agreement with the West Kern Water District for 987,000 to 1,974,000 gallons. Groundwater is currently extracted from five active wells on the southern boundary of NPR-1, however, the water extracted from the wells is not suitable as potable water because of its high level of dissolved solids. Much of the produced water is recycled by reinjection into the Tulare reservoir, which maintains reservoir pressure and extraction efficiency. In general, oil

and gas production in the region, and for the cumulative projects examined specifically (including NPR-2), is past its peak, so the overall level of activity and water demand are generally in decline. The potential increase of water consumption in the first years of future operation of NPR-1 is not expected to change this downward trend in the region. Potential cumulative impacts to groundwater quantity are therefore expected to be below significant levels.

Regarding potential cumulative impacts to groundwater quality, as explained in Section 4.4.2.3, most of the produced water on NPR-1 is injected into the Tulare Zone through several permitted wastewater disposal wells. The Tulare Zone is an exempt aquifer which does not have any beneficial uses other than as a potential source for oil-field waterflood operations. The hydrogeologic conditions indicate that the Tulare Zone is able to absorb the impacts caused by injection of produced water. Groundwater migration between the Tulare Zone, where wastewater is injected, and the alluvium, from which higher quality water is extracted for agricultural, municipal and industrial purposes, is prohibited by a clay barrier (Milliken 1992). The alluvium is geohydrologically isolated from the Tulare Formation, and the potential for groundwater quality impacts outside NPR-1 should be minimal.

4.4.4. References

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4.5. BIOLOGICAL RESOURCES

This section discusses the impacts of the various actions on the biological resources of NPR-1 and NPR-2. Section 4.5.1 summarizes the impacts to plants, animals, and threatened and endangered species for both sites. Section 4.5.2, presents the methodology used to assess the impacts and to identify appropriate mitigation measures. Sections 4.5.3 and 4.5.4 describe the impacts on biological resources at NPR-1 and NPR-2, respectively. Each section considers the impacts from all actions on plant and animal communities, threatened and endangered species, and species of concern, and identifies the applicable mitigation measures. Section 4.5.5 considers the cumulative impacts of the various alternatives in light of other activities in the region. A more detailed description of the specific impacts on biological resources for each site is presented in Appendix G.

4.5.1. Summary

4.5.1.1. NPR-1 Impacts

The following table summarizes the more significant anticipated biological impacts of the No Action Alternative and the Proposed Action at NPR-1 for the different biological components and their level of significance before and after the implementation of mitigation. These mitigation measures include (1) those that are mandatory under the present 1995 Biological Opinion (1995 BO), (2) additional mitigation measures that can be extrapolated (i.e., implied) from the 1995 BO for impacts over and above the limits set in the 1995 BO, (3) measures recommended in the BO and, (4) additional intended either to protect state listed endangered species or to adopt best management practices.

All three alternatives would cause significant impacts to biological resources that would be mitigated to less than significant by existing Federal and state regulatory programs. The most important potential impacts of the Proposed Action to biological resources needing mitigation are those to threatened and endangered species and other species of concern.[1] Under the Proposed Action, commercial development could jeopardize the continued existence of the San Joaquin kit fox, reduce the potential for recovery of listed species and increase the potential for listing additional species. These impacts would primarily result from (1) additional "permanent" habitat loss (from 20 to 231 acres over the reference case which is 144 to 355 acres over the allowed disturbance under the 1995 BO),[2] alteration, and fragmentation; and the associated loss of biological diversity, (2) mortality, injury and displacement of individual plants or animals, and (3) the loss of affirmative federal obligations under the Endangered Species Act to protect, conserve and help recover threatened and endangered species, including the greater likelihood that at the end of NPR-1's productive life it would be allowed to convert to wildlife habitat than if it were privately owned.

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[1] As noted in Section 3.5, for the purposes of this document species of concern are defined as species that (1) are recognized by the State of California as species of concern ("State special"); (2) are recognized by FWS as Category 1 species; or (3) formerly had federal status as Category 2 species (although FWS no longer has a Category 2 designation). These species are all included as species of concern, because they may be more sensitive to development activities than other species.

[2] The additional acreage calculated as follows: 446 new wells under the Reference Case, 452 new wells under the lower bound of the commercial development case and 628 under the upper bound with 1.0 acre of permanent disturbance for the well pad and 0.2 acres for access plus an additional 12 acres of new support facilities for commercial development, for a total "permanent" disturbance of 535, 555 and 766 acres, respectively. The disturbance lasts for the life of the well, at which time all structures are removed, ground returned to its prior grade, and either revegetated or allowed to revert to natural habitat. The disturbance is deemed "permanent" under the BO because it lasts more than two years.

Table 4.5-1
Impact Significance After Mitigation Measures

Key to Table Abbreviations

N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	No Action Alternative		Proposed Action	
	Level of Significance before Mitigation	Level of Significance after Mitigation	Level of Significance before Mitigation	Level of Significance after Mitigation
Plant Communities				
Habitat loss: Habitat loss, alteration, and fragmentation, with associated reduction in biological diversity of plant communities	L	N	L	N
Plant community loss: Destruction of, or damage to, plant communities from exploration and production activities	L	N	L	N
Erosion: Accelerated soil erosion from exploration, and production activities	N	---	N	--
Spills: Spills of oil, wastewater, and other oil-field chemicals to plant communities	L	N	L	---
Fire: Range fire caused by human activities	L	N	L	L
Grazing: Livestock grazing affecting plant communities	L	--	L	---
Species competition: Increased competition with other species caused by human activity	L	--	L	---
Animal Communities				
Habitat loss: Habitat loss, alteration and fragmentation, with associated reduction in biological diversity of animal communities	L	N	L	N
Animal Loss: Mortality, injury, displacement of animals	L	N	L	N
Shelter Loss: Loss or destruction of animal dens and burrows	L	--	L	---
Erosion	N	--	N	---
Spills	L	--	L	---
Fire	L	--	L	--
Grazing	L	--	L	---
Species competition	L	--	L	---
Noise: Displacement resulting from exploration and production related noises	N	--	N	---

Table 4.5-1
Impact Significance After Mitigation Measures (continued)

Key to Table Abbreviations
N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	No Action Alternative		Proposed Action	
	Level of Significance before Mitigation	Level of Significance after Mitigation	Level of Significance before Mitigation	Level of Significance after Mitigation
Program Funding Loss: Loss of funding to cover costs of protection, and management of conservation area	N/A	N/A	N for sc. 1&2, but S for sc. 3	L but implementation mechanism is uncertain
Reduced potential for recovery: Reduced potential for recovery of listed species and increased potential for listing additional species	N/A	N/A	S for sc. 1&2, but L for sc. 3	L
Plant Loss: Damage or destruction of T&E plants	S	L	S for sc.1&2, but L for sc. 3	L for all scenarios
Animal Loss: Mortality, injury, displacement of T&E animals	S	L	S	L
*Animal Shelter Loss:*Loss or destruction of animal dens and burrows	S	L	S	L
Spills	S	L	S	L
Grazing	N	--	L	--
Noise:	S	L	S	L
Pest Control	L	--	S	L
Species of Concern				
Species of concern impacts: Habitat loss of concern	S	L	S	L
Total Impacts: (Past and projected future)				
Total Impacts: Habitat losses and mortality, injury or displacement of plant and animal communities including T&E species	S	L	S	L

The potential impacts of the Alternative to the Proposed Action are lower than those of the Proposed Action because they would retain the affirmative federal obligations to protect, conserve and help recover threatened and endangered species. The impacts would be similar to those of DOE operation under the No Action Alternative. Table 4.5-9 in Section 4.5.3.4. provides a more complete comparison of the NPR-1 alternatives.

A key consideration in mitigating the biological impacts of the proposed action to less than significant is the mechanism for enforcing the mitigation requirements on the new owner, and the role that the Federal and state regulatory agencies would play in that enforcement. Initially, the NPR-1 sales

contract would provide for the transfer of the 1995 BO to the new owner. The new operator/owner would be able to operate NPR-1 without having to obtain a permit under Section 10 of the Federal Endangered Species Act (ESA), provided that the owner complies fully with the terms and conditions of the 1995 BO (the new owner would also need to obtain an incidental take "permit" under the California ESA as discussed below). As these are the same protections that DOE applies in its operations, this would mitigate the impacts to biological resources from commercial ownership to less than significant, at least for the short term. In order to be able to expand the current level of exploration and production, ultimately, the new owner would need to obtain a Section 10 permit. Additional mitigation measures would be required to assure that impacts to biological resources are mitigated to less than significant.

One additional measure that would be required is the preparation of a Habitat Conservation Plan (HCP) which is required by Section 10 as a condition of the issuance of an incidental take permit authorizing the unintentional taking of listed species.

The plan must specify:

- Impacts to listed species;
- Measures to monitor, minimize and mitigate the impacts; and
- Such additional measures as FWS may require.

HCPs can be either "small scale," "medium scale" or "regional." This section examines the use of both small scale and Kern County regional HCPs as possible mechanisms for meeting the requirement for an HCP.

As NPR-1 does not have a state endangered species incidental take permit, in addition to the transfer of the 1995 BO the new owner would either be required to reduce operations significantly in order to avoid a taking of any state listed threatened or endangered species in violation of the California ESA (which includes the federally listed species on NPR-1 as well as the San Joaquin antelope squirrel), or obtain necessary approvals from the California Department of Fish and Game (CDFG). A recent state court of appeals decision suspended CDFG's previous procedures of issuing approvals pursuant to Section 2081 of the California ESA. However, subsequent legislation restores CDFG's 2081 permitting authority. In addition, CDFG continues to have a number of possible mechanisms for granting the necessary approvals. For example, CDFG is required by the California ESA to participate in the Federal ESA HCP process to the extent California listed species (as is the case with NPR-1) are affected. It would be in the new owner's best interests to ensure that the additional measures taken to mitigate the impacts of future planned expansion are approved at both the state and Federal levels. Simultaneous negotiations with CDFG and the USFWS would allow the new owner to develop mitigation measures that meet the requirements of CEQA and the California ESA, as well as the Federal ESA. Such joint negotiations would ensure that expanded development of NPR-1 could be carried out as swiftly as possible without sacrificing the existing level of mitigation. This is the procedure currently employed in developing HCPs and conducting Section 7 consultations in the San Joaquin Valley for jointly listed species.

4.5.1.2. NPR-2 Impacts

All three alternatives examined would result in the permanent loss of an additional 88 acres with associated mortality, injury and displacement of individual plants and animals. Neither the Recommended Action (transfer to BLM) nor any of the alternatives, when analyzed separately, are likely to result in any significant impacts to biological resources.

4.5.1.3. Cumulative Impacts

The cumulative impacts of the proposed action and other activities in Western Kern County would be significant but would be mitigated to less than significant except for the cumulative impacts of the sale of NPR-2, combined with the NPR-1 Proposed Action. The latter would be highly significant because of the loss of continued stewardship by the Federal government for both NPR-1 and NPR-2, which represents a significant percentage of the critical habitat for a number of threatened and endangered species. However, even that impact could be mitigated to less than significant levels within the meaning of CEQA by the adoption and implementation of a regional HCP, or other mitigation measures properly structured to account for the loss of the Federal protection of NPR-1.

4.5.2. Methodology

4.5.2.1. Overview of Approach

This impact analysis is somewhat different from the biological impact analyses in the prior NPR-1 EIS and supplement for several reasons. First, the existing operations at NPR-1 have generated impacts to threatened and endangered species that have been largely mitigated through implementation of mandatory mitigation measures and best management practices under a series of Biological Opinions. Second, the legislation ordering DOE to sell NPR-1 allows the transfer of the terms and conditions of the 1995 BO to a new owner without having to reopen consultations with the U.S. Fish and Wildlife Service (FWS). These terms and conditions are not normally transferable from a Federal agency to a private entity. Furthermore, an agency usually would need to consult with the FWS before taking any action that could impact endangered or threatened species. However, since the legislation specifically provided for the transfer of the 1995 BO, reconsultation would be meaningless because the purpose would be to create a new BO that would be different from the one to be transferred. Therefore, the analysis focuses on the transfer of the 1995 BO instead of the normal consultation process associated with a Federal action affecting threatened and endangered species.

In addition to the discussion of the BO transfer process, this section analyzes the impacts to the biological components from oil and gas exploration and production activities at NPR-1 and NPR-2. The section quantifies the estimated habitat losses associated with each alternative. To accomplish this, the oil and gas production associated with each alternative was converted to acres of habitat disturbed. The analysis examines four sets of habitat disturbance numbers drawn from the Reference Case, the upper and lower bounds of the Commercial Development Case, and the upper and lower bounds of the Government Development Case in estimating impacts. Three of these pertain to the unmitigated impacts to biological resources (based on the amount of habitat disturbed) and one pertains to mitigation measures (see Table 4.5-2 for a summary of the habitat disturbance estimates). Specifically, the four sets are:

- The estimated future disturbances for the Reference Case, the Proposed Action and the No Action Alternative. Annual estimated future disturbances are presented in Appendix B.
- The total projected habitat disturbance for each case. This number is derived by adding the estimated future habitat disturbance for each case to the total amount of disturbance that has occurred at NPR-1 to date (approximately 6,884 acres).
- The difference between the total projected disturbance for the Proposed Action and No Action Alternative compared with the Reference Case.
- The difference between the total projected amount of disturbance for each case above the maximum acreage allowed to be disturbed by the 1995 BO (approximately 7,295 acres).

Table 4.5-2
Habitat Disturbance Estimates

	Reference Case	No Action Alternative- Government Development		Proposed Action and Alternative Action Commercial Development	
Permanent Habitat Disturbance		Lower Bound	Upper Bound	Lower Bound	Upper Bound
1. Actual Disturbance to 1988 (From 1995 BO)	6467	6467	6467	6467	6467
2. Actual Disturbance Since 1988 [3]	417	417	417	417	417
3. Total Disturbed to Date (Row 1 + Row 2)	6884	6884	6884	6884	6884
4. Permitted to be Disturbance from 1988 On (From 1995 BO)	828	828	828	828	828
5. Total Permitted to be Disturbed (Row 1 + Row 4)	7295	7295	7295	7295	7295
6. Estimated Future Disturbance (Appendix D)	535	303	600	555	766
7. Total Estimated Disturbance (Row 3 + Row 6)	7419	7187	7484	7439	7650
8. Projected Amount of Disturbance Above the 1995 BO Limit (Row 7 - Row 5)	124	N/A	189	144	355
9. Variance in Projected Total Disturbance from Reference Case (Row 7 - 7419)	0	<232>	65	20	231
10.Future Disturbance as Percent of Total Disturbance	7.5%	4.2%	8.0%	7.5%	10.0%

Other impacts were assessed by reviewing the ongoing conservation and recovery activities at the NPRs, which have been implemented by DOE to comply with the Federal government's affirmative conservation obligation under Section 7(a)(1) of the ESA, and projecting whether those measures would likely be required of the new owner under future Federal and state permitting processes.

The development of mitigation measures was an additive process. If DOE were to implement the No Action Alternative, the impacts of continued government development would be mitigated using the BO and some additional mitigation measures resulting from subsequent consultations with FWS to address potential impacts not evaluated in the 1993 SEIS or the BO. Impacts for the Proposed Action would be mitigated using the measures developed for the No Action Alternative with supplemental mitigation measures to address the additional acreage disturbed and the loss of the Federal government's affirmative conservation obligation under the ESA.

4.5.2.2. Standards of Significance

For the purposes of this NEPA/CEQA analysis, the Proposed Action and alternatives are assumed to have significant adverse impacts to endangered species if they:

[3] Latest estimates are that only 401 acres have been disturbed to date.

- Result in actions that would "jeopardize the continued existence" of any endangered or threatened species where "jeopardize" is defined as "...to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (Section 7(a)(2) and 50 CFR Part 402).
- Result in the authorized taking of threatened or endangered species or adverse modification of essential habitat to the extent that local populations may be adversely affected.
- Result in the unauthorized taking of threatened or endangered species (i.e. in excess of permit limitations).

CEQA has criteria to determine when an adverse impact is significant. Actions are considered to have significant adverse impacts to biological resources under CEQA (Section 15065) if they:

- Change the diversity of species or number of species.
- Reduce the number of unique, rare or endangered species of plants or animals, including not only listed species but also any species that meet the CEQA definition of endangered or rare species. CEQA Section 15380 defines a plant or animal as "endangered" when its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease or other factors. CEQA defines a plant or animal as "rare" when either:
  - Although not presently threatened with extinction, the species is existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens; or
  - The species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered "threatened" as that term is used in the Federal Endangered Species Act.
- Introduce new species of plants or animals that result in a barrier to normal replenishment of plants or movements of animals.
- Result in the deterioration of, or substantially reduce, existing fish and wildlife habitat.
- Cause a fish or wildlife population to drop below self-sustaining levels.
- Threaten to eliminate a plant or animal community.
- Reduce the number or restrict the range of a rare or endangered plant or animal.
- Potentially have impacts that are individually limited, but cumulatively considerable.

4.5.3. NPR-1 Impacts

4.5.3.1. No Action Alternative

This section briefly summarizes impacts resulting from on-going routine exploration, development and production activities at NPR-1 that have been discussed previously in detail (EG&G 1987; DOE 1991, DOE 1992); a more detailed description is provided in Appendix G. (Note that the impacts described in Appendix G are potential impacts without mitigation.) Impacts to species not previously considered, and impacts not previously evaluated, are also discussed. Mitigation measures (described at the end of each alternative and listed in Tables 4.5-3, 4.5-4, 4.5-5 and 4.5-6) would reduce the impacts of the No Action Alternative to less than significant levels.

Impacts

Plant Communities[4]

The principal impact of activities conducted under the No Action Alternative on vegetation at NPR-1 would be qualitatively similar to impacts resulting from past operations (see Section 3.5.2). Those impacts would be:

Habitat loss: Habitat loss, alteration and fragmentation, and associated reduction in biological diversity of plant communities would be expected to occur. The source of these impacts would be well pad construction and other ground disturbing activities that eliminate plant growth to create areas where they can no longer grow. Under the Government Development Case, the upper bound of additional "permanent" loss of habitat is projected to be 65 acres over the Reference Case for a total of 600 acres, while the lower bound is projected to be 233 acres less than the Reference Case, or 303 acres total loss. The upper bound of temporary habitat disturbance (which is in addition to the permanent loss) is projected to be 53 acres over the Reference Case, or 588 acres total, while the lower bound is projected to be 233 acres less than the Reference Case, or 303 acres total loss.

Plant community loss: Destruction of, or damage to, plant communities from exploration and production activities that disturb the ground would be expected to occur. The projected destruction would be the same number of acres as Habitat Loss.

Erosion: Accelerated soil erosion from exploration and production activities might be expected to occur. NPR-1 soils are often loose and prone to erosion. Soil erosion could occur if major precipitation events (generally rare) occurred during construction of facilities, especially if construction occurred on steep or unstable slopes. Under these circumstances, if construction activities exposed saline soils, erosion could transport this material and result in death or inhibit the growth of intolerant species.

Spills: Spills of oil, wastewater and other oil-field chemicals would be expected to occur as discussed in Section 4.10, Hazards Risk Assessment. Such spills could adversely affect local plant communities by causing destruction or injury within spill areas, removal of plants during spill clean-up, and uptake of contaminants by the plants.

[4] Note that the impacts evaluated in the sections entitled "Plant Communities" and "Animal Communities" do not include impacts to threatened and endangered species or to species of concern. Although impacts on threatened and endangered species and species of concern certainly affect the plant and animal communities as a whole, these impacts are discussed separately under the headings of "Threatened and Endangered Species" and "Species of Concern."

Fire: Human-caused range fire could possibly result from oil and gas exploration and production. Fires caused by accidental ignition from construction, operations and maintenance activities adversely impact plant communities by killing some shrubs and by changing plant community species composition and structure. A beneficial effect of range fires may be the encouragement of native grasses and forbs over otherwise more invasive and dominant exotic species.

Grazing: Livestock grazing affecting plant communities is expected to occur. Grazing is prohibited on NPR-1, but some trespass grazing occurs annually along the southwestern and northeastern flanks of Elk Hills. Adverse impacts of grazing include killing of plants, especially native forbs and grasses. Beneficial impacts of grazing may include reduction in density of exotic grasses and forbs, which may result in an increase in native grass and forb populations. The potentially beneficial impacts of grazing would not be expected over most of NPR-1 since livestock grazing is prohibited.

Species competition: Increased competition with other species caused by human activity is expected to occur. Imported non-native species and the destruction of fragile species by human activities allow the stronger species to crowd out native species.

As so little acreage would be disturbed even under the most intense government development, these impacts are expected to be less than significant. Mitigation measures listed in Tables 4.5-3 through 4.5-6 would reduce these impacts even further.

Animal Communities

The principle impacts of the No Action Alternative on NPR-1 animal communities are expected to be similar to those that have occurred in the past (see Sections 3.5.2 and 3.5.3) and to result primarily from exploration and production activities. Most impacts would result from the development of proposed wells and vehicular operations but would also include third-party pipeline projects and seismic surveys, maintenance of existing facilities, and other activities associated with normal daily operations. Those impacts would be:

Habitat loss: Habitat loss, alteration and fragmentation, and associated reduction in biological diversity of animal communities would be expected to occur. The construction of wells and their access roads permanently destroys habitat through the creation of compacted surfaces that the animal species can no longer use. The network of wells and access roads fragments the habitat and reduces the carrying capacity of the habitat (i.e., the ability of the land to support a given number of species). Significant seismic surveys would result in temporary disturbance of animal communities. This disturbance should be limited to the period of time the surveying activities are actually in progress. Animal habitat lost would be the same as the projected plant habitat loss discussed above.

Animal loss: Mortality, injury and displacement of animals would be expected to occur. Animals within well pad construction areas could be killed during construction, either trapped in collapsed burrows and dens, or crushed by equipment. Animals disturbed might disperse to other areas; dispersing individuals tend to have a lower survivorship (Emlen 1984; Ralls et al. 1986). Road kills and injuries are also expected, especially in construction areas. Animals may also be trapped and killed in well cellars and other oil field facilities.

Shelter loss: Loss or destruction of animal dens and burrows would be expected to occur. These impacts would be caused by well pad construction and other ground-disturbing activities.

Erosion: Erosion resulting from construction activities could destroy or alter habitat, or decrease the productivity of forage plants.

Spills: Operations and maintenance activities could impact animal communities when animals become trapped or injured by spilled oil. Additionally, animals could ingest oil-field chemicals directly or indirectly (through their prey), potentially causing or contributing to death, disease or diminished ability to avoid predation.

Fire: Accidental fires could affect animal communities if animals are harassed, burned or killed, or if fires reduce forage. Animals that are more dependent on saltbush would be particularly impacted. Periodic range fires may also have beneficial impacts.

Grazing: Impacts due to grazing are also not well understood, but could include direct mortality or injury resulting from collapsed burrows, loss of forage, and alteration of habitat.

Species competition: Human activity can result in the introduction of new species to an area, which compete with the existing species for food and shelter.

Noise: Displacement resulting from exploration and production related noises would be expected to occur. Noise from routine operations and well drilling, and ground vibrations from seismic explorations, could displace animals with sensitive auditory systems. Dispersing individuals tend to have lower survivorship.

Pest control: Impacts on non-target species of pest management programs would be expected to occur. DOE is a participant with BLM in evaluating the impacts of a State of California, Department of Food and Agriculture (CDFA) pest management program to control the beet leafhopper, which occurs on lands administered by these agencies. Pest control programs have the potential to reduce the survivability of non-target species.

These impacts, however, are expected to be less than significant. Mitigation measures listed in Tables 4.5-3 through 4.5-6 would reduce impacts (already less than significant) even further.

Threatened and Endangered Species

The principle impacts of the No Action Alternative on NPR-1 threatened and endangered (T&E) species are expected to be similar to those that have occurred in the past (see Sections 3.5.2 and 3.5.3) and similar to the impacts to plant and animal communities. Those impacts, resulting primarily from exploration and production activities would be:

Habitat loss: Significant habitat loss, alteration and fragmentation, and associated reduction in biological diversity affecting T&E species would be expected to occur. The sources of these impacts are similar to those for general plant and animal communities and the affected acreage would be the same.

Plant loss: Damage or destruction of T&E plants would be expected to occur. The sources of these impacts are similar to those for general plant and animal communities and the affected acreage might be the same. However, the actual size of the threatened or endangered plant community destroyed would depend on the activity location because those species do not occur uniformly throughout NPR-1

lands. The following significant impacts to one federally endangered plant and one federally threatened plant (Kern mallow[5] and Hoover's woolly-star, respectively) would be expected:

- Impacts on Hoover's woolly-star and Kern mallow due to seed reserve reductions during land clearing activities conducted after germination and before the seeds have set.
- Impacts on Hoover's woolly-star and Kern mallow due to seed removal during land clearing.

No impacts on the federally endangered San Joaquin woolly-threads or California jewelflower would be expected.

Animal loss: Mortality, injury and displacement of T&E animals would be expected to occur. The sources of these impacts are similar to those for general plant and animal communities. Significant impacts to four threatened and endangered animal species (San Joaquin kit fox, giant kangaroo rat, blunt-nosed leopard lizard, and San Joaquin antelope squirrel) would be expected

No significant impacts are expected to the Tipton kangaroo rat because it is restricted to an undeveloped section (Section 23S) of NPR-1, and future development of this section is unlikely. No impacts to the Swainson's hawk, western snowy plover, longhorn fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, or valley elderberry longhorn beetle are expected, as explained in Appendix G.

Animal shelter loss: Significant loss or destruction of animal dens and burrows would be expected . This impact could result from well pad construction and other ground-disturbing activities.

Spills: The sources of these impacts are similar to those for general plant and animal communities, and would be expected to be significant for threatened and endangered species.

Grazing: The sources of these impacts are similar to those for general plant and animal communities.

Noise: Construction noise may significantly impact giant kangaroo rats by affecting their behavior or damaging their sensitive auditory systems and perhaps displacing them from their burros, which would reduce survivability. During surveys conducted on NPR-1, most giant kangaroo rat burrows (73 percent) occurred within 100 meters of a disturbance (operating well, road, etc.), but impacts from well drilling or seismic explorations are not well known.

Pest control: The sources of these impacts are similar to those for general plant and animal communities but would be expected to be significant for threatened and endangered species. Impacts of this program are addressed in separate consultations with FWS and require mitigation measures in addition to ones presently implemented for routine operations at NPR-1.

The indicated impacts to T&E species under the No Action Alternative are considered to be significant because additional habitat loss under the upper bound of government development would exceed the permitted limits of the 1995 BO. Mitigation measures (see Tables 4.5-3 through 4.5-6), particularly BOEM-2 and 3, which provide for additional habitat loss compensation, would reduce the impacts to less than significant levels.

[5] As indicated in Section 3, no Kern mallows have been found on NPR-1 but suitable habitat does exist there.

Species of Concern

Several species or habitats of concern are known to exist on NPR (see Section 3.5.3.2). Impacts to those species would have sources similar to those for general plant and animal communities, and similar habitat loss. Without mitigation, significant impacts under the No Action Alternative would be expected on 11 plant, four mammal and one bird species of concern. Less than significant impacts are also expected for four other bird and two reptile species of concern. Depending on the location of the disturbance, the anticipated additional habitat loss could impact these species in varying degrees. Mitigations listed in Tables 4.5-3 through 4.5-6 would reduce impacts to less than significant for the No Action Alternative.

The No Action Alternative may impact the following 11 plant species of concern: Kern tarplant, oil neststraw, Lost Hills saltbush, heartscale, crownscale, San Joaquin bluecurls, Temblor buckwheat, hollisteria, cottony buckwheat, recurved larkspur and gypsum-loving larkspur. The No Action Alternative would be expected to impact four mammal species of concern□the short-nosed kangaroo rat, southern grasshopper mouse, San Joaquin pocket mouse, and American badger□and one bird species, the western burrowing owl.

Total Impacts

Total impacts from past and future government development would be significant but have been and would continue to be mitigated to less than significant levels. Total permanent loss of habitat from past and projected future government development is estimated to be 7,187 to 7,484 for the upper and lower bound, respectively. Additional total impacts would include, as discussed above, (1) mortality and injury, (2) destruction of dens and burrows, (3) spills, (4) noise, and (6) pest management programs. These would be mitigated to less than significant levels by ongoing mitigation measures at NPR-1 plus additional contributions to the conservation areas for any habitat disturbance over the limits set in the 1995 BO.

Mitigation Measures

Mitigation measures are designed and implemented to avoid, minimize or compensate for adverse impacts. The mitigation measures for the No Action Alternative fall into four categories: (1) mandatory mitigation measures contained in the 1995 BO; (2) mitigation measures that can be extrapolated from the BO likely to be required if development occurred that was not evaluated in the BO; (3) BO conservation recommendations that are not mandatory; and (4) additional biological resource mitigation measures, some of which currently have been implemented at NPR-1 and are intended to address more than just threatened and endangered species, such as state listed species and species of concern. These categories are discussed more fully below.

Each mitigation measure has been assigned a number to avoid lengthy repetition throughout this section. All biological resource measures are compiled in Tables 4.5-3, 4.5-4, 4.5-5, 4.5-6 and 4.5-8. The tables also indicate the impacts the measure is intended to mitigate and the current implementation status.

Mitigation measures identified in the 1995 Biological Opinion (BO Mitigations - BOMs). Table 4.5-3 summarizes the mitigation requirements of the 1995 BO, which were specifically designed to address impacts to threatened and endangered species from continuing activities at NPR-1. These mitigation measures must be implemented to minimize impacts on listed species and to maintain the

validity of the 1995 BO's conclusions and incidental take authorization. The incidental taking authorized are:

- San Joaquin kit foxes: 90 or 3/year for 30 years
- Blunt-nosed leopard lizards: 210 or 7/year for 30 years
- Giant kangaroo rats: 900 or 30/year for 30 years
- Tipton kangaroo rats: 30 or 1/year for 30 years

If these levels are exceeded, the causative action(s) must cease and DOE must reinitiate consultation with FWS. Biological Opinion Mitigation (BOM-1) includes all of the terms and conditions of the 1995 BO. For ease of reference, it is followed by 27 specific measures required by the BO. Many of the specific measures would serve to mitigate impacts on other species of concern and on general plant and animal communities, including BOM-1.1, BOM-1.11, BOM-1.12, BOM-1.13, BOM-1.14, BOM-1.15, BOM-1.16, BOM-1.17, BOM-1.18, BOM-1.19, and BOM-1.24.

Table 4.5-3
Mitigation Measures Required by the Biological Opinion

Key to Table Abbreviations
PC -- Plant Community
AC -- Animal Community
T&E -- Threatened and Endangered
SC -- Species of Concern
TI -- Total Impact

Key to Status Comments:
Ongoing - Ongoing program currently being fully implemented by DOE on NPR-1
Deferred - Implementation is deferred until the completion of the sales process at which time either DOE or the new owner would be required to implement
Partially Implemented - Some of the mitigation is currently implemented, some is being deferred.
Not Applicable - Not applicable at this time either because of the sale or because the necessary prerequisite has not triggered the mitigation requirement.

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOM-1.	Implement all mitigation commitments and terms and conditions as specified in 1995 BO. Collectively referred to as BOM-1, the specific measures are listed below.	N/A	See below
BOM-1.1.	Establish a 7,075 acre conservation area and habitat management program by Nov., 1998.	PC-Habitat Loss, AC-Habitat Loss, T&E- Habitat Loss, SC, TI	Deferred
BOM-1.2.	Continue to implement provisions of the NPR-1 Wildlife Management Plan. (Currently entitled "Conservation Plan for Protected Species on NPR-1")	T&E Impacts	Ongoing
BOM-1.3.	Continue to implement the NPR-1 Endangered Species Research and Monitoring Program.	T&E Impacts	Ongoing[6]
BOM-1.4.	Perform habitat reclamation of disturbances when no longer needed for operations.	PC-Habitat Loss, AC-Habitat Loss, T&E- Habitat Loss, SC, TI	Ongoing, 44.5 acres reclaimed to date

[6] Current research is being concluded and published. Additional research may be addressed as part of management plan for the conservation area.

Table 4.5-3
Mitigation Measures Required by the Biological Opinion (continued)

Key to Table Abbreviations
PC -- Plant Community
AC -- Animal Community
T&E -- Threatened and Endangered
SC -- Species of Concern
TI -- Total Impact

Key to Status Comments:
Ongoing - Ongoing program currently being fully implemented by DOE on NPR-1
Deferred - Implementation is deferred until the completion of the sales process at which time either DOE or the new owner would be required to implement
Partially Implemented - Some of the mitigation is currently implemented, some is being deferred.
Not Applicable - Not applicable at this time either because of the sale or because the necessary prerequisite has not triggered the mitigation requirement.

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOM-1.5.	Complete a comprehensive floristic survey of NPR-1.	T&E Plant Loss	Partially implemented[7]
BOM-1.6.	Initiate separate consultations for project-specific impacts to listed plants, except for impacts to Hoover's woolly-star.	T&E Plant Loss	Not applicable. No impacts to date
BOM-1.7.	Minimize adverse effects to Hoover's woolly-star by conducting preactivity surveys, relocating projects when reasonable, avoiding disturbing Hoover's woolly-star habitat after any plants have set seed, if possible, and re-using topsoil.	T&E Plant Loss	Ongoing
BOM-1.8.	Include Hoover's woolly-star in the habitat conservation area.	T&E Plant Loss	Deferred
BOM-1.9.	Use locally obtained native seed for revegetation efforts to the extent that they are commercially available at competitive prices.	T&E Plant Loss	Ongoing
BOM-1.10.	Ensure that oil neststraw habitat in sections 10R, 12R, and 17S is not developed.	T&E Plant Loss	Ongoing
BOM-1.11.	Continue to implement pre-activity surveys prior to all surface disturbing activities on NPR-1.	T&E Plant Loss, T&E Animal Loss, T&E Shelter Loss	Ongoing
BOM-1.12.	Use biological monitors during all critical construction activities occurring within or adjacent to sensitive endangered species habitat.	T&E Plant Loss, T&E Animal Loss, T&E Shelter Loss	Ongoing
BOM-1.13.	Minimize, to the maximum extent practicable, the areas disturbed by construction related activities and routine day-to-day operations.	PC-Habitat Loss, AC-Habitat Loss, T&E- Habitat Loss, SC, TI	Ongoing
BOM-1.14.	Confine all NPRC and contractor vehicles to existing roads or to project areas that have undergone a preactivity survey.	PC-Habitat Loss, AC-Habitat Loss, T&E- Habitat Loss, SC, TI	Ongoing
BOM-1.15.	Clean-up all spills of oil or liquids contaminated by oil and hazardous materials in a manner consistent with the NPR-1 Spill Prevention, Control and Countermeasure Plan.		Ongoing

[7] The survey is expected to be 35% complete at the time of possible sale.

Table 4.5-3
Mitigation Measures Required by the Biological Opinion (continued)

Key to Table Abbreviations
PC -- Plant Community
AC -- Animal Community
T&E -- Threatened and Endangered
SC -- Species of Concern
TI -- Total Impact

Key to Status Comments:
Ongoing - Ongoing program currently being fully implemented by DOE on NPR-1
Deferred - Implementation is deferred until the completion of the sales process at which time either DOE or the new owner would be required to implement
Partially Implemented - Some of the mitigation is currently implemented, some is being deferred.
Not Applicable - Not applicable at this time either because of the sale or because the necessary prerequisite has not triggered the mitigation requirement.

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOM-1.16.	Enforce all speed limits, which shall not exceed 25 mph in construction areas.	T&E Animal Loss, SC, TI	Ongoing
BOM-1.17.	Implement a litter control program.	T&E Animal Loss, SC, TI	Ongoing
BOM-1.18.	Minimize construction activities between dusk and dawn.	T&E Animal Loss, SC, TI	Ongoing
BOM-1.19.	Use qualified personnel to implement the Endangered Species Program.	T&E Impacts, TI	Ongoing
BOM-1.20.	Avoid damage or destruction to San Joaquin kit fox dens, giant and Tipton kangaroo rat burrows, and burrows potentially utilized by blunt-nosed leopard lizards to the greatest extent practicable.	T&E Shelter Loss, TI	Ongoing
BOM-1.21.	Known San Joaquin kit fox dens shall not be damaged or destroyed. Potential dens may be excavated without prior notification, provided the den is not a known kit fox den. Alternately, excavation of potential kit fox dens need not be conducted prior to construction activities, provided that no evidence of kit fox use of such dens is observed after three consecutive nights of monitoring immediately prior to the initiation of construction.	T&E Shelter Loss, TI	Ongoing
BOM-1.22.	San Joaquin kit foxes, blunt-nosed leopard lizards, and giant and Tipton kangaroo rats may be captured and relocated from construction sites, if the burrows of these animals cannot reasonably be avoided during construction with the approval of the FWS Field Office provided certain other conditions are met.	T&E Animal Loss, TI	Ongoing
BOM-1.23.	At the end of each day during all major projects, all open pipeline trench segments and other steep-walled holes or trenches greater than two feet deep shall either be covered or equipped with escape ramps no further than one-quarter mile apart. Trapped wildlife shall be removed by qualified personnel.	T&E Animal Loss, TI	Ongoing

Table 4.5-3
Mitigation Measures Required by the Biological Opinion (continued)

Key to Table Abbreviations
PC -- Plant Community
AC -- Animal Community
T&E -- Threatened and Endangered
SC -- Species of Concern
TI -- Total Impact

Key to Status Comments:
Ongoing - Ongoing program currently being fully implemented by DOE on NPR-1
Deferred - Implementation is deferred until the completion of the sales process at which time either DOE or the new owner would be required to implement
Partially Implemented - Some of the mitigation is currently implemented, some is being deferred.
Not Applicable - Not applicable at this time either because of the sale or because the necessary prerequisite has not triggered the mitigation requirement.

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOM-1.24.	Prior to the sale of NPR-1, the Department shall initiate and complete a subsequent Section 7 consultation as to this Federal action.	All Impacts	Not applicable; superseded by P.L. 104-106
BOM-1.25.	Submit an annual report within 90 calendar days following the end of each fiscal year to FWS' Sacramento Field Office.	All Impacts	Ongoing
BOM-1.26.	Accompany FWS personnel on tours of construction sites or other locations, to review project impacts to endangered species and their habitats.	All Impacts	Ongoing
BOM-1.27	Apply BO terms and conditions to third party activities on site	All Impacts	Ongoing
BOM-1.28	Notify FWS within three days or death or injury of listed species	T&E Animal Loss, TI	Ongoing

BO Extrapolated Mitigation Measures (BOEMs). In addition to the above BO mitigation measures, the following mitigation measures (Table 4.5-4) are likely to be applied in the event of reconsultation. Reconsultation may be necessary if DOE undertakes more aggressive development than is currently occurring, or if projects at NPR would permanently disturb more than the 828 additional acres authorized under the BO. To date, approximately 417 of these 828 acres have already been disturbed. If future development falls close to the lower bound of the Government Development Case, which estimates future permanent disturbance of only 303 acres, then no reconsultation would be required (estimated total past permanent disturbance of 417 acres plus 303 acres projected for the future for a total of 720 acres, which is less than the BO limit). If, on the other hand, future government development results in the upper bound of estimated disturbances, i.e., a total of 600 acres projected future disturbances plus the existing 417 acres (1,017 acres total) this would exceed the 828 acres designated in the BO by 189 acres, and, therefore, would acquire reconsultation and likely additional mitigation. This is illustrated graphically by Figure 4.5-1.

Temporary disturbances are also associated with this development case. To estimate environmental impacts conservatively, this SEIS/PEIR has assumed a 1:1 temporary to permanent disturbance ratio for well pad development. However, the BO estimated only 50 acres of temporary disturbance for the 828 acres of permanent disturbance (six percent). Applying this latter ratio to the 189 acres of additional permanent disturbance under the upper bound of government development estimate results in an additional 12 acres of temporary disturbance requiring mitigation.

Table 4.5-4
Biological Opinion Extrapolated Mitigation (BOEM) Measures

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOEM-2	FWS Guidelines for conservation set-asides require 3:1 compensation for permanent habitat loss. The additional 189 acres of disturbance under the government development upper bound would require an additional contribution to the conservation area of 567 acres over the 7,075 acres.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI	N/A
BOEM-3	FWS Guidelines for conservation set-asides require a 1:1 compensation for temporary loss, requiring an additional contribution to the conservation area of 12 acres in addition to the above requirements.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI	N/A

Biological Opinion Conservation Recommendations (BOCRs). In addition to those measures listed above, the BO recommends five additional conservation measures (Table 4.5-5) as discretionary agency (DOE) activities to minimize or avoid adverse affects of agency actions on listed species or critical habitat, to help implement recovery plans, or to develop information. These, if implemented, would further reduce the current/future impacts to biological resources under the No Action Alternative.

Biological Resources Mitigation measures (BRMs). Table 4.5-6 presents mitigation measures in addition to those designed specifically to reduce impacts to listed species, species of concern, and other protected species. These additional measures address impacts to biological resources that were not evaluated in DOE's previous consultations with FWS. These measures include some best management practices at NPR-1 that also serve to mitigate impacts to biological resources. The implemented measures would help reduce impacts to biological resources to less than significant levels.

4.5.3.2. Proposed Action for NPR-1

Under the Proposed Action biological resources would be significantly impacted. In addition to the significant impacts of the No Action Alternative (habitat loss, threatened and endangered species loss, etc.) commercial development poses other risks: (1) the loss of affirmative federal obligations to protect, conserve and help recover threatened and endangered species and their habitats, the most significant of which is the greater likelihood that if retained by the Federal Government, NPR-1 would be converted to a habitat conservation area at the end of oil and gas development; (2) the potential lack of funds for protection and management of the 1995 BO-required conservation area (particularly under Sales Scenario 3, the split sale scenario); and (3) reduced potential for recovery of listed species and increased potential for listing additional species. These significant impacts would be associated with differences in conservation and habitat management requirements for threatened and endangered species between publicly-owned and privately-owned land described below. Other impacts would be similar to those described under the No Action Alternative, but would be more extensive or numerous due to the increase in development activities. Nonetheless, despite the transfer from public ownership to private ownership, the mitigation measures or incentives discussed below that could be imposed under the extensive Federal and state regulation of threatened and endangered species would mitigate these impacts to less than significant levels.

Figure 4.5-1
Comparison of Acreage Loss

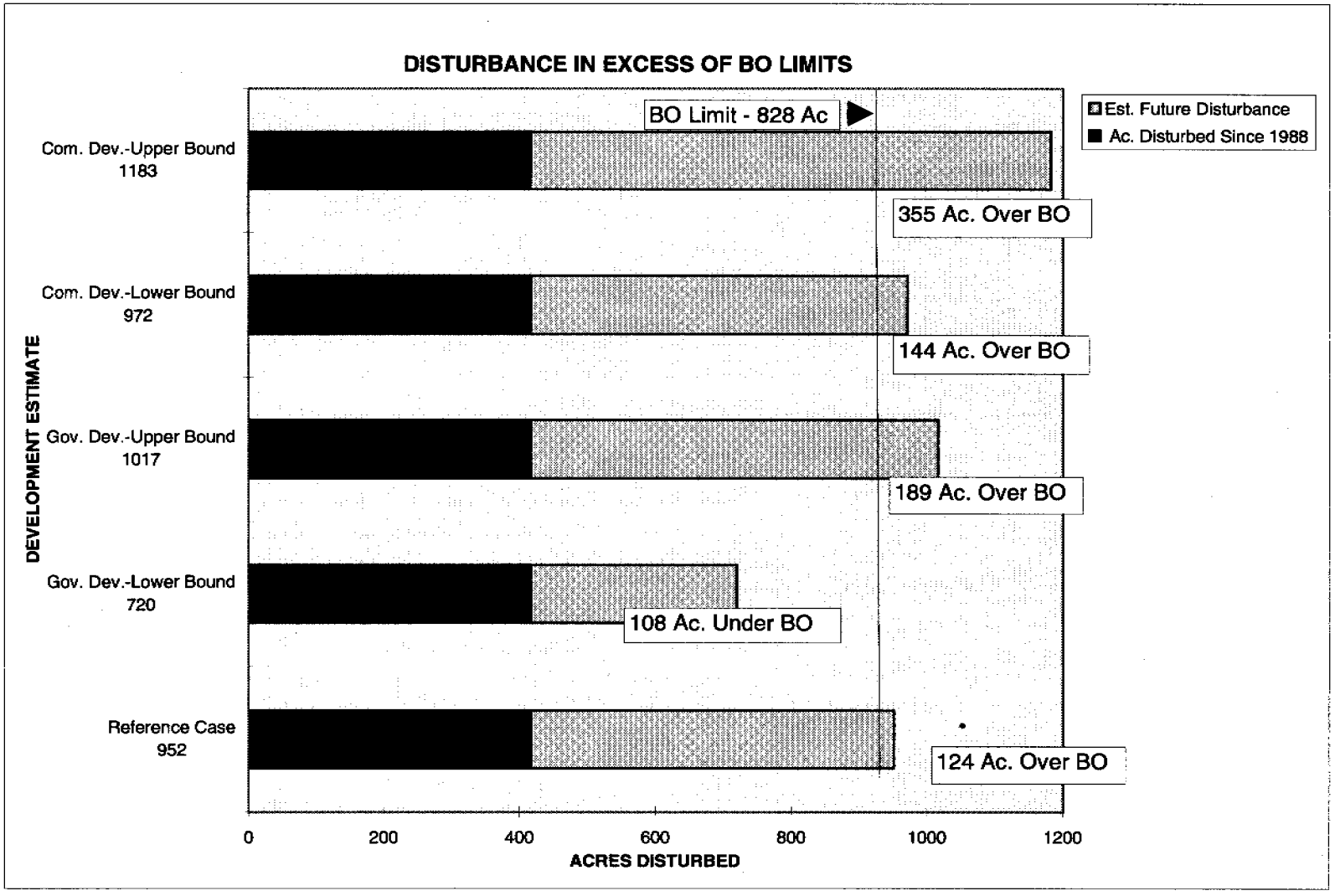

Table 4.5-7
Comparison of NPR-1 Endangered Species Program Versus Section 10 Mitigation, and Conservation Responsibilities

Activity	NPR-1 §7	Private §10	Discussion of Differences	Impact Resulting From Privatization
Habitat Compensation	Yes, 7,075 acres	Yes	Habitat compensation is a key element used to mitigate project impacts. Section 10 requires a private owner to prepare a Habitat Conservation Plan (HCP) to establish and maintain compensation for lost or damaged habitat.	No significant impact. Compensation for lost or damaged habitat would be a requirement of both Sec 7 and Sec 10 processes.
Take Avoidance Measures	Yes	Yes	Take avoidance measures such as preactivity surveys, exclusion zones, biological monitors, restrictions on vehicle speed, off-road travel, timing of activities, etc. benefit species conservation via protecting individuals from project-related take. These measures are key elements of Federal Sec 7 consultations and Sec 10 permits.	Potentially significant impact. Similar requirements would be in place through both the Sec 7 consultation and Sec 10 permit process, however, the scope of DOE take avoidance measures is more comprehensive and offers greater protection.
Habitat Revegetation	Yes	Optional	Habitat reclamation at NPR-1 is performed as a part of DOE's compensation for habitat disturbance. It is not performed for species conservation or recovery purposes, although the results of revegetation may have some benefit. Revegetation that would benefit species conservation and recovery would need to be done beyond the extent required to mitigate project impacts.	Less than significant impact from termination of DOE revegetation program.

Impacts from Scenarios 1 and 2 (Complete Sale to One or More Commercial Entities)

Plant Communities

Additional "permanent" plant habitat loss under commercial development is projected to be from 20 to 231 acres over the Reference Case for a total of 555 and 766 acres for the lower and upper bound, respectively. The upper bound of temporary habitat disturbance (which is in addition to the permanent loss) is projected to be 219 acres over the Reference Case, or 754 acres total, while the lower bound is projected to be eight acres more than the Reference Case, or 543 acres total. This slight increase in development would result in less than significant impacts. Mitigations listed in Tables 4.5-3 through 4.5-6 would reduce some impacts (already less than significant) even further.

Animal Communities

Impacts would be similar to the No Action Alternative, except that habitat loss would be increased as indicated in the discussion of Plant Communities to between eight and 231 acres over the Reference Case, and would still be less than significant. Mitigations listed in Table 4.5-3 through 4.5-6 would reduce some impacts (already less than significant) even further.

Threatened and Endangered Species

Significant impacts to threatened and endangered species on NPR-1 under the Proposed Action's Commercial Development Case, Sales Scenarios 1 and 2, would be similar to government development, except that greater habitat loss would be expected to occur as indicated under Plant Communities. Possibly more significant would be the following three additional impacts:

Federal Protections Loss: Loss of affirmative federal obligations to protect, conserve and help recover T&E species and their habitats is considered a significant impact. The affirmative obligations of federal agencies to use their authorities to protect and conserve endangered and threatened species, and to ensure that their actions do not jeopardize the continued existence of listed species, would no longer exist. Given the well recognized importance of NPR-1 lands for supporting numerous endangered, threatened and other species of concern, the large contiguous nature of this habitat area, and the long-term protection afforded this publicly-owned land for the protection and conservation of natural resources, simple adoption of take-avoidance measures typically required to minimize taking on private lands would result in a substantial reduction in prospective opportunities to achieve recovery goals of the Federal ESA, goals that federal agencies are obligated to support. Table 4.5-7 provides a comparison of how the present NPR-1 Endangered Species Program elements under Section 7 would compare with a private party's mitigation, compensation and conservation responsibilities pursuant to Section 10 of the ESA. The most significant differences might occur at the end of the field's productive life (50+ years). It is more likely that the government would decide to convert the field to a species conservation area (assuming species recovery plans were not yet successful in delisting NPR-1 T&E species) than a private owner. DOE has already made this recommendation for NPR-2.

Program Funding Loss: Loss of funding to cover costs of protection and management of the conservation area would be significant. The sale of the Government's interest in NPR-1 could result in unfunded protection and management of the endangered species conservation area that DOE committed to establish as compensation for past and proposed disturbances at the site. Mechanisms such as endowments typically require approximately $500 funding per acre for land protection and habitat management in perpetuity. Additionally, DOE has committed to conduct endangered species monitoring and other activities to benefit the management and recovery of listed species. These activities would likely be outside the scope of activities usually included in management endowments.

Table 4.5-6

Biological Resources Mitigation Measures

Key to Table Abbreviations
PC -- Plant Communities
AC -- Animal Communities
T&E -- Threatened and Endangered Species
SC -- Species of Concern
TI -- Total Impacts

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BRM 9.	Continue administrative and operating guidelines currently implemented at NPR-1, but not specifically discussed in the BO. These include: prohibitions on public access by maintaining a perimeter fence and continuing routine patrols; prohibitions on hunting and the general use of firearms on NPR-1; continue prohibitions on grazing unless future research indicates that controlled grazing is beneficial; and continue to prohibit domestic pets on site.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI	Ongoing
BRM 10.	Restrict pest management programs to areas in and immediately surrounding occupied facilities to the extent practical. Only those pesticides, herbicides and rodenticides approved for use within the range of the NPR-1 listed species are to be used.	AC-Pest Control, T&E-Pest Control, SC-Pest Control, TI	Ongoing to the extent practical
BRM 11.	Formalize the preactivity survey program and take avoidance measures to include the San Joaquin antelope squirrel.	SC	Current measure already provide some protection
BRM 12.	Expand the NPR-1 preactivity survey program to include western burrowing owl, the American badger, the LeConte's thrasher, and the northern loggerhead shrike. Activities impacting nests/dens to be relocated where practical.	SC	Not implemented
BRM 13.	Avoid populations of oil neststraw to the extent practical, and an adequate area surrounding each population (100 meters), during all future activities at NPR-1.	T&E-Plant loss	Ongoing
BRM 14.	The NPR-1 Preactivity Survey program would be modified so that exclusion zone distances are consistent with resource agency standards.	T&E-Plant loss, T&E Animal loss, TI	Any additional changes require FWS approval and may require reconsultation
BRM 15.	Research impacts to the plant and animal community resulting from project-related fires and adjusting the site's fire suppression and habitat management program accordingly.	PC-Fire, AC-Fire, T&E-Fire, SC, TI	Not implemented

Table 4.5-5
Biological Opinion Conservation Recommendations

Key to Table Abbreviations

PC -- Plant Community
AC -- Animal Community
T&E -- Threatened and Endangered
SC -- Species of Concern
TI -- Total Impact

Mitigation #	Description of the Mitigation	Impact Mitigated	Status
BOCR 4.	Consider placing NPR-1 lands outside of the primary production and mandated conservation areas into conservation status. Oil and gas withdrawal activities could continue on these lands, but the current habitat quality should be maintained.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI	Not implemented
BOCR 5.	DOE should continue monitoring of kit fox and lagomorph population trends and rainfall patterns on lands formerly contained in NPR-1 and NPR-2 to study factors affecting kit fox population size and distribution as well as to contribute to information needed to implement recovery strategies.	T&E Animal Loss	Partially implemented for small survey area
BOCR 6.	DOE should increase monitoring population trends and other demographic factors for blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Kern mallow, Hoover's woolly-star, San Joaquin woolly-threads, San Joaquin antelope squirrel, and some selected species of concern occurring on NPR-1.	T&E Animal Loss	Not implemented
BOCR 7.	DOE should contribute $100,000 per year to fund research projects and species and habitat management activities in addition to other funds required to implement other mitigation measures or other conservation recommendations.	All Impacts	Not implemented
BOCR 8.	Consider selling only the mineral rights to NPR-1, rather than all rights, title and interest.	All Impacts	Considered as part of this SEIS/PEIR. See 2.2.4.2.4

Table 4.5-7
Comparison of NPR-1 Endangered Species Program Versus Section 10 Mitigation, and Conservation Responsibilities (continued)

Activity	NPR-1 §7	Private §10	Discussion of Differences	Impact Resulting From Privatization
Population Monitoring	Yes	No	Population monitoring programs can provide information useful for conservation and species recovery. Many aspects of the programs at NPR-1 have been designed and conducted long enough that they contribute significantly to the information upon which conservation and recovery programs are based. Monitoring programs either are not included in Section 10 HCP's, or provide only minimal information useful to conservation and recovery efforts.	Less than significant impact since DOE's support of long-term population monitoring is being reduced. Loss of information obtained from well-designed monitoring efforts may adversely affect conservation planning, recovery monitoring, and habitat management research, but this would occur under the No Action Alternative.
Habitat Management	Yes	Partial	Habitat management broadly encompasses all activities carried out for the purpose of maintaining or enhancing conditions that are favorable to, or essential for, the long-term maintenance of biological diversity with an emphasis on benefiting threatened and endangered species.	Potentially significant impact. Habitat management activities, or funds to support them, are a typical component of impact mitigation and compensation requirements resulting from Sec 7 consultations and Section 10 permits. In the context of Sec 10(a) HCPs, habitat management activities are usually limited to the habitat compensation area and include minimal requirements, such as fencing, signage, etc. Federal agencies, however, have habitat management responsibilities over all lands they administer (not just compensation lands).

Table 4.5-7
Comparison of NPR-1 Endangered Species Program Versus Section 10 Mitigation, and Conservation Responsibilities (continued)

Activity	NPR-1 §7	Private §10	Discussion of Differences	Impact Resulting From Privatization
Protection of Listed Plants	Yes	No	Prohibitions against taking federally-listed plant species are much reduced in scope compared with animals, and the prohibitions are applicable only on Federal lands.	Protection of listed plants would be substantially reduced though both the loss of affirmative federal obligations to conserve, protect, and recover listed species and their habitat, and due to the loss of protection against taking on private land.
Field Research	Yes	No	Field research at NPR-1 was initiated to evaluate impacts to listed species and their habitat, or to test the effectiveness of various mitigation measures. Many of these field studies have had conservation benefit. Field studies are not required of HCPs and are typically not included or are of limited scope.	Less than significant impact. Under Section 10 field research typically would not be conducted, although some limited information may be collected ancillary to implementation of take avoidance measures. However, NPR-1 field research is being reduced.
Scientific Publication	Yes	No	Publication and presentation of information gathered at NPR-1 has provided substantial benefit to conservation and recovery efforts. These activities are not undertaken in Sec 10 HCPs.	Less than significant since much of NPR-1 research program is being reduced in scope.
Educational Outreach	Yes	No	Educational and technical outreach can have significant benefits to listed species conservation and recovery.	Less than significant impact.
Conservation and Recovery Program Participation	Yes	Optional	Participation in regional conservation and species recovery programs by NPR-1 personnel and contractors represents an important contribution by DOE. This type of participation would not be required through the Sec 10 permit process.	Possible impact if private owner chooses not to participate in regional cooperative conservation programs (see later discussion of Kern County Valley Floor HCP).

Reduced potential for recovery: Reduced potential for recovery of listed species and increased potential for listing additional species could occur if the current Endangered Species Protection Program were eventually reduced largely to take avoidance measures. It could also occur through the eventual loss of the mitigation measures and commitments DOE has made during past consultations with the FWS. The loss of DOE commitments to conduct endangered species monitoring and other activities as part of its management of NPR-1, which benefit the management and recovery of listed species in the region, may also significantly impact recovery efforts in the region.

As discussed below, mitigations listed in Tables 4.5-3 through 4.5-6 and 4.5-8 if imposed on a private owner by the relevant Federal and state regulatory agencies would reduce these impacts to less than significant levels.

Species of Concern

Impacts to species of concern at NPR-1 under the Proposed Action's Commercial Development Case, Sales Scenarios 1 and 2, would be similar to the No Action Alternative and would be significant. The most significant impact on species of concern would be the loss of affirmative obligations of Federal agencies to use their authorities to protect and conserve threatened and endangered species, which secondarily protect a number of other species of concern. Similarly, these impacts would be mitigated to less than significant levels.

Total Impacts

Total impacts of past government and future private development activities to plant communities, primarily the permanent loss of 7,439 to 7,560 acres post development (lower and upper bound, respectively), would be significant but have been and would continue to be mitigated to less than significant levels.

Sales Scenarios 1 and 2 Mitigation Measures

Under the Proposed Action's Commercial Development Case, Sales Scenarios 1 and 2, mitigation measures would be the same as those described in the No Action Alternative with additional measures to address the significant impacts associated with expanded development and the loss of federal trusteeship for natural resources, particularly impacts on endangered and threatened species. The No Action Alternative discussion included a number of measures currently being implemented to reduce the impacts of government development on NPR-1 biological resources to less than significant levels or even lower. These mitigation measures could be implemented by the new owner(s) as well to reduce many of the impacts of commercial development to less than significant levels. However, the differing objectives of a Federal agency and a private owner seeking to maximize the return on the substantial investment to acquire NPR-1 provide different incentives to implement the mitigation measures. The issue then becomes how to assure that the mitigating measures necessary to reduce the impacts to less than significant are addressed, consistent with the objective of Public Law 104-106 of maximizing the value of NPR-1 to the Federal government.[8]

Under NEPA, it is sufficient to identify the mitigation measures, and a decision can be made by owners not to implement them. Furthermore, as DOE's control over the property would end under the

[8] CEQA declares it to be state policy not to approve projects if mitigation measures are available to lessen the significant impacts of a project, unless conditions make the adoption of those mitigation measure infeasible. California Public Resources Code, Division 13, Chapter 1, § 21002.

proposed action, it would have only limited means to impose any mitigation measures on the new owner because of the need to maximize the value of NPR-1. Any such terms and conditions might prove difficult to enforce and would involve DOE in the continued oversight of NPR-1, contrary to the Congressional direction to DOE to sell "All rights, title, and interest" in NPR-1. CEQA, on the other hand, requires assurances of the implementation of the feasible mitigation measures before any state or local agency can approve a project. Thus mitigation implementation would need to transition from DOE to the new owner with oversight by the Federal and state regulatory agencies to assure that impacts to biological resources are reduced to less than significant levels. This would be a multi-step process that begins with the mitigation measures contained in the 1995 BO (BOM-1, Table 4.4-3).

Most of the mitigation measures that reduce the impacts of government development under the No Action Alternative come from the 1995 BO as a result of DOE's Section 7 consultation with FWS. Ordinarily, Section 7 consultation is only required for Federal agencies, and consequently, ordinarily a FWS BO and its terms and conditions and incidental take authority would not be transferable to a private owner. However, Public Law 104-106 authorized the transfer of the 1995 BO along with its terms and conditions and incidental take statement to any new owner, which is without precedent. This was done because some process was needed to address the requirements of the Federal ESA, given the threatened and endangered species on NPR-1, and the restrictive time frame for the potential sale of NPR-1; i.e., the new owner(s) of NPR-1 would not have time to apply for and obtain an incidental take permit under Section 10 of the ESA before taking over operation of the field by February 10, 1998, as required by P.L. 104-106.

NPR-1 has been issued thousands of permits that were required as a condition of development and operation under a variety of Federal, state and local laws. Most can be transferred from owner to owner. NPR-1 has a plan for transferring these permits as part of the turnover process, if the sale proceeds. Since DOE does not have a Section 10 permit, there is no permit to transfer. Due to the number of threatened and endangered species on the site, requiring any new owner to secure a Section 10(a) permit could delay the sale for months. Therefore, Public Law 104-106 authorized the transfer of the Section 7 permit (i.e., the 1995 BO) ". . . if the Secretary determines that transfer of the permit is necessary to *expedite* the sale of the reserve in a manner that maximizes the value of the sale to the United States . . . ." subject to the same terms and conditions[9] that apply at the time of the transfer (§ 3413(d) emphasis added).

Thus the first step in the mitigation process would be to transfer the 1995 BO to the new owner(s) subject to its terms and conditions. These terms and conditions include not just those under the heading on page 22 of the document (Appendix F), but all of the terms and conditions included throughout the BO. These are listed in Table 4.5-3 and explained in the 1995 BO. A new owner would be required to comply with all of these terms and conditions or would be in violation of the ESA if a taking of a listed species occurred after the transfer. Thus, for the short term, most of the impacts of private operation would be mitigated by compliance with the 1995 BO terms and conditions, including the implementation of NPR's current Protected Species Conservation Plan, which includes best management practices not fully delineated in the BO.

A key concern in the transfer of the 1995 BO is the establishment of the 7,075 acre set aside by November 1998 and the development of a plan for its management (including funding). Any contract for

[9] The 1995 BO requires that DOE reconsult if the decision is made to sell NPR-1. However, it has been determined that reconsultation would not be required before the transfer of the 1995 BO incidental take permit because the objective of reconsultation is a revised BO, and any new BO would not be the one transferred to the new owner,-it is the existing BO that Congress authorized to be transferred.

the sale of NPR-1 would obligate the new owner(s) to abide by the terms and conditions in Table 4.5-3 as a condition of transferring DOE's 1995 BO and incidental take statement. As discussed in the 1995 BO, establishment of the conservation area includes the protection of a management plan that would require the approval of FWS, that would assure among other things, how the land would be managed. Funding the cost of such management is implicit in the 1995 BO and would have to be addressed by the new owner. Typically, endowments to provide management into perpetuity for such lands require from $300 to $500 an acre.

Additionally, the new owner would obtain approval of its habitat conservation plans and take avoidance measures under the CESA (and depending upon the status of the court appeal, possibly a 2081 permit). Alternatively, the new owner could choose to reduce operations to avoid any unauthorized takings, which would also mitigate impacts to biological resources to less than significant levels, but this is probably not a likely event. Until recently, private owners were required to obtain a Section 2081 management permit under CESA from the CDFG. Such a permit would assure that the new owner of Elk Hills took appropriate measures to protect state-listed species (e.g. the federally listed species plus the San Joaquin antelope squirrel and state species of concern). The California Court of Appeals recently overturned CDFG's authority to issue 2081 permits for the purpose of authorizing incidental takings of listed species as beyond the scope of the statutory authority.[10] However, the acceptance by the California Supreme Court of the appeal of the lower court's decision under California civil procedure suspends the lower court ruling. Consequently, CDFG has again begun to process 2081 permits. At this time, a new owner would have a number of possible alternatives to obtain the necessary approvals. All would assure the implementation of appropriate mitigation measures to reduce the impacts of commercial development to less than significant levels. Four possible alternatives are:

Issuance of a 2081 permit. Recently enacted legislation (AB21 and SB879) has rendered the California Court of Appeals ruling moot, so that a new owner will be assured of obtaining a 2081 permit. Therefore, this is the most likely approach that a new owner would take in order to obtain the necessary approvals from CDFG. However, these recent changes, enacted in two separate bills, in addition to providing the authority for CDFG to issue a 2081, contain two provisions that are potentially significant to the mitigation of the impacts of the proposed action. Until the necessary regulatory changes are adopted, further understanding of the significance of these changes to the issues analyzed in this document cannot be achieved. First, the revisions provide that if a party already has a Federal Endangered Species Act permit, further authorization is not required under the CESA if the Federal Permit is consistent with CESA. Since the San Joaquin Antelope Squirrel is a state only listed Species, then the new owner would appear to require a 2081 permit. The second important provision is that 2081 has been amended to provide that mitigation measures must be "roughly proportional" to the impacts to the species. Absent implementing regulations, it is uncertain what this means. However, any permit would still be subject to the requirements of CEQA which require the adoption of mitigation measures to reduce the impacts of the action to less than significant. Therefore, at the current time, the discussion in this chapter remains the best available analysis of the impacts of the Proposed Action.

CDFG Approval of a Natural Community Conservation Plan (NCCP). The owner could seek to participate in an NCCP and seek to have a state or local agency (such as Kern County or DOGGR) obtain CDFG and FWS approval with respect to adding a privatized NPR-1 to an NCCP. Such a plan would need to include all of the elements of a Federal ESA HCP, including analysis of impacts and mitigation measures. Given the short time frame in which to obtain the permit before completion of the sales process, and the extensive analysis required to prepare a conservation plan for a property as large as NPR-1, the only practical alternative would be to modify the conservation plan based on the 1995 BO,

[10] Planning and Conservation League v. Department of Fish and Game, (Docket No. A074048, First Appellate District, 4/11/97).

perhaps allowing expanded oil and gas exploration and development,[11] including all mitigation measures, plus any additional measures listed in Table 4.5-8 needed to mitigate impacts to state-only listed species. Thus, this approach would assure the continued implementation of the 1995 BO measures and the mitigation of oil and gas exploration and production activities on NPR-1 to less than significant levels. Both the CDFG and the sponsoring agency would be responsible for assuring compliance with the mitigation measures under the NCCP.

Other State Agency Sponsored Consultation with CDFG. The new owner could request that an affected state lead agency such as DOGGR could initiate a consultation under the California ESA section 2090 to develop another plan for mitigating all impacts of commercial development to less than significant. This process could take a significant amount of time unless all mitigation measures that are identified in this SEIS/PEIR as necessary to reduce biological resource impacts to less than significant are also adopted as part of that process.

Participation in a Regional HCP Approved by CDFG and U.S. Fish and Wildlife Service. The final alternative approach would be for the new owner to participate in a regional HCP that has been approved by CDFG. An important regional HCP currently under consideration by FWS and CDFG is the Valley Floor Habitat Conservation Plan (VFHCP). The VFHCP is a cooperative effort among various Federal (including FWS and BLM), state (including DOGGR), and local (Kern County) agencies as well as affected industries, to develop a strategic plan for addressing biological and endangered species issues in western Kern County. The development of the plan began with a memorandum of understanding between FWS, BLM, CDFG, the California Energy Commission, DOGGR and Kern County. The purposes of the program to be established under the memorandum were as follows:

- The conservation and protection of species of concern and their habitats in Kern County.
- The standardization of mitigation/compensation measures to satisfy Federal, state and local requirements without duplication and unnecessary delay.
- The specification of mitigation measures to lessen or avoid the cumulative effects of development activities including conservation plan(s), a public/private implementing agreement to ensure execution of the plans, and Section 10 permit(s) to authorize incidental takings.
- The equitable distribution of mitigation/compensation costs.

The memorandum goes on to discuss the relationship of the program to Section 7 of the ESA, stating:

> Section 7 of the ESA requires all Federal agencies to initiate formal consultation if their actions may affect federally listed species (50 CFR §402.14). Though a conservation plan may address in some fashion Federal land, the issuance of a Section 10(a) permit does not eliminate the need for Federal agencies to comply with Section 7. Nonetheless, the appropriate use by a Federal agency, regardless of whether that agency is a signatory to the Memorandum or any conservation plan, of mitigation/compensation measures established by an approved conservation plan, will satisfy the requirements of Section 7. (Kern County 1997)

[11] This may not be required if the new owner elects to implement techniques to minimize the use of land for well pads such as directional drilling so that more than one well can be located on a well pad and thus is able to keep future disturbances to less than the 828 acre limit allowed by the BO.

The most recent version of the draft plan was issued in April 1997 (Kern County and DOGGR 1997). The plan applies to western Kern County, except for certain areas including the Bakersfield metropolitan area and certain lands in other HCPs. The plan classifies the applicable land into three categories:

- Red zones, which represent primary management areas with high conservation value for the affected species of concern.
- Green zones, which represent habitat areas of moderate conservation value.
- White zones, which are of limited conservation value primarily due to intensive land uses such as agriculture. Although habitat in the white zones that could be developed under the plan represents a substantial number of acres, the value of those areas is greatly reduced by their scattered, isolated distribution.

The key elements of the plan are:

- Creating a long-term (30 year) plan to conserve Federal and state protected species and/or other species of concern consistent with operation of the oil and gas industry, farming, ranching, water conveyance, urban development, public infrastructure and other activities.
- A specific conservation strategy for oil and gas activities.
- The identification of lands that fall into the three habitat zones in western Kern County: red (most critical habitat), green (critical) and white (already heavily developed).
- Preserving 90% of red zones and 75% of green zones with a margin of safety to assure compliance with the red zone objective.
- Establishing a three-acre compensation requirement for drilling a well in a red or green zone (a 3:1 compensation for other development) with incentives for large size parcels and provision for payments in lieu of the conservation set-aside.
- Providing compensation reduction credits for conducting species surveys.
- Providing for management of the conservation areas by CDFG, or other habitat management entities subject to approval by CDFG and FWS.
- Providing for payments by parties developing in Western Kern County to support management of the conservation area.
- Requiring take-avoidance measures, including preactivity surveys.
- Providing for the issuance of a single FWS and possibly CDFG incidental take permit (once CDFG authority is resolved) so that private participants do not need their own permit if they are in compliance with the plan.
- Providing a "no surprise" guarantee to industry participants against future requirements from additional listings of species.

As the plan is only in a draft stage and does not include NPR-1 (NPR-1 elected to proceed under the 1995 BO). It would have to be revised before the protections provided in the plan would apply. It would be the responsibility of the new owner to promote the process of negotiation and amendment with

the support of Kern County and DOGGR. However, it is unlikely that this process could be completed before the proposed sale of NPR-1. Nonetheless, this approach would offer the new owner the following advantages:

- Provide a readily determined mechanism for management of the conservation area, avoiding the need to negotiate this issue under the 1995 BO as part of the establishment of the 7,075 conservation area.
- Avoid the need to obtain separate new Section 10 permit.
- Eliminate surprises; future obligations under ESA and CESA would be readily determined.
- Permit un-utilized NPR-1 land incorporated within the conservation areas by parties developing elsewhere in western Kern County who otherwise cannot meet their conservation obligation, thus increasing the value of NPR.

If the owner did not utilize one of the options providing for joint CFDG approval/10a permit the final step in the process would be for the new owner to determine whether to obtain an independent Section 10 permit. While there is no requirement that the new owner follow this course, it is likely that they would do so. The 1995 BO was based on the NPR-1 operating plans and objectives then current. The 1995 BO calls for reconsultation in the event that such plans and objectives would change. A Section 10 permit would be required by a new owner if: (1) the owner intends to intensify development of Elk Hills (the commercial development case is based on a likely change in operating philosophy by the new owner), (2) the land to be disturbed exceeds the acreage remaining under the 1995 BO (828 acres permitted by the BO less 417 acres already disturbed, or 411 additional acres), or (3) the species take limits in the 1995 BO would be exceeded.

Once the new owner begins to operate under the Section 10 permit, the lower mitigation responsibilities of that permit, compared to the 1995 BO, creates the potential for impacts to listed species through the loss of the affirmative obligations of Federal agencies reflected in the terms and conditions of the 1995 BO. However, this loss would no longer be relevant, given the standards that would be imposed through the state permitting process, except with respect to the ultimate disposition of NPR-1.

The difference in likely final disposition of the property can also be mitigated to less than significant levels. First, as discussed above, participation in the VFHCP could essentially assure that significant portions of NPR-1 habitats would remain undeveloped. Alternatively, even if NPR-1 is not included in the VFHCP, there is precedent for wildlife agencies authorizing the acquisition of unrelated lands to mitigate impacts to lands covered by an HCP. Thus, NPR-1 lands could be authorized for purchase as compensation for development of lands covered by the VFHCP. It would be the responsibility of the new owner to seek such approval from CDFG with the support of DOGGR or other affected state or local agency as a precondition to any other state or local action under this SEIS/PEIR. Once accomplished, the difference in likelihood of ultimate use could no longer be determined to be significant in any reasonable fashion.

There can be little dispute that the loss of the affirmative Federal obligation to protect biological resources would have some impact on those resources in the future. However, the extensive Federal and state permitting process and all the accompanying mitigation measures discussed above, including those likely to be applied given the new owner's need to move rapidly to obtain state approval, would reduce

any such impacts to less than significant levels. Additional mitigation measures that would reduce impacts to less than significant levels for the Proposed Action are in Table 4.5-8 below:

Table 4.5-8
Additional Private Owner Mitigation Measures

Key to Table Abbreviations
PC -- Plant Communities
AC -- Animal Communities
T&E -- Threatened and Endangered Species
SC -- Species of Concern
TI -- Total Impacts

Mitigation #	Description of the Mitigation	Impact Mitigated
BRM-16.	Transfer Section 7 permit with all its terms and conditions, including the requirements for the establishment of a 7,075 acre conservation area.	All Impacts
BRM-17.	Obtain CDFG approval of site specific habitat conservation plan and take avoidance measures under any of the discussed approaches.	All Impacts
BRM 17.1.	Formally add the San Joaquin antelope squirrel to the other federally listed species to which the take-avoidance measures apply.	T&E Animal Loss
BRM 17.2.	To compensate for the additional habitat disturbance associated with the commercial development alternative, the 7,075 acre conservation in the BO could be increased by a 3:1 ratio for any additional permanent development above the 828 acres in the BO (estimated to be 144 acres (417+555-828) and 355 (417+766-828) acres for the lower and upper bounds of the Commercial Development Case, respectively). Additional temporary disturbance compensation would be 9 to 21 acres. The total additional area would be 441 to 1,086 acres above the 7,075 acres in the BO.	PC Habitat Loss, AC Habitat Loss, T&E Habitat Loss, SC
BRM 18.	As an alternative to BRM 17, include NPR-1 in a regional HCP (either a new HCP or as an amendment to an existing HCP which would need to include the additional compensation area of 441- 1086 acres calculated in BRM 17.1).	All Impacts
BRM-19.	As an alternative to BRM-17 or 18, implement this BRM including 19.1, 19.2, 19.3 and 19.4.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI
BRM-19.1.	To compensate for the habitat disturbance, the 7,075 acre conservation area could be increased by an estimated 441 to 1086 acres.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI
BRM-19.2.	All surface lands contained within NPR-1 could be placed into conservation status in perpetuity as commercial oil and gas withdrawals are completed.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI, loss of Federal protection, reduce potential for recovery

Table 4.5-8
Additional Private Owner Mitigation Measures (continued)

Key to Table Abbreviations
PC -- Plant Communities
AC -- Animal Communities
T&E -- Threatened and Endangered Species
SC -- Species of Concern
TI -- Total Impacts

BRM-19.3.	All surface lands contained within NPR-1 could be remediated to a preproject condition as commercial oil and gas withdrawals are completed. Remediation would mean to remove all contaminants, structures, equipment, facilities, trash, and other features not part of a natural landscape; and to establish a self-perpetuating native plant community. Oil and gas withdrawals would be considered completed on a quarter-section basis when existing wells are shut-in and no new wells are constructed within 1 year of the last abandonment.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI
BRM-19.4.	Fund in perpetuity programs for the conservation, enhancement and monitoring of species and their habitats. This mitigation measure could be implemented through a mechanism such as the establishment of an endowment to fund stewardship programs and conservation easements on title to land to help ensure that future land uses (after oil and gas) are consistent with, or exceed, present obligations to conserve species and habitat. (Approximate cost $300 to $500 and acre.)	Loss of program funding and affirmative Federal obligation
BRM-20.	As an alternative to providing additional compensation above the current 7,075, implement directional drilling techniques to drill more than one well from a well pad or other advanced techniques to reduce habitat disturbance to below the 828 acres authorized in the BO.	PC-Habitat Loss, AC-Habitat Loss, T&E-Habitat Loss, SC, TI

Memorandum of Understanding Mitigation measures (MOUMs). In addition to those measures previously listed, the draft CESA MOU by and between the Elk Hills Unit Operator (EHUO) and the California Department of Fish and Game (CDFG) proposes additional mitigation measures.

MOUM-1: At least 30 days before initiating ground-disturbing activities, the EHUO should designate a representative responsible for communications with CDFG and overseeing compliance with the CESA MOU. CFGD should be notified in writing of the representative's name, business address and telephone number, and should be notified in writing if a substitute representative is designated.
MOUM-2: The EHUO should notify CDFG 14 days before initiating ground-disturbing activities. CDFG should specify other notification timing at its discretion.
MOUM-3: The EHUO should clearly delineate the boundaries of the project site by posting stakes, flags, and/or rope or cord, and should post signs and place fencing as necessary to exclude vehicle traffic unrelated to project construction.
MOUM-4: All project-related parking and equipment storage should be confined to the construction site or to previously disturbed off-site areas. Undisturbed areas and off-site Covered Species habitat should not be used for parking or equipment storage.
MOUM-5: The EHUO should conduct an orientation program for all persons who will work on-site during construction. The program should consist of: 1) a brief presentation from a person knowledgeable about the biology of the Covered Species, the terms of the CESA MOU and CESA; 2) a discussion of the biology of the Covered Species, their habitat needs, their status under CESA, and management measures of the CESA MOU; 3) a fact sheet containing all this information; and 4) upon completion of the

orientation, employees shall sign a form stating that they attended the program and understand all protection measures.
MOUM-6: Exclusion zones should be established to protect dens, nests and burrows as necessary.
MOUM-7: At sites likely to support blunt-nosed leopard lizard, the EHUO should evaluate potential for take of that species before conducting ground-disturbing work. If there is a likelihood of take, the EHUO should modify the project, or employ relocation or other take-avoidance measures subject to CDFG's written or verbal approval.
MOUM-8: Disturbed areas should be revegetated within two years from the cessation of disturbance, given normal rainfall for two consecutive years.
MOUM-9: For specific construction projects, the EHUO should conduct compliance inspections once a week during construction. CDFG should require summary compliance reports on a monthly or longer basis for long-term projects, and should require a final compliance report within 45 days of project completion.
MOUM-10: The EHUO should allow CDFG representatives access to the project site to monitor compliance with the terms and conditions of the CESA MOU.
MOUM-12: The EHUO should provide habitat management lands prior to disturbances. The habitat lands should be on or adjacent to the EHU, and CDFG should require that they be adjacent to other protected lands.
MOUM-13: The habitat management lands acreage is based upon biological assessment of the project's impact on the Covered Species and an estimate of the acreage necessary to provide for adequate biological carrying capacity at a replacement location.
MOUM-14: The EHUO should agree to provide a recent preliminary title report and initial hazardous materials survey report for the habitat management lands to CDFG.
MOUM-15: Prior to the transfer of habitat management lands to CDFG, the EHUO should inspect the habitat lands and remove any debris located thereon. A biologist acceptable to CDFG should be contracted to recommend suitable protection for the habitat management lands.
MOUM-16: If fee title to the habitat management lands is transferred to CDFG or to an approved non-profit corporation, the EHUO agrees to provide to CDFG or the non-profit corporation, a check in an amount to be determined by an analysis of the scope of management, but at least $375/acre, drawn from a banking institution located within California for use as principal for a permanent capital endowment. Interest from this amount should be available for the operation, management and protection of the habitat management lands. Operation, management, and protection activities should include reasonable administrative overhead, biological monitoring, improvements to carrying capacity, law enforcement measures, and any other action designed to protect or improve the habitat values of the habitat management lands. The endowment principal should not be drawn upon unless such withdrawal is deemed necessary by CDFG or non-profit corporation to ensure the continued viability of the species on the habitat management lands. Monies received by CDFG pursuant to this provision should be deposited in a special deposit account established pursuant to Government Code 16370. CDFG should pool the endowment with other endowments for the operation, management and protection of habitat management lands for local populations of the Covered Species.
MOUM-17: The EHUO should agree to reimburse CDFG for reasonable expenses incurred as a result of the approval and implementation of the project, including costs of title and document review, expenses incurred from other state agency reviews, CDFG costs directly related to administration of the CESA MOU, including travel, personnel, and overhead. The Parties estimate that this project would create an additional cost to CDFG of no more than $3,000.00 annually.

Impacts of Split Sale - Sale of Production Areas of NPR-1 to a Commercial Entity(ies) and Sale of Non-producing Areas to a Conservation Entity (Scenario 3)

Under the Proposed Action, Sale Scenario 3 (Split Sale), the 7075 acre area plus any additional non-production areas that could be identified would be sold to a conservation entity. The impacts of this scenario might be less than those for Sale Scenarios 1 and 2 with respect to the area because the conservation entity would likely have conservation and management objectives congruent with the obligations of federal agencies under the ESA, and would continue required actions in perpetuity.[12] The impacts to the rest of NPR-1 would be the same as Sale Scenarios 1 and 2.

Nonetheless, uncertainty of future funding for protection and management of non-producing areas by a conservation entity would be substantial. Funding mechanisms, such as endowments, typically require an initial amount of approximately $500 per acre for long-term management and protection; acquisition costs are an additional expense but are assumed to be nominal under this scenario. The high costs to a conservation entity (usually non-profit organizations with limited financial resources) for implementing this scenario detract from its feasibility due to the probable lack of funding. Thus, despite the fact that a conservation entity would probably take the same stewardship approach to the conservation area as the Federal government, the lack of funding may result in the same impacts as those of Sale Scenario 1 and 2.

Sale Scenario 3 Split Sale Mitigation Measures

The mitigation measures under Sale Scenarios 1 and 2 would assure funding for the 7,075 acre conservation area as part of the transfer of the 1995 BO and any additional Federal and state approvals. Given the uncertainty of funding for this approach, and the measures that mitigate the impacts under Sale Scenarios 1 and 2, which at the choice of the new owner, may result in NPR-1 lands being transferred to a conservation entity, with funding, the latter appears to offer the more certain approach to mitigating the funding impacts to less than significant.

4.5.3.3. Alternative to the Proposed Action for NPR-1: Transfer to BLM for Lease of Mineral Rights with BLM Management of Surface Property (Scenario 1) or Transfer to a Federal Corporation (Scenario 2)

Direct and indirect impacts would be similar to those described under the No Action Alternative, but would be more extensive or numerous due to the increase in land requirements. There are not expected to be any significant differences in the types of extent or impacts between Scenario 1 or Scenario 2.

Plant Communities. Impacts would be similar to the No Action Alternative, except that the upper bound of additional "permanent" loss of habitat is projected to be 231 acres over the Reference Case for a total of 766 acres, while the lower bound is projected to be 20 acres over the Reference Case, or 555 acres total. The upper bound of temporary habitat disturbance (which is in addition to the permanent loss) is projected to be 219 acres over the Reference Case or 755 acres total, while the lower bound is projected to be 8 acres more than the Reference Case, or 543 acres total.

Animal Communities. Impacts would be similar to the No Action Alternative, except that habitat loss would be increased as discussed under Plant Communities.

Threatened and Endangered Species. Impacts would be similar to the No Action Alternative, except that habitat loss would be increased as discussed under Plant Communities. In addition, there may

[12] Assumed to be those in the BO (i.e., the 7,075 acres of NPR-1 conservation area plus any additional acreage required to mitigate development above the 828 acres in the BO taken from areas with the least oil and gas development).

be differences in practice between the level of effort and resources that DOE has provided in fulfilling its Endangered Species Act Section 7 requirements (i.e., protecting, conserving, and helping recover threatened and endangered species) and the level of effort that BLM is able to commit due to differences in funding for BLM leasing management compared to funding for NPR activities. A Federal Corporation may also be unable to commit the level of effort or resources required by ESA Section 7.

Species of Concern. Impacts would be similar to the No Action Alternative, except that habitat loss would be increased as discussed in Plant Communities.

Mitigation Measures. Mitigation measures would be the same as those described in the No Action Alternative.

4.5.3.4. Comparison of Impacts Resulting from the Proposed Action and Alternatives for NPR-1

The Proposed Action Commercial Development Case, Sale Scenarios 1, 2, and 3 would have the greatest impacts on threatened and endangered species except that Sale Scenarios 1 and 2, (complete sale of NPR-1 to a commercial entity(ies)) might offer greater protection of the 1995 BO required conservation area. The No Action Alternative and the alternatives would have qualitatively similar impacts to biological resources, but impacts would vary in extent and severity. All alternatives, including the No Action Alternative and the Proposed Action, are presented in order of least impacts to most impacts:

1. No Action Alternative;
2. Alternatives, Transfer to BLM for Lease of Mineral Rights with BLM Management of Surface Property (Scenario 1) or Federal Corporation (Scenario 2);
3. Proposed Action, Sale of All Government Interest in NPR-1 (Scenarios 1 & 2); and
4. Proposed Action, Split Sale (Scenario 3).

Table 4.5-9 provides a comparative summary of the impacts to biological resources on NPR-1.

4.5.4. NPR-2 Impacts

This section identifies environmental impacts and mitigation commitments to plant and animal species of concern that may occur on NPR-2. Additional information on possible effects and mitigation can be found in the Biological Assessment for NPR-2 (Appendix I). In May 1994, DOE initiated formal consultation under Section 7 of the Endangered Species Act with FWS regarding projected future petroleum production activities on NPR-2. During the consultation process, FWS and DOE agreed to wait until the formal consultation for continuing operations at NPR-1 was completed, and decisions regarding the potential sale of NPR-1 and NPR-2 were made before concluding the consultation. The NPR-1 consultation was concluded in November 1995. However, no further action has taken place regarding the consultation on NPR-2. The impacts and appropriate mitigation measures presented in this section are based on DOE's 1994 Biological Assessment and the requirements set forth by FWS for continuing operations on NPR-1. These could change pending the outcome (if completed) of the ongoing consultation between DOE and FWS for continuing operations on NPR-2.

4.5.4.1. No Action Alternative for NPR-2 - Continued DOE Leasing for Private Operation

The No-Action Alternative to the Recommended Action (retention by DOE and continued leasing for oil and gas development with some third party activities) would result in impacts that would be mitigated to less than significant from the "permanent" loss of 88 acres and temporary impacts to another 200 acres.

Plant Communities. Impacts to Plant Communities would be less than significant. Potential effects on plant communities on NPR-2 would include (1) direct disturbance during facility construction and maintenance, geophysical surveying, and right-of-way pipeline/powerline maintenance; (2) potential accidental oil spills; and (3) wildfires that may affect vegetation. Approximately 88 acres of previously undisturbed vegetation would be lost between 1993 and 2018. In addition, some previously disturbed vegetation may be redisturbed. Accidental oil spills could impact plants and preclude natural revegetation in areas affected by the spills. Wildfires could cause short-term changes in vegetation structure, especially the loss of shrubs. Herbaceous perennial plants would resprout during the following growing season (Heady 1977; O'Farrell and Mitchell 1985). Loss of vegetation may cause soil erosion, especially on steep or unstable slopes.

Animal Communities. Impacts to animal communities would be less than significant. The primary potential effect of the No Action Alternative on the animal communities at NPR-2 would be the loss or alteration of habitat as described previously in the section on plant communities. Construction of proposed facilities (e.g., wells pads, pipelines, etc.) and some third-party projects would result in the long-term loss of about 88 acres of habitat. Seismic surveys and pipeline installation would result in temporary disturbance of animal communities on a total of about 200 acres. This could be offset by plugging and abandoning unproductive wells, removing all surface structures, and restoring the existing environment. Animals within the project area have the potential to be killed or injured by entrapment in burrows or crushed by equipment during construction activities. Other animals may be displaced as a result of habitat loss or habitat fragmentation, short-term increases in noise levels or worker presence. Dispersed populations tend to have low survivorship (Emlen 1984; Ralls *et al.* 1986). No increase in mortality from vehicular collisions would be expected because the number of workers on the site would not increase. Accidental fires associated with existing and/or new facilities is considered remote. Wildfires (both of natural and human origin) occur on a yearly basis and could affect animal communities if animals were burned or died within their burrows, or if the wildfires reduced forage.

Table 4.5-9
Comparison Summary of Impacts to Biological Resources on NPR-1

Key to Table Abbreviations

N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	No Action Alternative	Proposed Action Commercial Development		Alternative To The Proposed Action	
		Scenarios 1 & 2	Split Sale Scenario 3	Transfer To BLM & Lease Minerals Scenario 1	Federal Corp. Scenario 2
Plant Communities					
Habitat Loss	303-600 total additional acres lost	555-766 total additional acres lost	555-766 total additional acres lost	555-766 total additional acres lost	555-766 total additional acres lost
	L	M	M	M	M
Plant Community Loss	M	M	M	M	M
Erosion	L	L	L	L	L
Spills	M	M	M	M	M
Fire	L	L	L	L	L
Grazing	M	L	L	L	L
Animal Communities					
Habitat Loss	L	M	M	M	M
Animal Loss	M	M	M	M	M
Shelter Loss	L	M	M	M	M
Erosion	L	L	L	L	L
Spills	M	M	M	M	M
Fire	L	L	L	L	L
Grazing	M	L	L	L	L
Noise	L	L	L	L	L
T&E Species					
Habitat Loss	L	M	M	M	M
Federal Protections Loss	N/A	M	PS	N/A	N/A
Federal Funding Loss	N/A	M	S	N/A	N/A
Reduced Potential for Recovery	N/A	M	PS	N/A	N/A
Animal Loss	M	M	M	M	M
Animal Shelter Loss	L	M	M	M	M
Spills	M	M	M	M	M
Grazing	M	L	L	L	L
Noise	M	M	M	M	M
Pest Control	M	M	M	M	M
Species of Concern	M	M	M	M	M
Total Impacts	M	M	M	M	M

Threatened and Endangered Species. Impacts to threatened and endangered species would be mitigated to less than significant. Potential effects to threatened and endangered species would be similar to those identified for plant and animal communities. Potential effects are not anticipated to be significant based on analysis, mitigations, and potential compensation identified in consultation with FWS (EG&G/EM, Inc. 1993) (Appendix E). The potential effects on threatened and endangered species would be reduced to less likely and less severe than the effects on general biota by using the preactivity survey process to avoid protected species and their habitat and the use of mitigation and/or compensation when habitat disturbance cannot be avoided. Potential effects to listed plant species is expected to be minimal. Potential effects to protected animals include vehicular collisions, crushing or burial during surface-disturbing activities, entrapment in oil spills and well cellars, exposure to contaminants, and habitat loss, but these could be mitigated to less than significant. Further information on potential effects on threatened and endangered species and their significance is presented in Appendix E.

Species of Concern. The impacts to plant and animal species of concern would be similar to those for threatened and endangered species.

Total Impacts. Total impacts from past and future development would be mitigated to less than significant levels. Total impacts from the recommended action would be similar to the cumulative impacts of the NPR-1 No Action Alternative, and would be mitigated to less than significant by requiring the lessees to return the lease property to its natural condition at the end of production. This process is currently ongoing for some of the leases.

Mitigation Measures. Although not necessary for this analysis of impacts associated with the proposed action on NPR-1, mitigation measures that DOE implements on NPR-2 are nearly identical to the mitigation measures implemented for NPR-1. The most significant difference is the lack of a conservation area requirement for NPR-2 because the Section 7 process has not yet been completed.

4.5.4.2. Recommended Action for NPR-2: Transfer of NPR-2 to Bureau of Land Management

The Recommended Action (Transfer of NPR-2 to BLM) would result in impacts that would be mitigated to less than significant: the permanent loss of 88 acres and temporary impacts of 200 additional acres.

Plant Communities. Impacts to plant communities would be less than significant. Impacts requiring mitigation include (1) habitat loss, alteration and fragmentation; (2) mortality, injury and displacement (3) accelerated erosion; and (4) spills of oil, wastewater and other oil-field chemicals.

Animal Communities. Impacts to animal communities would be less than significant. Impacts that would be mitigated include (1) habitat loss, alteration and fragmentation; (2) mortality, injury and displacement; (3) loss or destruction of dens or burrows; and (4) accelerated erosion; (5) spills of oil, wastewater and other oil-field chemicals.

Threatened and Endangered Species. Impacts to threatened and endangered species would be mitigated to less than significant. Impacts that would require mitigation include (1) habitat loss, alteration and fragmentation; (2) mortality, injury and displacement; (3) loss or destruction of dens or burrows for animals; (4) loss of local Hoover's woolly-star, Kern mallow and San Joaquin woolly threads populations; (5) diminishment of local Hoover's woolly-star, Kern mallow and San Joaquin woolly threads seed banks; (6) accelerated erosion; and (7) spills of oil, wastewater, and other oil-field chemicals.

Species of Concern. Impacts to species of concern would be mitigated to less than significant. Impacts requiring mitigation include (1) habitat loss, alteration and fragmentation; (2) mortality, injury and displacement; (3) loss or destruction of dens or burrows; (4) accelerated erosion; and (5) spills of oil, wastewater and other oil-field chemicals.

Mitigation Measures. Mitigation measures under BLM management would be virtually identical to those under the "No action - continued DOE leasing" alternative since both are federal agencies and have the same requirements under the Endangered Species Act.

Total Impacts. Total impacts from past and future development would be mitigated to less than significant. Total impacts from the recommended action would be similar in nature to the cumulative impacts of the NPR-1 No Action Alternative, and would be mitigated to less than significant, by requiring the lessees to return the leased property to its natural condition at the end of production. This process is currently being conducted on some of the leases.

4.5.4.3. Alternative to the Recommended Action for NPR-2 - Sale of All Government Interest in NPR-2 to a Commercial Entity Subject to the Existing Leases

The Alternative to the Recommended Action (Sale of all government interest in NPR-2) would result in potentially significant impacts from the permanent loss of 88 acres and temporary impacts to 200 additional acres, the loss of Federal protections and affirmative obligations to conserve listed species and participate in their recovery, and the potential for additional agricultural or residential development beyond that which has already occurred. Listed plants and animals would also be significantly impacted due to the loss of federal protections on private property. These impacts might be mitigated to less than significant if the new owner decided to participate in the VFHCP.

Plant Communities. Impacts to plant communities potentially would be significant. Impacts that would require mitigation include: (1) loss of federal protections and affirmative conservation obligations; (2) loss of federal protections of listed plants; (3) habitat loss, alteration and fragmentation; (4) mortality, injury and displacement; (5) loss of local Hoover's woolly-star and Kern mallow populations; (6) diminishment of Hoover's woolly-star and Kern mallow seed banks; (7) accelerated erosion; and (8) spills of oil, wastewater and other oil-field chemicals.

Animal Communities. Impacts to animal communities potentially would be significant. Impacts that would require mitigation include: (1) loss of federal protections and affirmative conservation obligations; (2) habitat loss, alteration and fragmentation; (3) mortality, injury and displacement; (4) loss or destruction of dens or burrows; (5) accelerated erosion; and (6) spills of oil, wastewater and other oil-field chemicals.

Threatened and Endangered Species. Impacts to threatened and endangered species potentially would be significant. Impacts that would require mitigation include: (1) loss of federal protections and affirmative conservation obligations; (2) loss of federal protections of listed plants; (3) mortality, injury and displacement; (4) loss or destruction of dens or burrows; (5) loss of local Hoover's woolly-star, Kern mallow and San Joaquin woolly threads populations; (6) diminishment of local Hoover's woolly-star, Kern mallow and San Joaquin woolly threads seed banks; (7) accelerated erosion; and (8) spills of oil, wastewater and other oil-field chemicals.

Species of Concern. Impacts to species of concern potentially would be significant. Impacts that would require mitigation include: (1) loss of federal protections and affirmative conservation obligations; (2) loss of federal protections of listed plants; (3) mortality, injury and displacement; (4) loss or

destruction of dens or burrows; (5) accelerated erosion; and (6) spills of oil, wastewater and other oil-field chemicals.

Mitigation. Although NPR-2 is included in the draft VFHCP, when it becomes final participation by an individual owner is still voluntary. If this alternative is implemented, and the new owner chooses not to participate in the VFHCP, the impacts from the sale would be potentially significant. If the possible new owner does participate, then the impacts would be mitigated to less than significant.

Total Impacts. Total impacts would be significant. Cumulative impacts from the Alternative to the Recommended Action would be similar in nature to the cumulative impacts of the NPR-1 Proposed Action, and would be significant unless mitigated.

4.5.4.4. Comparison of Impacts Resulting from the Proposed Action and Alternatives for NPR-2

Table 4.5-10 compares the impacts of the Proposal Action and Alternatives for NPR-2. Impacts associated with the No Action Alternative (Continued DOE Leasing) and the Recommended Action (Transfer of NPR-2 to the Bureau of Land Management) are very similar, and would be mitigated to a less than significant level. Impacts from the Alternative to the Recommended Action (Sale of All Government Interest in NPR-2) would have significantly greater impacts than the other two alternatives.

4.5.5. Cumulative Impacts

This discussion examines the cumulative impacts on biological resources of western Kern County from the NPR-1 Proposed Action and Alternatives and the NPR-2 Recommended Action and Alternatives, along with other past, present and reasonably foreseeable actions that may affect those resources. Rather than limiting the analysis to the western Kern County oil fields, a broader analysis of cumulative impacts was chosen because western Kern County provides critical habitat for a number of threatened and endangered species, and species of concern. The loss of NPR-1 and NPR-2 habitat could make the recovery of those species less likely or increase the likelihood of additional listings of species of concern as threatened or endangered. The potential for significant impacts from all possible combinations of alternatives is considered, except for the combination of the NPR-1 No Action Alternative and either transfer or sale of NPR-2.[13] The analysis concludes that, in general, cumulative impacts of past and future development, either by the government or by a commercial entity, would be significant when considered in conjunction with other activities occurring in the region; however, the cumulative impacts can be mitigated to less than significant. The cumulative impacts are summarized at the end of the discussion in Table 4.5-13.

[13] It is assumed that if NPR-1 is not sold, divestiture of NPR-2 would not be authorized by Congress and would continue to be managed by DOE.

Table 4.5-10
Summary of Impacts to Biological Resources on NPR-2

Key to Table Abbreviations
N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	No Action Alternative	Recommended Action	Alternative to the Recommended Action
	Continued DOE Leasing	Transfer to BLM	Sale of all Government Interest
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	Permanent loss of 87.5 acres and temporary impacts to 200 acres of habitat mitigated to less than significant impact	Permanent loss of 88 acres and temporary impacts to 200 acres of habitat mitigated to less than significant impact	Permanent loss of 87.5 acres and temporary impacts to 200 acres of habitat mitigated to less than significant impact
Loss of affirmative federal obligations to protect, conserve, and help recover T&E species and their habitats	N	N	PS
Unfunded protection and management of DOE established conservation area	N	N	PS
Reduced potential for recovery of listed species and increased potential for listing additional species	N	N	PS
Incorporation into provisions of Kern County Valley Floor Habitat Conservation Plan	N	N	S
Mortality, injury, displacement	M	M	PS
Loss or destruction of dens and burrows	M	M	PS
Local Hoover's woolly-star, Kern mallow and San Joaquin woolly threads populations lost	M	M	PS
Hoover's woolly-star, Kern mallow and San Joaquin woolly threads seed bank diminished	M	M	PS
Accelerated erosion	M	M	M
Spills of oil, waste water and other oil-field chemicals	M	M	M
Range fire	N	N	N
Livestock grazing	N	N	PS
Competition with other species enhanced by human activity	N	N	M
Noise	N	N	N
Impacts to non-target species from pest management programs	M	M	M
Total Impacts	M	M	PS

4.5.5.1. Background on Cumulative Impacts

The FWS' draft San Joaquin Valley Multi-Species Recovery Plan's strategy bases many recovery goals on the assumption that the San Joaquin kit fox serves as an "umbrella species" whose protection would result in the stabilization of habitat essential for many of the other species treated in the recovery plan. Habitat at NPR-1 is key to the recovery of three San Joaquin threatened and endangered species and one species of concern (San Joaquin kit fox, giant kangaroo rat, blunt-nosed leopard lizard, and San Joaquin antelope squirrel, respectively) for the following reasons:

1. A detailed population viability analysis of San Joaquin kit foxes showed that the persistence of three metapopulations of kit foxes (in the Carrizo Plain Natural Area, Western Kern County (NPR-1, NPR-2, Lokern Natural Area and surrounding lands) and the Ciervo-Panoche Hills, plus persistent populations in 3-5 smaller satellite populations, were essential for the long-term survival and ultimate recovery of the kit fox. Probability of extinction increased substantially when populations in any of the three core areas were lost.[14]
2. NPR-1 comprises approximately 41 percent of the Western Kern County core area (Table 4.5-11). The sale alternatives of the proposed action would have the effect of eliminating guarantees for stewardship of endangered and threatened species in perpetuity. Not being able to rely on NPR-1 for kit fox conservation would have a significant impact on future opportunities for survival and recovery of this species. A similar result holds true for San Joaquin antelope squirrels. The percentage of blunt-nosed leopard lizard habitat lost from privatization of NPR-1 is smaller (14 percent), but is still a significant impact. Comparable estimates for the other species were not developed as adequate data were not available.

Table 4.5-11
Threatened and Endangered Species Habitat on NPR-1 Versus Core Population Area or Total Habitat (Acres)

Species	NPR-1 Habitat	Western Kern (1 of 3 Core Population Areas)	Total Habitat	Percent Represented by NPR-1
San Joaquin kit fox	47,424	114,361		41% [1]
Blunt-nosed leopard lizard	14,720	–	105,000	14% [2]
Giant kangaroo rat	12,600	–	27,540	46%
Tipton kangaroo rat	100	–	63,367	0.2%
San Joaquin antelope squirrel	47,424	–	101,961	47% [2]

[1] Proportion of Western Kern County core population area represented by NPR-1; Western Kern County is one of three core population areas.
[2] Proportion of extant habitat represented by NPR-1

[14] Waiting for permission to cite this document.

3. The federal lands at NPR-1 are the second-largest contiguous block of public lands in the southern San Joaquin Valley. The 180,000 acre Carrizo Natural Area is the largest and is comprised mostly of former private lands that were recently acquired by the Federal Government for several million dollars for the purpose of species conservation.

Ongoing and future activities that may impact threatened and endangered species, species of concern, and thus the biological diversity of the general plant and animal communities in western Kern County include petroleum field operations, maintenance and development; further urban expansion; and additional agricultural development. Relevant habitat in the area affected by cumulative impacts are shown in Table 4.5-12.

Table 4.5-12
VFHCP Habitat Affected by Cumulative Impacts

Habitat Area	Acres
NPR-1	47,409
Red Zones	128,594
Green Zones	774,348
White Zones	1,087,241
Oil Zones (Falling across Red, Green and White Zones as well as Metropolitan Bakersfield HCP including NPR-2))	497,176
Oil Zones plus NPR-1	544,585

Gas and oil activities on NPR-1, NPR-2, Asphalto Oil Field, Midway-Sunset Oil Field, McKittrick Oil Field, Railroad Gap Oil Field, North Coles Levee Oil Field, South Coles Levee Oil Field, Paloma Oil Field, Yowlomne Oil Field and Cymric Oil Field are presently represented by over 22,800 active oil wells. If each well and its associated facilities occupies 1.2 acres, the minimum existing disturbance would equal 27,360 acres or five percent of the VFHCP oil zone acreage plus NPR-1.

4.5.5.2. Cumulative Impacts of the NPR-1 Reference Case, NPR-2 No Action Alternative and Cumulative Projects

The cumulative impacts on biological resources NPR-1 Reference Case, NPR-2 No Action Alternative and Cumulative Projects would be mitigated to less than significant. This group of projects represents the cumulative impacts that would occur with no change at NPR-1 or NPR-2. It is presented first to provide a baseline against which to compare the other possible combination of projects.

Plant and Animal Communities

The following cumulative impacts to plant and animal communities (excluding threatened and endangered species and species of concern) are likely to occur from the NPR-1 Reference Case, NPR-2 No Action Alternative and Cumulative Projects.

Habitat loss, alteration and fragmentation, and associated reduction in biological diversity. Total habitat loss, alteration and fragmentation on NPR-1 and NPR-2 under the NPR-1 Reference Case and NPR-2 No Action Alternative is projected to be 7,529 acres. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

Loss of plant communities due to exploration and maintenance. As indicated above, the affected acreage would be 7,529 acres but the actual impacts would depend upon the distribution of the plant communities on the affected acreage. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

Mortality, injury, displacement of animals. Mortality, injury and displacement of animals would occur with the disturbance of the 7,529 acres; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce these impacts to less than significant.

Threatened and Endangered Species

The following cumulative impacts to threatened and endangered species are likely to occur from the NPR-1 Reference Case, NPR-2 No Action Alternative and Cumulative Projects.

Habitat loss, alteration and fragmentation, and associated reduction in biological diversity. Total habitat loss, alteration and fragmentation on NPR-1 and NPR-2 under the NPR-1 Reference Case and NPR-2 No Action Alternative is projected to be 7,529 acres. Future habitat losses included in this total are estimated to exceed the 1995 BO limits by 124 acres. Therefore, the impacts of this habitat loss are considered to be significant even though these 124 acres represent less than three hundredths of a percent of the oil and gas lands in western Kern County. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices plus an additional conservation contribution in a 3:1 ratio for the 124 acres or 372 acres, plus an additional eight acres for associated temporary disturbances, would reduce this impact to less than significant.

Loss of protection of T&E plants from damage, or destruction. The affected acreage would be 7,529 acres, but the actual impacts would depend upon the distribution of the plant communities on the affected acreage. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

Mortality, injury, displacement of T&E species. Mortality, injury, and displacement of animals would occur with the disturbance of the 7,529 acres; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

Species of Concern

The following cumulative impacts to species of concern are likely to occur from the NPR-1 Reference Case, NPR-2 No Action Alternative and Cumulative Projects.

Impacts on species of concern (plant and animal species). Habitat disturbance would include 7,529 acres. Mortality, injury and displacement of plants and animals would occur from the same activities discussed above, including habitat: disturbance; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

4.5.5.3. Cumulative Impacts of the NPR-1 No Action Alternative , NPR-2 No Action Alternative and Cumulative Projects

The cumulative impacts on biological resources NPR-1 No Action Alternative, NPR-2 No Action Alternative and Cumulative Projects would be mitigated to less than significant. This group of projects represents the cumulative "No Action Alternative."

Plant and Animal Communities

The following cumulative impacts to plant and animal communities (excluding threatened and endangered species and species of concern, discussed below) are likely to occur from the NPR-1 No Action Alternative, NPR-2 No Action Alternative and Cumulative Projects.

Habitat loss, alteration and fragmentation, and associated reduction in biological diversity. Additional habitat loss may range from less than the cumulative baseline to 65 acres more than the baseline under the lower and upper bound of government development at NPR-1. The cumulative impacts of the maximum additional loss of 65 acres over the baseline loss of 7,529 acres would be less than significant.

Loss of plant communities due to exploration and maintenance. The cumulative impacts of the maximum additional loss of 65 acres over the baseline loss of 7,529 acres would be less than significant.

Mortality, injury, displacement of animals. The cumulative impacts of the maximum additional loss of 65 acres over the baseline loss of 7,529 acres would be less than significant.

Threatened and Endangered Species

The following cumulative impacts to threatened and endangered species are likely to occur from the NPR-1 No Action Alternative, NPR-2 No Action Alternative and Cumulative Projects.

Habitat loss, alteration and fragmentation, and associated reduction in biological diversity. As the maximum additional loss of up to 65 acres over the baseline loss of 7,529 acres exceeds the future disturbance limits in the 1995 BO, this additional loss is significant. However, an additional 3:1 conservation contribution of 195 acres plus four acres for associated temporary disturbances, along with the other mitigating measures being implemented on NPR-1, would reduce the impact to less than significant.

Loss of protection of T&E plants from damage or destruction. The additional affected acreage would be up to 65 acres but the actual impacts would depend upon the distribution of the plant communities on the affected acreage. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

Mortality, injury, displacement of T&E species. Mortality, injury and displacement of animals would occur with the additional disturbance of up to 65 acres; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce these impacts to less than significant.

Species of Concern

The following cumulative impacts to species of concern are likely to occur from the NPR-1 No Action Alternative, NPR-2 No Action Alternative and Cumulative Projects.

Impacts on species of concern (plant and animal species). Additional habitat disturbance would be up to 65 acres. Mortality, injury, and displacement of plants and animals would occur from the same activities discussed above, including: habitat disturbance; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under Section 7 of the Endangered Species Act and NPR standard management practices would reduce this impact to less than significant.

4.5.5.4. Cumulative Impacts of the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects

The cumulative impacts on biological resources NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects could be mitigated to less than significant. This group of projects represents the cumulative "Proposed Action."

Plant and Animal Communities

The following cumulative impacts to plant and animal communities (excluding threatened and endangered species and species of concern, discussed below) are likely to occur from the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects.

Habitat loss, alteration and fragmentation, and associated reduction in biological diversity. Additional habitat loss may range from 20 to 231 acres more than the baseline under the lower and upper bound of commercial development at NPR-1. The cumulative impacts of the maximum additional loss of 65 acres over the baseline loss of 7,529 acres would be less than significant.

Loss of plant communities due to exploration and maintenance. The cumulative impacts of the maximum additional loss of 20 to 231 acres over the baseline loss of 7,529 acres would be less than significant.

Mortality, injury, displacement of animals. The cumulative impacts of the maximum additional loss of 20 to 231 acres over the baseline loss of 7,529 acres would be less than significant.

Threatened and Endangered Species

The following cumulative impacts to threatened and endangered species are likely to occur from the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects.

Loss of Federal obligation to protect, conserve, and help recover T&E species and their habitats. The loss of affirmative federal obligations to protect, conserve and help recover threatened and endangered species could result in reducing the potential for long-term protection and eventual recovery of listed species in the region and would be a significant cumulative impact of the cumulative "Proposed Action." This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity. As the maximum additional loss of 20 to 231 acres over the baseline loss of 7,529 acres exceeds the future disturbance limits in the 1995 BO, this additional loss would be significant. However, an additional 3:1 conservation contribution of 60 to 693 acres plus one to 42 acres for associated temporary disturbances, along with the other mitigating measures being implemented on NPR-1, would reduce the impact to less than significant.

Loss of protection of T&E plants from damage, or destruction. The additional affected acreage would be 20 to 231 acres but the actual impacts would depend upon the distribution of the plant communities on the affected acreage. Ongoing mitigation measures under the Endangered Species Act and standard management practices would reduce this impact to less than significant.

Mortality, injury, displacement of T&E species. Mortality, injury, and displacement of animals would occur in the additional disturbance of 20 to 231 acres; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. Ongoing mitigation measures under the Endangered Species Act and standard management practices would reduce this impact to less than significant.

Change in regional biological baseline with reduced recovery potential for T&E species. Privatization of federal resources on NPR-1 would change the regional environmental baseline for threatened and endangered species. The federal land status of NPR-1 provides substantial assurances to FWS and CDFG that highly important endangered species habitat would be protected. Privatization of NPR-1 would significantly reduce the amount of federal land in one of the three essential core population areas for kit foxes. Privatization of NPR-1 and the consequent loss of federal protections of biological diversity and the increased risk to species of concern may result in additional listings under the Federal and State Endangered Species Acts. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

Potential for increased limits on other projects in region. The FWS and CDFG would likely take a more cautious view of other proposed projects in the southern San Joaquin Valley. Privatization of these lands may also result in a higher habitat compensation ratio used for other projects affecting species occurring at NPR-1. A revised environmental baseline that places listed species at substantially greater risk may also result in jeopardy findings for other proposed projects in the area, and would thus require that other proposed projects implement FWS defined reasonable and prudent alternatives to avoid jeopardy. Privatization of NPR-1 could increase the burden on the private sector by placing additional importance on private lands as necessary for species survival and recovery. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

Potential for increased financial needs for conservation area acquisition/management. If NPR-1 is privatized, it is highly likely that the same lands would be identified as high priority for habitat acquisition programs. The total cost to the public would be substantially higher if these federal lands were sold and then returned, than if they were to remain in federal ownership. Repurchase of NPR-1 habitat would have a cumulative impact on public funds for conservation of threatened and endangered species. Public funding has also been used to purchase habitat in the Carrizo Plains Natural Area. Additional costs to the public could result from increased workload to State and federal resources agencies staff. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

Species of Concern

The following cumulative impacts to species of concern are likely to occur from the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects.

Impacts on species of concern (plant and animal species). Additional habitat disturbance would be 20 to 231 acres. Mortality, injury, and displacement of plants and animals would occur from the same activities discussed above, including: habitat disturbance; being struck by vehicles; destruction of dens and burrows; entrapment in facilities and trenches; oil, wastewater and hazardous materials spills; and pesticide programs. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

4.5.5.5. Cumulative Impacts of the NPR-1 Proposed Action, NPR-2 No Action Alternative and Cumulative Projects

The cumulative impacts on biological resources NPR-1 Proposed Action, NPR-2 No Action Alternative and Cumulative Projects would be the same as cumulative impacts of the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects and similarly could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

4.5.5.6. Cumulative Impacts of the NPR-1 Proposed Action, NPR-2 Sale Alternative and Cumulative Projects

The cumulative impacts on biological resources NPR-1 Proposed Action, NPR-2 Sale Alternative and Cumulative Projects are likely to be more significant than cumulative impacts of the NPR-1 Proposed Action, NPR-2 Recommended Action and Cumulative Projects unless mitigated to less than significant by inclusion of NPR-1 and participation of the new NPR-2 owner in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8.

Plant and Animal Communities

Additional cumulative impacts to plant and animal communities (excluding threatened and endangered species and species of concern, discussed below) are likely to occur from the NPR-1 Proposed Action, NPR-2 Sale Alternative and Cumulative Projects because some development for purposes other than oil and gas development is already occurring on NPR-2 and might conceivably expand if NPR-2 were sold. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or implementation of the alternative mitigating measures in Table 4.5-8 and participation of the new NPR-2 in the VFHCP.

Threatened and Endangered Species

Additional cumulative impacts to threatened and endangered species are likely to occur from the NPR-1 Proposed Action, NPR-2 Sale Alternative and Cumulative Projects because some development for purposes other than oil and gas development is already occurring on NPR-2 and might conceivably expand if NPR-2 is sold. This would add to the burden of participating in the VFHCP with possible adverse impacts to that plan because NPR-2 lands are already included in the red zone lands in the draft VFHCP. This impact could be mitigated to less than significant by inclusion of NPR-1 in the VFHCP or

implementation of the alternative mitigating measures in Table 4.5-8 and participation of the new NPR-2 in the VFHCP.

Species of Concern

Similar additional cumulative impacts to species of concern are likely to occur from this groups of projects unless NPR-1 and NPR-2 participate in the VFHCP.

4.5.5.7. Cumulative Impacts of the NPR-1 Alternative Action, NPR-2 Recommended Action and Cumulative Projects

The cumulative impacts on biological resources from the NPR-1 Alternative Action, NPR-2 Recommended Action and Cumulative Projects would be nearly similar to "No Action" projects because NPR-1 would remain under Federal ownership except that permanent additional habitat losses would be from 20 to 231 acres from commercial-like development as opposed to a maximum 65 acres under government development. As this is above the 1995 BO this would be considered to be significant but could be mitigated to less than significant.

4.5.5.8. Cumulative Impacts of the NPR-1 Alternative Action, NPR-2 No Action Alternative and Cumulative Projects

The cumulative impacts on biological resources for the NPR-1 Alternative Action, NPR-2 No Action Alternative and Cumulative Projects would be the same as the NPR-1 Alternative Action, NPR-2 Recommended Action and Cumulative Projects and would be mitigated to less than significant.

4.5.5.9. Cumulative Impacts of the NPR-1 Alternative Action, NPR-2 Divestiture Alternative and Cumulative Projects

The cumulative impacts on biological resources from the NPR-1 Alternative Action, NPR-2 Divestiture Alternative and Cumulative Projects while not as severe as the impacts from NPR-1 Proposed Action, NPR-2 Sale Alternative and Cumulative Projects because NPR-1 would remain would under Federal ownership, nonetheless would have the second most significant cumulative impacts. Like the other NPR-2 sale cumulative projects, this comes from the potential for development on NPR-2 for purposes other than oil and gas production. This would be mitigated to less than significant by the participation of the new owner in the VFHCP.

4.5.5.10. Growth-Inducing Impacts

No growth-inducing impacts are expected. Table 4.5-13 summarizes the mitigation measures for the Proposed Action and Alternative to the Proposed Action.

Table 4.5-13
Significance of Cumulative Impacts

Key to Table Abbreviations
N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	Reference NPR-1 Ref. Case, NPR-2 No Act. and Cumulative Projects	No Action NPR-1 No Act., NPR-2 No Act. and Cumulative Projects	Proposed Action NPR-1 Sale, NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 Sale and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Sale and Cumulative Projects
Plant and Animal Communities								
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	M	L	L	L	PS Mitigated to less than significant by a regional HCP	L	L	L
Loss of plant communities due to exploration and maintenance	M	L	L	L	PS Mitigated to less than significant by a regional HCP	L	L	L
Mortality, injury, displacement of animals	M	L	L	L	PS Mitigated to less than significant by a regional HCP	L	L	L

Table 4.5-13
Significance of Cumulative Impacts (continued)

Key to Table Abbreviations
N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	Reference NPR-1 Ref. Case, NPR-2 No Act. and Cumulative Projects	No Action NPR-1 No Act., NPR-2 No Act. and Cumulative Projects	Proposed Action NPR-1 Sale, NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 Sale and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Sale and Cumulative Projects
T&E Species								
Loss of Federal obligation to protect, conserve, and help recover T&E species and their habitats	N/A Because Federal Government continues to own NPR-1 & NPR-2	N/A	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	N/A	N/A	PS Mitigated to less than significant by a regional HCP
Habitat loss, alteration, and fragmentation, and associated reduction in biological diversity	M	M	M	M	PS Mitigated to less than significant by a regional HCP	M	M	PS Mitigated to less than significant by a regional HCP
Loss of protection of T&E plants from damage, or destruction	M	M	M	M	M	M	M	M
Mortality, injury, displacement of T&E species	M	M	M	M	M	M	M	M
Change in regional biological baseline with reduced recovery potential for T&E species	N/A	N/A	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	N/A	N/A	PS Mitigated to less than significant by a regional HCP

Table 4.5-13
Significance of Cumulative Impacts (continued)

Key to Table Abbreviations
N -- Not Significant
L -- Less than Significant
M -- Mitigable to Less than Significant
PS -- Potentially Significant
S -- Significant
N/A -- Not Applicable

Potential Impact	Reference NPR-1 Ref. Case, NPR-2 No Act. and Cumulative Projects	No Action NPR-1 No Act., NPR-2 No Act. and Cumulative Projects	Proposed Action NPR-1 Sale, NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Sale, NPR-2 Sale and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Trans. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 No Act. and Cumulative Projects	Alternative NPR-1 Alt., NPR-2 Sale and Cumulative Projects
Potential for increased limits on other projects in region	N/A	N/A	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	N/A	N/A	PS Mitigated to less than significant by a regional HCP
Potential for increased financial needs for conservation area acquisition/management	N/A	N/A	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	N/A	N/A	PS Mitigated to less than significant by a regional HCP
Species of Concern								
Impacts on species of concern (plant and animal species)	M	M	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	M	M	PS Mitigated to less than significant by a regional HCP
Total Impacts (past and future)	M	M	PS Mitigated to less than significant by a regional HCP	PS Mitigated to less than significant by a regional HCP	S	M	M	PS Mitigated to less than significant by a regional HCP
Growth Inducing Impacts	N	N	N	N	N	N	N	N

4.5.6. References

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4.6. CULTURAL RESOURCES

This section discusses the current status of the analysis of potential impacts of the Proposed Action and Alternatives to cultural resources on NPR-1 and NPR-2. Section 4.6.1 summarizes the analysis to date. Section 4.6.2 describes the methodology used to identify and determine the significance of cultural resources. Section 4.6.3 discusses the ongoing analysis at NPR-1. Section 4.6.4 discusses cultural resources on NPR-2. Finally, Section 4.6.5 discusses the potential for cumulative impacts.

4.6.1. Summary of Impacts

Approximately 50 percent of the area of NPR-1 has been subject to archaeological survey and inventory. There are 106 historic archaeological sites (including five historic components of prehistoric/historic multi-component sites) and three isolated finds documented at NPR-1. These sites consist of artifacts relevant to the history of industrial development in the region. Fifty-seven (57) prehistoric sites and 35 prehistoric isolates had been documented at NPR-1 as of December 1996. These sites are represented by accumulations of flaked and ground stone, shell and bone artifacts, features, faunal dietary remains (especially *Anadonta* shell) and (at two known sites) human remains. Results of a review of the records of all of these sites and prehistoric resources, with field testing of some during 1997, form the basis for recognition of an Elk Hills Archaeological District that is eligible for the NRHP under criterion 36CFR60.4(d), due to its potential to yield information important in prehistory. Further evaluation of the information discussed in the DSEIS/PEIR has resulted in a determination by DOE that four prehistoric sites are eligible for the NRHP. In August 1997, the California State Historic Preservation Officer (SHPO) concurred in this determination.

Under both the No Action Alternative and the Alternative to the Proposed Action, there would be a continuing Federal obligation under the National Historic Preservation Act and other applicable statutes to protect cultural resources and to consult with the SHPO before taking any action that could affect such resources. This would mitigate any impacts of future oil and gas development under either of these alternatives to less than significant.

Under the Proposed Action, preliminary archaeological surveys indicate that no impacts to significant historic archaeological sites or buildings are expected primarily because any such sites already have been so disturbed as to destroy their informational values. The potential loss of information from the District under the NPR-1 Proposed Action or the NPR-2 Alternative Action is expected to be mitigated through a data recovery program stipulated in a Programmatic Agreement among DOE, the SHPO and the Advisory Council on Historic Preservation. This agreement currently is in preparation, with completion expected by December 1997. The mitigation measures to be included in the agreement are expected to be completed by February 1998 before any proposed sale of NPR-1.

Sites containing human remains have religious significance for Native Americans. There are two known locations containing human remains and six others that are considered likely to contain remains because of similarities in their makeup to sites on or near NPR-1 that contain human remains. DOE believes that all locations likely to contain human remains have been identified because, following an analysis of all previously recorded prehistoric resources, an additional archaeological survey of approximately 3000 acres was completed September 1997 of all previously unsurveyed areas predicted to be sensitive for prehistoric archaeological resources. None of the newly recorded prehistoric resources identified by the recently-completed survey appeared to be like the two locations where human remains have been previously found. Impacts to the two locations where human remains have been previously found and to some of the other locations that are considered or likely to contain human remains, which have religious significance, could be mitigated through inclusion of these sites within the acreage set-

aside for conservation of biological resources. However, it is uncertain that all of the locations of concern would be included within the conservation set-aside. Hence both the NPR-1 Proposed Action and the NPR-2 Alternative Action are likely to have significant impacts on some places of religious significance to Native Americans.

4.6.2. Methodology

The California SHPO has indicated that the sale or transfer of Federal land is considered to be an undertaking that may have an adverse effect on cultural resources. To determine the potential impacts of the Proposed Action and Alternatives, the SHPO will need to concur on DOE determinations of NRHP-eligibility for identified sites, historic districts or cultural landscapes in the sale area and then consider potential effects on these. The SHPO has concurred that there are prehistoric resources eligible for the NRHP and is currently reviewing a request for concurrence on significance of a cultural landscape comprising the historic period sites. Concurrence on the significance of the prehistoric Elk Hills Archaeological District will be a part of the Programmatic Agreement.

CEQA approaches the determination of the significance of archaeological resources with more stringency than the Federal criteria for eligibility to the National Register of Historic Places. Under CEQA, if a project may cause damage to an "important archaeological resource," the project may have a significant effect on the environment. For the purposes of CEQA, an "important archaeological resource" is one which:

A. Is associated with an event or person of:
   1. Recognized significance in California or American history, or
   2. Recognized scientific importance in prehistory;

B. Can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential and reasonable or archaeological research questions;

C. Has a special or particular quality such as oldest, best example, largest or last surviving example of its kind;

D. Is at least 100 years old and possesses substantial stratigraphic integrity; or

E. Involves an important research question that historical research has shown can be answered only with archeological methods.

The proposed Elk Hills Archaeological District includes resources that meet CEQA definitions of importance and DOE is working with the SHPO through the Programmatic Agreement process to develop appropriate mitigation. Likewise, should the SHPO concur on the significance of the historic cultural landscape, DOE will include appropriate mitigation of impacts in the Programmatic Agreement.

The SHPO also inquired whether any Native American groups have expressed concern about the proposed sale of NPR-1. DOE is currently working with Native Americans (Yokuts, Paiute, Kitanemuk and inland Chumash) with traditional ties to Elk Hills to identify their concerns (see Section 3.6.3.4) and possible mitigation measures (see below).

In late July 1997, DOE submitted a draft Programmatic Agreement to the SHPO for concurrence on project effects and mitigation measures. The SHPO declined to comment until it received information documenting the presence of NRHP-eligible historic properties on NPR-1. Following SHPO concurrence in August 1997 on the NRHP-eligibility of four prehistoric sites, DOE and SHPO began discussing

revisions to the initial draft Programmatic Agreement. DOE and the SHPO expect to complete an agreement, with approval of the Advisory Council, by December 1, 1997.

4.6.3. NPR-1 Impacts and Mitigation

Approximately 50 percent of the area of NPR-1 has been subject to archaeological survey and inventory. There are 106 historic archaeological sites (including five historic components of prehistoric/historic multi-component sites) and three isolated finds documented at NPR-1. The sites are classified into eight types: Navy Wells; 4-Pad Wells; General Wells; Industrial Plant; Kiln Remnants; Structural Remnants; Railroad Grades; and Trash Dumps. Three historic period isolated finds are formally documented, although individual and clusters of historic period artifacts are widely distributed at NPR-1. The historical archaeologist currently working on analyzing the historical resources reports that all 21 of the documented historic period sites inspected in 1997 have sustained significant damage by vandalism, which has compromised their integrity. None of the recorded historic period sites or artifacts is regarded as individually eligible for listing in the National Register of Historic Places (NRHP) according to 36 CFR 60.4 (Criterion D). NPR-1 itself may be NRHP-eligible at the local, state or national level, as a rural historic landscape according to 36 CFR 60.4, Criterion A for its role in the development of the California oil industry, as the nation's first Naval Petroleum Reserve and for its relationship to the infamous "Teapot Dome" scandal of the Harding presidential administration. On September 16, 1997, DOE submitted a recommendation to the SHPO that NPR-1 may be NRHP-eligible as a rural historic landscape. The SHPO is currently reviewing this evaluation.

Fifty-seven (57) prehistoric sites and 35 prehistoric isolates are documented at NPR-1. These sites are represented by accumulations of flaked and ground stone, shell and bone artifacts, features, faunal dietary remains (especially *Anadonta* shell) and (at two known sites) human remains. Hypothetically, these remains could date from 10,000 years before present (B.P.) to historic times (ca. A.D. 1850) but studies at NPR-1 prehistoric sites to-date suggest that most remains date to the late prehistoric period post-A.D. 1500.

The actual number of prehistoric archaeological sites and isolated finds at NPR-1 is uncertain. Based on work completed in September 1997, on analyzing the previously recorded sites, DOE archaeologists have determined that the vast majority of prehistoric archaeological sites at NPR-1 occur in geomorphic environments characterized by deflation. It is very difficult to ascertain, based on surface inspection alone, whether observed cultural material is *in situ* and whether the material retains integrity. The majority of 18 sites inspected by archaeologists in 1997, using limited subsurface excavation, were found to be so substantially deflated that they do not retain integrity. At the same time, cultural remains on the surface of other "sites" were found to have been redeposited to their observed location by wind and rain. Additionally, oil field development in the high production area of NPR-1 has so substantially transformed the topography of the area that it is unlikely that the number and distribution of prehistoric archaeological sites in those portions of the installation can ever be known.

Twelve prehistoric archaeological sites at NPR-1 have been evaluated for NRHP eligibility and four have been determined by DOE to be potentially eligible for NRHP listing according to 36 CFR 60.4 (Criterion D): CA-KER-3079, CA-KER-3080, CA-KER-3082 and CA-KER-3085/H. SHPO concurred in this determination in August 1997. Results of a review of all sites and prehistoric resources recorded as of late 1996, with field testing of some in 1997, form the basis for recognition of an Elk Hills Archaeological District that is eligible for the NRHP under criterion 36CFR60.4(d), for its potential to yield information important in prehistory. SHPO concurrence on the significance of the prehistoric Elk Hills Archaeological District will be a part of the Programmatic Agreement.

4.6.3.1. No Action Alternative

There would be no effect on archaeological resources if DOE continues its current procedures of pre-activity survey and consultation with the SHPO to prepare treatment plans when historic properties or CEQA-important sites cannot be avoided. There may be impacts on places of traditional or religious importance to Native Americans if there are sites other than sites containing human remains that have this importance. Currently there is no overall inventory of such sites on NPR-1 and no procedures requiring project-specific inventories as part of the clearance process. However, all locations known to contain or considered likely to contain human remains are recognized to have religious significance to Native Americans. Because these are protected by the same procedures that protect archaeological resources, no impacts to resources of this type are expected.

There are no impacts expected to paleontological resources under any of the alternatives. As indicated in Section 3.6, there are only two exposures of significance on NPR-1 and these are currently exposed in road cuts. Continued road maintenance is expected to keep the exposures visible and accessible to scientists and there is no expectation that future production activities would destroy these localities. Future work may expose additional localities, but is not expected to provide exposures of other significant paleontological resources. Hence no impacts are expected.

4.6.3.2. Proposed Action

The SHPO has concurred that there are significant prehistoric resources at NPR-1 and that some of these have religious significance for Native Americans. The SHPO is reviewing the possibility that the historic resources at NPR-1 comprise a historic cultural landscape. DOE and SHPO staff are developing a Programmatic Agreement to fulfill DOE's responsibilities under the National Historic Preservation Act.

Although SHPO consultation is still in progress, preliminary results suggest the following conclusions about impacts. No impacts to historic archaeological sites or buildings are expected from any of the NPR-1 alternatives as these sites have already been so disturbed as to destroy their value. None of the individual historic sites appear to meet the criteria for NRHP-eligibility or importance under CEQA criteria, i.e., they embody no significant values that would be lost if they are damaged or destroyed. As a group, they may comprise a historic cultural landscape significant for the role it played in local and state history and development of the oil and natural gas fields; the SHPO has not yet made this determination. However, even if the landscape is determined to be NRHP-eligible, the sale of NPR-1 is not expected to have an impact on the landscape because the sale will not change the nature of the landscape, i.e. oil and gas production activities will continue. Should the SHPO determine that additional historic research is warranted to document the historical values embodied in the landscape, such research will be specified as a requirement in the Programmatic Agreement. With regard to prehistoric resources, the SHPO has agreed that the Proposed Action would cause impacts unless DOE carries out mitigation measures to be specified in the Programmatic Agreement. Furthermore, at least two locations contain human remains, which makes them significant for Native Americans. It appears that the prehistoric sites that are NRHP-eligible, CEQA-important, and of concern to Native Americans, are located away from active oil production areas. However, under the Proposed Action, some of these sites might be disturbed or destroyed as a result of oil production or related activities.

4.6.3.3. Mitigation

DOE and the SHPO are currently in the process of entering into a Programmatic Agreement concerning cultural resources at NPR-1. This agreement will include appropriate mitigation measures that DOE will commit to prior to the sale of NPR-1. Although this is not expected to be finalized until December 1, 1997, the agreement is likely to include the measures discussed below.

An additional survey of approximately 3,000 acres was completed in September 1997. This survey encompassed those areas known to be archaeologically sensitive based on the results of prior archaeological survey and archival historic research. As a result of this latest survey, all areas expected to be archaeologically sensitive for prehistoric resources have been surveyed.

A set of prehistoric resources representative of those types known on NPR-1 would be treated through data recovery consisting of surface mapping and collection, subsurface excavations and analysis to address questions in the research design prepared as part of the ongoing studies ancillary to preparation of this document. Work would be conducted under permits issued pursuant to the Archaeological Resources Protection Act of 1979(ARPA) with appropriate notice to Native Americans in compliance with the Native American Graves Protection and Repatriation Act (NAGPRA). This work will be completed before the completion of the sale process. The treatment plan is expected to reflect consideration of NPR-1 as a prehistoric archaeological district, with emphasis on recovering the information that makes the district NRHP-eligible and protecting Native American values identified through consultation. Additionally, archaeological collections would be curated to appropriate standards. An article would be prepared for archaeological journals and a booklet describing the results of the analysis would be prepared and distributed to oil museums, schools, government agencies and others.

Protection of Native American values could be accomplished by inclusion of as many as possible of those locations known to contain human remains or considered likely to contain human remains (based on the above studies) in the acreage set-aside for biological resource conservation. The SHPO has indicated to DOE that the Programmatic Agreement that will define mitigation of impacts to the prehistoric archaeological resources must also address concerns related to NAGPRA. As DOE develops the Programmatic Agreement with the SHPO, DOE will provide for involvement and comment by Native Americans, both from tribes on the NAGPRA list and from others with traditional ties to Elk Hills.

Although physical destruction of historic archaeological sites would not affect the criteria that make them contributors to a NRHP-eligible historic cultural landscape (if SHPO concurs that one is present), DOE would mitigate potential effects on specific development features and the overall historic landscape in the following ways.

A. Prepare a scholarly history of NPR-1 based on archival research that provides a context for understanding the buildings and archaeological features that have been recorded;

B. Publish findings of the historic archaeological research and field work through 1997 in scholarly journals;

C. Prepare and publish a history of NPR-1 for the lay public, to be distributed to schools and historical societies in California; and

D. Update existing site records to ensure that good examples of each type of historic archaeological site are thoroughly recorded to the most recent state of California standards.

4.6.3.4. Alternatives to the Proposed Action

The impacts under the Alternative to the Proposed Action would be the same as the No Action Alternative, as the government would continue to hold an ownership interest in the property.

4.6.3.5. Comparison of Impacts

No Action and the Alternative to the Proposed Action would have no effect, except on Native American traditional or religious sites. The Proposed Action would have potential effects, mitigable through the measures described above.

4.6.4. NPR-2 Impacts

4.6.4.1. No Action Alternative

There would be no effect on archaeological resources if DOE continues its current procedures of pre-activity survey and consultation with the SHPO to prepare treatment plans when historic properties or CEQA-important sites cannot be avoided. There may be impacts on places of traditional or religious importance to Native Americans unless current procedures are augmented to require specific consideration of these resources in ongoing activities. Currently there is no overall inventory of such sites on NPR-2 and no procedures requiring project-specific inventories as part of the clearance process.

4.6.4.2. Recommended Action

Continued oversight by a federal agency would require continued compliance with the NHPA. Hence, as with the No Action Alternative, no significant impacts would result. This conclusion extends to Native American sites on the assumption that the Bureau of Land Management would apply to NPR-2 its guidelines for Native American consultation (BLM 1990 and 1994).

4.6.4.3. Alternative Action

Impacts under this action would be similar to impacts under the commercial sale scenarios for NPR-1 and would depend upon the degree to which CEQA would apply to production activities and to particular sites and site types at NPR-2. This impact analysis will be completed when this information is available from the NPR-1 SHPO consultation process.

4.6.5. Cumulative Impacts

Both NPR-1 and NPR-2 sale scenarios would add to ongoing impacts to significant prehistoric sites, some of which have Native American values associated with burials and cemeteries. The cumulative effect would be more than additive because only NPR-1 and NPR-2, among all the projects considered, currently require NHPA compliance. Hence, a block of sites that has been protected up to this time would be lost. However, the mitigation measures discussed above would likely reduce this effect to less than significant.

4.6.6. References

BLM see U.S. Department of the Interior, Bureau of Land Management.

U.S. Department of the Interior, Bureau of Land Management, 1990, BLM Manual Section 8160 - Native American Coordination and Consultation, Washington D.C., January.

U.S. Department of the Interior, Bureau of Land Management, 1994, BLM Manual Handbook H-8160 - 1, General Procedural Guidance for Native American Consultation, Washington D.C., November.

4.7. LAND USE

4.7.1. Summary of Impacts for NPR-1

Under the Proposed Action for NPR-1, the impact on acreage from commercial development is 766 acres or 1.6 percent of the site. This is not a significant impact on land use relative to the development projected to occur under the Reference Case of 535 acres or compared to the No Action Alternative of 600 acres. In addition, NPR-1 would have a "Mineral or Petroleum" land use designation in the Kern County General Plan; thus the nature of land use would not change. The primary land use impacts might occur after 2050 when the land could convert to non-oil field developments such as agricultural and residential development. Such land uses appear compatible with existing use in the vicinity. Commercial development would not impact off-site land use because it is compatible with existing land use in the vicinity.

The potential for increased production from the Proposed Action or Alternative Action at NPR-1 or any alternative at NPR-2 does not pose a significant cumulative impact on regional land uses. This is due to increasingly stringent environmental regulation of oil and gas production and the overall trend of minimizing or even decreasing environmental impacts over time based on the declining level of oil production in the region.

4.7.2. Methodology

The analysis of potential on-site land use impacts was based on estimating the acreage that would be disturbed by oil production activities for the Proposed Action and alternatives. The potential off-site impacts were characterized in the context of the land uses surrounding NPR-1 and the Kern County land use plans.

According to Appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will:

- Conflict with adopted environmental plans and goals of the community where it is located;
- Disrupt or divide the physical arrangement of an established community; or
- Convert prime agricultural land to non-agricultural use or impair the agricultural productivity of prime agricultural land.

For the purposes of this SEIS/PEIR, it is considered a significant impact if the project: Conflicts with the Kern County General Plan and Zoning designations for the project site; results in inconsistencies with the adopted environmental plans or goals of Kern County; is incompatible with the existing land uses in the vicinity of the project site; affects existing agricultural resources or operations; or disrupts or divides the physical arrangement of Kern County.

4.7.3. NPR-1 Impacts

4.7.3.1. No Action Alternative

Impacts

To date, approximately 6,884 acres of NPR-1 (13.8 percent of the site) have been disturbed since development began in the early part of the century (see Table 4.5-2). Revegetation has been completed, or is in progress, on 2,192 disturbed acres (4.6 percent of the site). Therefore, the existing environment consists of 4,692 acres of development (8.8 percent of the site).

The Reference Case would result in the development of approximately 535 additional acres (1.1 percent of the site) on NPR-1 over the next 40 plus years (see Table 4.5-2) for Federal and nonfederal facilities. The Reference Case also includes the revegetation of all land associated with facilities that have been, or would be, abandoned because they are not needed for operations. This has been estimated to be 1,262 acres through the year 1998 (1995 BO).

The No Action Alternative is expected temporarily to affect another 226 acres per year in connection with seismic surveys. Over a 40-year period this amounts to 6,780 acres, approximately 50 percent of which should be on NPR-1.

Historically, oil exploration and production have been conducted on NPR- 1 and the surrounding area since the mid-to-late 1800's (Maher et al. 1975). The No Action Alternative would be consistent with this tradition and with the provisions of the Naval Petroleum Reserves Production Act of 1976. Exploration and development activities associated with the No Action Alternative would be consistent with current land use on and around the site and with planning objectives stated in the Kern County General Plan. Government development is expected to result in the use of approximately 303 to 600 additional acres under the lower and upper bound of the government development case.

It is anticipated that petroleum development, urban development, agricultural irrigation and sheep and cattle grazing would continue on lands surrounding the site. The continued use of NPR-1 for petroleum development might, in turn, result in some minor increase in commercial or industrial development in nearby local communities. Site activities are not expected to affect adversely the surrounding recreational resources (e.g. Buena Vista Aquatic Recreation Area, Tule Elk State Reserve) because activities will be away from site boundaries. Although the increased amount of activities and production facilities would result in additional visual degradation, these impacts would be only incremental in nature, with a minimal number of off-site views affected.

The No Action Alternative is not expected to have significant impacts because government development does not conflict with adopted environmental plans and goals of the community; disrupt or divide the physical arrangement of an established community; or convert agricultural use or impact the agricultural productivity of prime agricultural land.

Mitigation

No mitigation is required as the impacts of government development of NPR-1 are less than significant.

4.7.3.2. Proposed Action

Impacts

The impacts under the Proposed Action would be similar to the ones under the No Action Alternative except for the number of acres that would be affected, as outlined below.

The Proposed Action would result in the development of approximately 555 to 766 additional acres under the lower and upper bound of the Commercial Development Case respectively (1.2 percent and 1.6 percent respectively) over the next 40 plus years (see Table 4.5-2). The Proposed Action also includes the revegetation of all land associated with facilities that have been, or would be, abandoned because they are not needed for operations.

The Proposed Action would also temporarily affect NPR-1 and non-NPR lands in connection with seismic surveys as part of the development process. The extent of disturbance would be slightly greater than under government development because of more intense oil and gas development. Oil exploration and production under the Proposed Action Alternative would also be consistent with traditional and current land use activities in the area as well as with objectives stated in the Kern County General Plan.

The continued use of NPR-1 for petroleum development under the Proposed Action is expected to have only a slightly greater impact on industrial developments in nearby local communities as compared to the No Action Alternative. As with the No Action Alternative, no adverse affect on surrounding recreational resources is expected. An increase in the number of oil production facilities under the Proposed Action would result in slightly more visual degradation; however, a minimal number of off-site views would be affected due to the location of production activity away from site boundaries.

Land use impacts of the Proposed Action are less than significant because the Proposed Action does not conflict with adopted environmental plans and goals of the community; disrupt or divide the physical arrangement of an established community; or convert agricultural use or impact the agricultural productivity of prime agricultural land.

Mitigation

As the impacts are less than significant, no mitigation is needed.

4.7.3.3. Alternative to the Proposed Action

Impacts

All the scenarios considered under the Alternative to the Proposed Action would result in land use impacts similar to the ones under the Proposed Action, (both Commercial Development Cases) in Section 4.7.3.2. Therefore, the impact analysis is not repeated in this section.

Mitigation

As the impacts are less than significant, no mitigation is warranted.

4.7.4. NPR-2 Impacts

4.7.4.1. No Action Alternative

This alternative provides for the continued production and development of known reserves at NPR-2 under DOE's administration by the current mineral leases. The impacts of this alternative include drilling and installing approximately 75 new reservoir wells, restoring and increasing oil production in older wells through remedial well workovers and redrilling and/or enhancing recovery techniques from wells with decreased production. A net decrease in distributed acreage is projected, with no other land use impacts until oil production ceases.

4.7.4.2. Recommended Action

This alternative includes transferring NPR-2 to BLM for management under current BLM programs and possible leasing of currently unleased acreage under the Mineral Leasing Act. This is approximately the same as the No Action Alternative. Approximately 287 acres would be affected by new development for a total of 2,309 acres of disturbed land. A total of 656 acres would be set aside for habitat reclamation for a proposed net decrease in total disturbed acres from 2,309 to 1,653 acres (DOE 1994). Control of production and development decisions would remain with the current lease holders, and oil production activities would be expected to remain the same.

4.7.4.3. Alternative to the Recommended Action

This alternative involves selling all government interest in NPR-2 to a commercial entity subject to the existing leases. The most significant difference compared to the Recommended Action or No Action Alternative is that the government would no longer control how the land would be used in addition to the existing leases. Since NPR-2 is nearing the end of its productive life and is close to residential development; non-oil field development is a future possibility that could result in significant land use changes in the NPR-2 environment.

4.7.5. Cumulative Impacts

The section analyzes cummulative impacts from the various alternative actions for NPR-1 in conjunction with other past, present, and reasonably forseeable future actions that could have impacts on land use. Cumulative impacts include not just Federal, but other state and private oil and gas activities in the surrounding area. Oil and gas production in the region in general and for the cumulative project examined is past its peak and the overall level of production and related activity is in decline. Current land uses in the evaluated project areas are not expected to change as a result of the proposed action. In addition, the Proposed Action at NPR-1 would not significantly accelerate a shift to land uses other than oil production expected in the region as production declines, which is not expected to occur for 40 plus years.

4.7.6. References

Maher, J.C., R.D. Carter, and R.J. Lantz, 1975, Petroleum Geology of Naval Petroleum Reserve No. 1, Elk Hills, Kern County, California, U.S. Geological Survey Professional Paper 912. Washington, DC.

U.S. Department of Energy, 1994, Environmental Assessment for Continued Exploration, Development, and Operation NPR-2, (Buena Vista Hills), Kern County, California, Washington, DC, September.

4.8. NOISE IMPACTS

4.8.1. Summary of Impacts for NPR-1

Noise impacts were analyzed in terms of effects of activities on nearest residential receptors. For NPR-1, the only expected noise impact that might occur during the initial ten years is under the higher levels of commercial development, but that impact is expected to be less than significant. The Proposed Action at NPR-1 is not expected to contribute to a significant increase in cumulative impacts of ongoing petroleum production projects because of the effect that distance between noise source and residential receptor has on attenuation of noise levels.

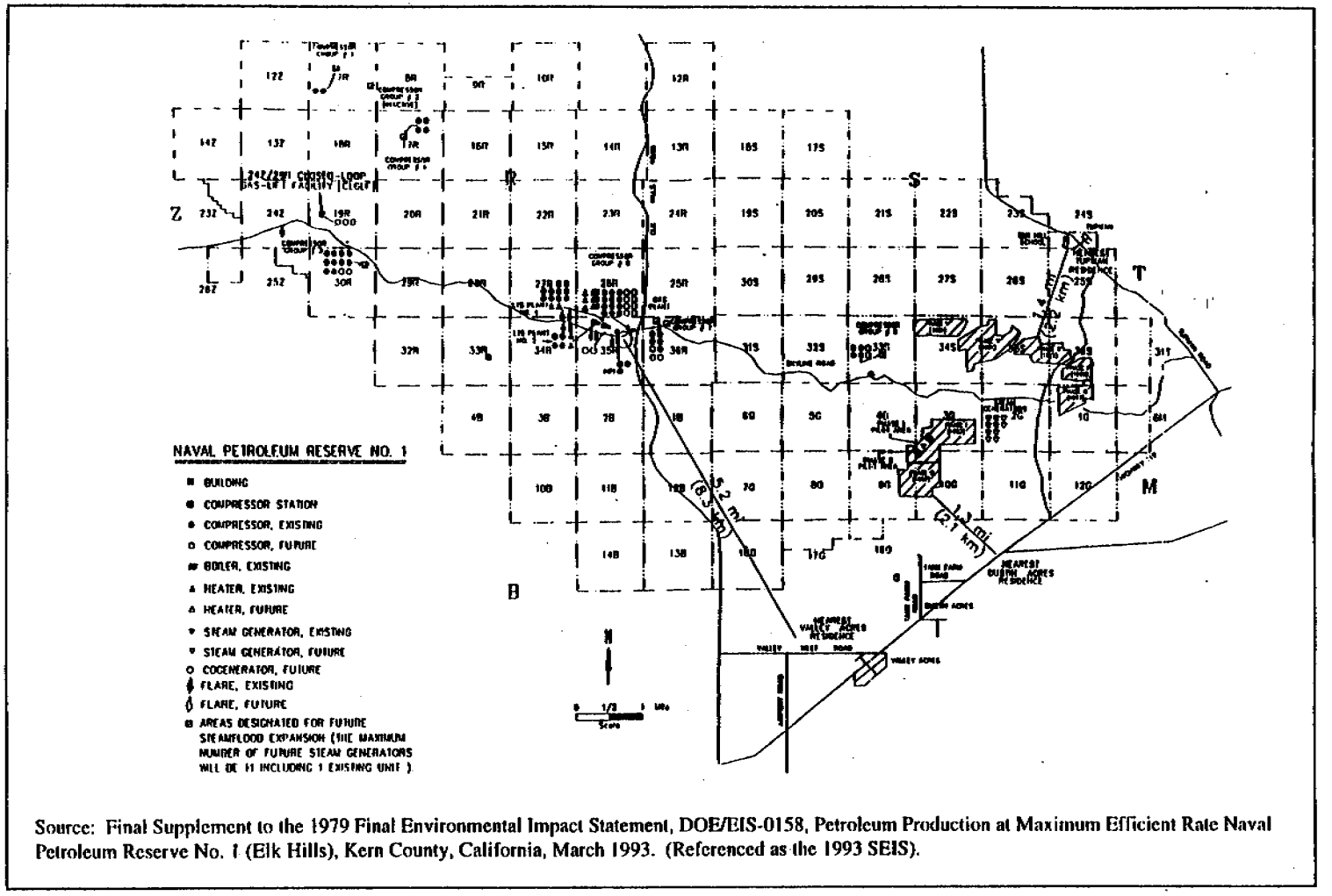
4.8.2. Methodology

Analyses were conducted for the 1993 SEIS of both baseline (existing) ambient noise environments and worst-case intrusive (future) noise emissions to the residential communities nearest to the NPR-1 property lines for steamflood enhanced oil recovery expansion then planned through the year 1996. Those analyses are still applicable because the sensitive receptors surrounding NPR-1 are still the same distance from the operations and the noise generated under the Proposed Action and Alternatives would involve the same services analyzed in the 1993 SEIS. The probability of hearing increased drilling, steam injection, gas-compression, power-generation and associated trucking activities was investigated using the Fidell probabilistic delectability model (Fidell and Horonieff 1982). These are the only major sources that would be audible at the residential communities. Noise from other, smaller sources would not be audible at the distances under consideration. Variables in the acoustic model included terrain effects (groundcover and hill-shielding), as well as the fundamental attenuation mechanisms of spreading, atmospheric absorption and scattering losses due to air turbulence (BB&N 1984).

Three community locations were selected for analysis (Figure 4.8-1). These locations are still (in 1997) the residential sites closest to the areas within NPR-1 where the greatest concentrations of noise-producing activities would occur during any phase of the Proposed Action and Alternatives. Table 4.8-1 lists the distances between NPR-1 noise-producing activities and the selected residential locations. This approach to the selection of source and receiving locations results in conservative (worst case) numerical results. Distances from sources to receptors of interest are mostly in the range of two to seven kilometers. Sound attenuation over such distances is very large (typically 90 to 150 decibels, in the middle of the audible-frequency range).

California requires that each community have a general plan containing, among other items, a noise element (California Government Code, Division 1, Planning and Zoning, Chapter 3 - Local Planning, Article 5, Section 65302). This requirement is met by the noise element of the Kern County General Plan adopted by the Kern County Board of Supervisors, the Tupman Rural Community Plan, the Dustin Acres Rural Community Plan, and the Valley Acres Rural Community Plan. Collectively, these documents define a requirement for a proposed new facility to provide plans for mitigating noise emissions if the proposed action is likely to cause outdoor noise levels in the community in excess of 55 decibels, community noise equivalent level (CNEL) or day-night sound level (L_{dn}). This corresponds to about a 48-decibel residual level for similar acoustic environments (Conner 1978; Bishop 1979; Fidell et al. 1981; and U.S. Air Force 1987).

Figure 4.8-1
Locations of Nearest Residences to Major Noise Sources at NPR-1



Source: Final Supplement to the 1979 Final Environmental Impact Statement, DOE/EIS-0158, Petroleum Production at Maximum Efficient Rate Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California, March 1993. (Referenced as the 1993 SEIS).

Source: Final Supplement to the 1979 Final Environmental Impact Statement, DOE/EIS-0158, Petroleum Production at Maximum Efficient Rate Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California, March 1993. (Referenced as the 1993 SEIS).

Table 4.8-1
Average Distances Between Worst-Case (Shortest-Path)
Combinations of Noise-Source and Residential Locations Selected for Analysis

Noise Source	Distance to Residential Sites (km)		
	Tupman	Dustin Acres	Valley Acres
Phase I Wells (3G)	5.9	2.6	6.0
Phase II Wells (35S)	2.2	4.4	9.3
Phase III(A) Wells (9/10G)	5.9	2.1	4.3
Phase III(B) Wells (1G)	3.2	3.7	7.0
Phase IV Wells (36S)	2.7	4.5	7.8
Phase V Wells (34/35S)	2.7	4.4	7.0
Gas-turbine generator (35R)	11.0	10.4	8.3
Compressor group (33S)	5.1	5.3	7.0

Source: 1993 SEIS

According to Appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will increase substantially the ambient noise levels for adjoining areas. For the purposes of this SEIS/PEIR, it is considered a significant impact if the proposed action results in an inconsistency with the noise standards, as defined in the Kern County General Plan Noise Element.

4.8.3. NPR-1 Impacts

4.8.3.1. No Action Alternative

Impacts

For this analysis, audible-noise sources at NPR-1 for the No Action Alternative are assumed to be the same as that of the Reference Case, i.e., those that that were evaluated for the Proposed Action in the 1993 SEIS: 18 compressors with a total rated capacity of 37,500 horsepower, ten additional steam generators rated at 62.5-million BTU/hour each, two heaters rated at 41.5-million BTU/hour each, and two gas-turbine-driven cogenerators, each rated at 21 megawatts and equipped with exhaust-heat recovery steam generators. Table 4.8-2 lists the relative acoustic-power emission levels of the noisiest pieces of equipment in use. Further, for this analysis, noise levels for the Government Development Case from these sources are projected to be the same as the Reference Case. This assumption is based on the production projections in Figure 2.1-2, which show that the peak annual rate of production for the Government Development Case (2001) is the same as the Reference Case. Further, no significant additional noise sources are projected to be added under government development.

The results of the modeling analyses reported in the 1993 SEIS indicated that only insignificant increases in A-weighted residual noise level would occur in any of the three communities as a result of the proposed action: about three decibels maximum in Tupman (in the year 2000), three decibels maximum in Dustin Acres (in 1991), and about one decibel maximum in Valley Acres (in 1996). These increases in the residual environmental noise levels would result in no CNEL or L_{dn} levels greater than about 48 decibels in any community. Therefore, no significant impacts are foreseen.

Table 4.8-2
Typical Acoustic Power of NPR-1 Noise Sources

Equipment	Acoustic Power (watts)
21-MW gas-turbine system	8.0
5,500-hp compressor engine	2.6
466-hp drilling rig engine	1.0
62.5 x 10^6 -BTU/h steam generator	0.72
Heavy truck (accelerating)	0.32

Source: 1993 SEIS

Mitigation

No mitigation is warranted because there would be no significant increases in noise level.

4.8.3.2. Proposed Action

Impacts

Under the Proposed Action (lower-bound of the Commercial Development Case), new audible noise sources would be comparable to those under the No Action Alternative because projected production figures are similar. Hence no significant impact is foreseen. Should some of the new facilities be located closer to residential communities than projected for the No Action Alternative, they might contribute to an increase in residual environmental noise levels. This cannot be quantified without specific knowledge of facility locations, but only one new facility with significant acoustic power (a compressor station) is expected to be constructed, and the likely location would be in a central location, well away from human habitation.

Under the upper-bound of the Commercial Development Case, it is assumed that in the initial five-to-10 years, the major new audible-noise sources at NPR-1 would be one to two additional drilling rigs (over two to three under the Reference Case) plus the additional compressor. Some drilling might be located closer to residential communities, although most would remain in the area of previously developed infrastructure. After the first ten years, the number of new activities would return to the level of the Reference Case as exploration activities decrease (see Figure 2.1-2). The Reference Case analysis is based on major equipment sources with a total acoustic power of approximately 75 watts. The additional sources would increase that power by only six percent. Therefore assuming, as is likely, that the new equipment is centrally located on the production areas of NPR-1, the three decibel maximum impact of the Reference Case is not likely to surpass the 48 decibel threshold in any communities, so as to trigger noise mitigation measures in the respective community plan. No noise impacts would be expected after the initial ten years unless new facilities are located close to residential communities, which is presumed unlikely.

Mitigation

No mitigation is warranted because there would be no significant increases in noise level.

4.8.3.3. Alternatives to the Proposed Action

Impacts

Noise impacts associated with the Commercial Development Cases under the Alternatives to the Proposed Action would be comparable to those analyzed for the Proposed Action.

Mitigation

No mitigation is warranted because there would be no significant increases in noise level.

4.8.3.4. Comparison of Impacts

The upper bound of the Commercial Development Case under the Proposed Action might have noise impacts during the initial ten years of development but would not be significant. No noise impacts are foreseen for the other alternatives.

4.8.4. NPR-2 Impacts

4.8.4.1. No Action Alternative

The No Action Alternative was analyzed in the 1994 EA for continued operation at NPR-2. The analysis found that ambient noise levels are expected to decrease over the next 25 years as oil production and related activities decrease. Temporary increases in noise due to construction were expected to have no impacts because construction activities would take place at distances that would attenuate the noise to an acceptable level.

4.8.4.2. Recommended Action

Noise impacts under the Recommended Action (transfer to BLM) are expected to be the same as the No Action Alternative because production levels would be similar and government control would continue.

4.8.4.3. Alternative to the Recommended Action

Under oil and gas development under the Alternative to the Recommended Action (sale of NPR-2), noise impacts are expected to be the same as the No Action Alternative. However, as the new owner would be free to develop the property in any number of ways after the field was no longer producing, it is not possible to predict whether that development would have significant impacts to communities, some of which are actually on NPR-2.

4.8.5. Cumulative Impacts

The off-site noise levels measured in the 1993 analysis would include background noise from all sources, including oil and gas development and production activities in the area. Therefore that analysis includes the cumulative impacts of NPR-1 with other activities in the region. Therefore, as the analysis indicates, the Proposed Action for NPR-1 would not cause any cumulative rise in ambient noise levels above acceptable levels.

4.9. SOCIOECONOMICS

4.9.1. Summary of Impacts for NPR-1

The purpose of this section is to determine whether either the Proposed or Alternative Actions for NPR-1 independently, or cumulatively, result in a significant economic or social change with particular emphasis on ones that would cause an effect on the surrounding physical environment. Although the Proposed and Alternative Actions could result in privatization of NPR-1 neither action involves a major structural change in current operations.

Under any alternative, the incremental changes to the regional economy are minor and would not lead to any significant physical impacts to the environment due to their relatively small nature in comparison to the overall economic activity of the region. Consequently, any associated growth-inducing impacts are negligible.

Table 4.9-1 shows the direct, total and incremental effects for Kern County for the three different development cases examined. The exhibit shows that, at most, the commercial development case differs from the lower-bound government case (No Action) only by about $5.4 million in total output. This effect is not large enough to have a significant growth-inducing impact on Kern County. Table 4.9-2 summarizes the potential socioeconomic impacts for each case.

Table 4.9-1
Direct, Total, and Incremental Impacts to Kern County for NPR-1 and NPR-2

Case	NPR Direct Expenditures in Kern County ($ millions)	Total Output Impacts in Kern County ($ millions)	Maximum Incremental Output Impacts in Kern County ($ millions)
Reference	$46.60	$84.9	$0.0
Gov. - Lower Bound	$44.66	$81.4	$0.0
Com. - Lower Bound	$46.65	$85.0	$3.6
Gov. - Upper Bound	$46.89	$85.5	$0.0
Com. - Upper Bound	$47.62	$86.8	$5.4

The Notice of Preparation (NOP) initial study, indicated potentially significant impacts to Public Services (fire protection and police protection) and Utilities and Service Systems (storm water drainage, solid waste disposal and local or regional water supplies). As analyzed in this section and sections 4.2 and 4.4, it has been determined that either the proposed action or the alternatives would have less than significant impacts to the demand for these services.

4.9.2. Methodology

Socioeconomic impact areas addressed in this section include fiscal impacts (local tax revenue), employment and economic output. Fiscal impacts were analyzed by multiplying the assessed value of the land by the annual property tax rate in Kern County to determine the direct tax revenue the county would receive under the proposed action. Impacts to direct employment were estimated based on DOE's 1995 Long Range Plan (LRP) (DOE 1995). Indirect impacts of the proposed and alternative actions were estimated using employment and output regional multipliers obtained from the U.S. Department of Commerce's Regional Input-Output (I-O) Modeling System (RIMS II) (Department of Commerce 1992).[1] Effects on population, housing and the demand for public services were primarily analyzed by assessing employment impacts, because these three factors are indirectly driven by changes in the regional employment level. Significant changes in population, housing or the demand for public services could possibly require modification of emergency response plans or emergency evacuation plans, which could lead to a finding of a significant effect on the environment according to Appendix G of the State CEQA Guidelines.

Table 4.9-2
Comparison of Kern County for Each Action

Potential Impact	No Action Alternative		Proposed Action	Alternative to the Proposed Action
	Government Lower Bound	Government Upper Bound	Commercial Development Upper and Lower	Commercial Development Upper and Lower Bound
Fiscal Impacts	No Change	No Change	Annual Direct gain of $25 million in property tax revenue	Change Negligible
Employment	No Change	25 Additional Temporary Employees	Loss of 200 to 300 Jobs	Loss of 200 to 300 Jobs
Population	No Change	Negligible Impact	Negligible Impact	Negligible Impact
Housing	No Change	Negligible Impact	Negligible Impact	Negligible Impact
Public Facilities	No Change	Negligible Impact	Negligible Impact	Negligible Impact

The RIMS II California State multipliers are used to estimate total economic impacts in Kern County resulting from changes in NPR expenditures. Total economic impacts consist of both the direct and indirect effects of an activity. The direct economic effects result from the initial round of spending by NPR-related activities in Kern County. The indirect effects include the impacts on other industrial and service sectors in the regional economy caused by the direct NPR-related activity spending. Because the projected changes are relatively small compared to the size of the county's economy, the basic

[1] The input-output analysis also calculates the expenditures associated with the Reference, Government Development and Commercial Development Cases to determine affects on employment, output and earnings by industry sector. The use of a state multiplier to estimate the effects to a local economy will most likely overstate actual impacts because a local economy is more likely to import materials into their economy than is a larger state government.

assumption behind I-O multipliers—that the structure of the economy (i.e., the relative proportions of the industries in the county) remains approximately the same throughout the forecast period—is not violated.

Impact on income, normally a major focus of socioeconomic analyses, is not addressed in detail because most of the oil and gas produced at NPR-1 and NPR-2 is currently exported to other areas of California, outside of Kern County, as is most of the revenue from wellhead sales. This situation is not anticipated to change under either the Proposed or Alternative Actions.

The socioeconomic analysis considers NPR-1 and NPR-2 impacts separately, and on an annual average basis.[2] Impacts from the Reference Case were first reviewed and then compared to the No Action Alternative, which is based on revised government production data. Impacts corresponding to the Proposed and Alternative Actions are estimated based on comparisons to the lower-bound No Action Alternative estimate, which provides a conservative assessment of the maximum possible incremental change to the regional economy.

To quantify the incremental economic effects for each alternative, this analysis relied on NPR activity data to estimate the incremental expenditures associated with the Reserve under each Alternative. Specifically, this analysis estimated the number of new well drillings and well workovers as an approximate measure of the additional economic activity occurring at the Reserve annually under each alternative. The analysis assumed that the average cost of a new well drilling is $700,000 and that the average cost for a well workover is $65,000. The analysis assumed that baseline NPR expenditures were $169.6 million, which was obtained from the NPR-1 1995 LRP (DOE 1995). For all cases, it was assumed that only 25 percent of the total NPR expenditures would be spent directly in Kern County. This assumption is based on a standard industry/local expenditures ratio. The remaining 75 percent of expenditures is assumed to leave the county directly in exchange for well drilling and workover equipment, which is not available within Kern County. This assumption was originally made in the 1993 EIS, which used a similar methodology to estimate economic impacts. Table 4.9-3 presents an overview of the assumptions used to estimate the total economic activity directly impacting Kern County under each Alternative for NPR-1.

Table 4.9-3
Estimated Kern County Total Direct Expenditures

Case	Average Annual New Drillings	Average Annual Well-Workovers	Total ($ millions)	NPR Direct Expenditures in Kern County ($ millions)
Reference	12	128	$186.39	$46.60
Gov. - Lower Bound	7	66	$178.64	$44.66
Com. - Lower Bound	12	130	$186.60	$46.65
Gov. - Upper Bound	13	134	$187.55	$46.89

[2] Production activity at NPR-1 and NPR-2 is expected to decrease over time, regardless of whether the Reserve is owned and operated by the government or a commercial entity. Only the rate of extraction is expected to vary based on ownership and operational characteristics. Using an annual average, while easier for presentational purposes, will not significantly bias the incremental differences between the alternatives.

4.9.3. NPR-1 Impacts

This subsection analyzes the economic activity associated with the Reference Case, the No Action Alternative, the Proposed Action and Alternative Actions for NPR-1.

4.9.3.1. The Reference Case

Impacts

Under the Reference Case, a total of 446 new well drillings are estimated to take place over the time frame of this analysis. In addition, a total of 4,753 remedial well activities are also projected. Total annual spending, under this scenario, is estimated to be about $186 million, which results in a total direct impact to the region of about $46.6 million based on the assumption that 75 percent of NPR expenditures would be spent directly outside the county. Total impacts to the region are estimated to be $84.9 million based on I-O analysis, which estimates the total effect of the direct expenditures being spent within the county. These estimates are based on the assumption that the government maintains a level of funding consistent with the Reference Case to pursue exploration and enhance oil recovery operations. This assumption, however, is currently unlikely in light of recent government appropriations.

Public Services

The Reference Case will not significantly affect the level of demand for public services, including fire protection, police protection, schools, maintenance of public facilities (including roads) and other government services because this case is a continuance of current government activities which are projected to ultimately to decline and further does not result in any significant growth-inducing impacts.

Utilities and Service Systems

The Reference Case will not significantly affect the level of demand for utilities and service systems, including electricity and natural gas, communication systems, water treatment or distribution systems, sewer or septic tank systems, storm water drainage, solid waste disposal and water supplies because this case is a continuance of current government activities which are projected to ultimately to decline and further does not result in any significant growth-inducing impacts.

Mitigation

The Reference Case is not expected to lead to any socioeconomic impacts that would require mitigation measures.

4.9.3.2. No Action

The No Action Alternative assumes that the government does not divest the current interests in NPR-1 and that Federal ownership of and DOE responsibility toward NPR-1 continues. As previously discussed in this analysis, physical production for the years 1995 and 1996 were lower than previously estimated in the 1995 LRP Plan projections, on which the Reference Case was based. The continuation of lower than previously estimated production constitutes the lower bound of government development under the No Action Alternative, which results in a total direct expenditure estimate for Kern County of $44.7 million. The upper bound of government development assumes that the government produces the

Reserve at a rate consistent with maximum economic development of the reservoir. If this were to occur it would result in direct expenditures of about $46.9 million within the county.

Impacts

Direct Effects

The lower bound of government development would not cause any direct socioeconomic effects beyond those already occurring under government operation because these estimates are based on the current level of economic activity at the Reserve. NPR direct expenditures in Kern County are estimated to be about $44.7 million. While the upper bound assumes government production will increase by about $9.0 million from the lower bound estimate, this production is assumed to require fewer than 25 additional employees. These 25 employees would probably already reside and be employed in the county and therefore have a negligible impact on incremental changes to population housing and public facilities. Finally, because the Federal government need not pay property taxes or make other payments to the local government, the county relinquishes $30 million in annual property taxes that it could collect if the NPR-1 were owned by a private firm.

Total Effects

Because the lower bound of government development is synonymous with the current level of economic activity, incremental indirect effects are expected to be negligible. This Alternative results in insignificant changes in employment and, therefore, population, income and trade. The tax base also would not be adversely or positively affected significantly. Based on the total effect multiplier, Kern County output effects would be about $81.4 million, which differs from the Reference Case by only $3.5 million.

In the short run, the upper-bound results in increased production at the Reserve. The expanded, enhanced recovery at NPR-1 would result in a slight increase in Reserve employment. However, due to the small number of new positions created and the fact that Kern County has a skilled labor force to fill these short-term positions, population, housing and the demand for public services in Kern County are not expected to be affected significantly. Based on the I-O analysis, total Kern County output effects would be about $85.0 million, differing from the total estimated Reference Case output by about one-half million dollars, and not leading to any significant economic impacts within the county.

Cumulative Impacts and Growth-inducing Impacts

The No Action Alternative would not cause any cumulative or growth-inducing impacts, because employment is estimated to remain at current levels or increase slightly, resulting in negligible effects on the local economy.

Public Services

The No Action Alternative will not significantly affect the level of demand for public services, because this case is a continuance of government activities, which although they are projected to temporarily increase ultimately are projected to decline and in any event would not increase above their previous production peak. Further, the No Action Alternative does not result in any significant growth-inducing impacts.

Utilities and Service Systems

The No Action Alternative will not significantly affect the level of demand for utilities and service systems because this case is a continuance of government activities, which although they are projected to temporarily increase ultimately are projected to decline and in any event would not increase above their previous production peak. Further, the No Action Alternative does not result in any significant growth-inducing impacts.

Mitigation

The No Action Alternative is not expected to result in the need for any socioeconomic mitigation measures.

4.9.3.3. Proposed Action

The Proposed Action assumes that the government divests all interests in NPR-1 and that the Reserve becomes entirely commercially-owned and operated. Impacts associated with the Proposed Action were estimated based on both the lower and upper bound of the commercial development case, which predicted 12 to 17 annual new drillings and 130 to 138 annual well-workovers. Direct expenditures in Kern County associated with the lower bound estimate are estimated to total $46.6 million, while upper bound expenditures are estimated to total $47.6 million, a difference of only $1.0 million, annually.

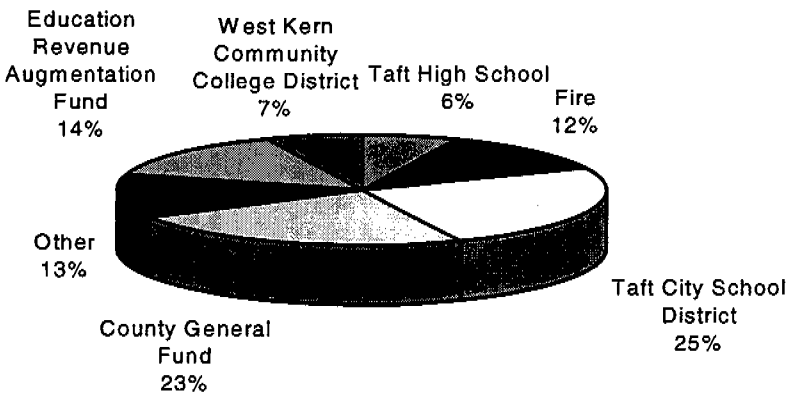
Impacts

Direct Effects

The sale of NPR-1 to commercial interests would have the greatest impact on Kern County government because commercial entities, unlike the Federal government, would be required to pay property taxes on their investment. The Kern County Auditor-Controller's Office approximated the value of Elk Hill at $2.5 billion, which would result in approximately $25 million in additional annual property taxes. Figure 4.9-1 illustrates how the additional county tax revenue would be proportionately distributed among primary recipients, according to the Kern County Assessor's Office. The largest recipient would be the Taft City school district, which would receive about 25 percent of the additional revenues, or about $6.2 million in additional annual funding.

In addition to the annual increase in property tax revenues, the Kern County Assessor's Office estimates that a one-time "supplemental" property tax assessment at the time of the sale would amount to an estimated $33 million based on an estimated $2.5 billion sales price. The Education Revenue Augmentation Fund would receive the largest portion of this windfall, estimated to be about $4.8 million. This money would be distributed by the Superintendent of Schools to the county's various school districts. The Kern County Assessors Office estimates that 142 county agencies would receive some amount of windfall revenues from the sale of Elk Hills. In addition, DOE has agreed to contribute nine percent of the sales amount to the California State Teachers' Retirement System, to augment cost-of-living increases for the retirees.

Figure 4.9-1
Annual Distribution of Elk Hills Property Taxes



Source: Kern County Assessor's Office

Under commercial development, requirements for personnel at NPR-1 are expected to decrease by about 250 to 350 total employees. This estimate is based on the observation that the NPR has already begun to downsize employment (mainly non-field personnel) by about 25 percent from original levels due to increases in labor productivity. This downsizing is not expected to affect the overall productivity of NPR-1 in terms of extraction activity. Under the commercial case, the downsizing is expected to accelerate but will be somewhat dampened by an increase in demand for field labor as extraction activities begin. Due to the size and diversity of the Kern County economy, individuals affected by this change are expected to find alternative employment in the area. Consequently, Kern County is not expected to experience any significant environmental impacts as a result of reductions in facility employment. Further, the trend in recent employment reductions at NPR-1 indicates that by the time the Proposed Action is implemented, staff reductions may have occurred already, resulting in minimal future reductions.

Although as many as 350 jobs may be lost as a result of the Proposed Action, projected growth in the economy has the ability to absorb these jobs elsewhere, and therefore the county may experience a slightly reduced rate of population growth as compared to the No Action Alternative, but not an actual decline in population. It is not expected that the Proposed Action would adversely affect housing, transportation, utilities or other public services and facilities in the vicinity of NPR-1 because impacts to population are not expected to be significant.

Total Effects

I-O analysis shows that total impacts to employment, output and earnings, resulting from increased expenditures in the low and high commercial cases, are small and positive. Indirect employment impacts are negligible, but may help to offset some of the lost jobs resulting from the Proposed Action. Total output for the low and high commercial cases ranges from $81.4 to $86.8 million, respectively. These estimates, at a maximum, differ from the No Action case by about $5.4 million. Consequently the Proposed Action is expected to result in small, positive impacts to output,

earnings and employment in Kern County, but is not expected to be of sufficient magnitude to influence physical economic growth or the resulting demand for public services.

In addition to the indirect effects of private expenditures, Kern County is projected to receive an additional $25 million in annual tax revenues. Because this analysis did not investigate the expenditure patterns of the Kern County government to determine the amount of revenue that is directly spent on goods and services produced in the county, this analysis assumes that the county would spend 50 percent of this amount locally. (Based on prior studies of locally generated and spent income, 50 percent is a conservative estimate that probably overestimates the amount that actually would be spent in the county.) The majority of this amount is expected to be channeled to educational and other government services. Based on the RIMS II Services multiplier for the State of California, an expenditure of $12.5 million could generate an additional $0.5 million in local output and create an additional 60 jobs. These total effects, compared to the overall structure of the local economy, are insignificant and are not expected to cause any growth-inducing impacts.

Cumulative Impact and Growth-inducing Impacts

The small, positive impacts to the economy resulting from the Proposed Action are not expected to cause any cumulative or growth-inducing impacts due to overall small net changes in output and employment within the county. Consequently, under State CEQA Guidelines, the sale of NPR-1 is not expected to interfere with existing emergency response or evacuation plans.

Public Services

The NOP initial study indicated that the Proposed Action could potentially impact significantly local fire and police protection resources because of the possible additional facilities and infrastructure at the sight from commercial development. As subsequently developed, the Commercial Development Case projects no significant new facilities and infrastructure as the projected levels of production can be accommodated by existing facilities. Therefore, the Proposed Action will not significantly affect the level of demand for public services, because although they are projected to temporarily increase ultimately are projected to decline and in any event would not increase above their previous production peak. Further, the Proposed Action does not result in any significant growth-inducing impacts.

Utilities and Service Systems

The NOP initial study indicated that the Proposed Action could potentially impact significantly storm water drainage, solid waste disposal and local or regional water supplies. These impacts have already been analyzed in Section 4.2 and 4.4. As discussed in those sections, the Proposed Action would not significantly impact storm water drainage as additional changes to natural patterns are expected to small and natural habitat would be restored as production declines and wells are shut in. The proposed action would not significantly impact solid waste disposal services, because current capacity is available to meet maximum projected requirements, which would be expected to quickly decrease as production declines. The Proposed Action has the potential to significantly impact local groundwater quality, however, oil spill cleanup requirements and DOGGR underground injection controls would mitigate that risk to less than significant. Therefore no direct impacts to utility and service systems are expected that would not be otherwise mitigated to less than significant and no indirect impacts are expected as the Proposed Action Alternative does not result in any significant growth-inducing impacts.

Mitigation

The Proposed Action is not expected to result in the need for any socioeconomic mitigation measures.

4.9.3.4. Alternatives to the Proposed Action

Impacts

The scenarios under this alternative vary based on whether the Federal government would lease the mineral rights, or establish a government-owned corporation. In general, all socioeconomic impacts resulting from the Alternative to the Proposed Action would be similar to those of the Proposed Action because the new operator would likely increase production to a level similar to a private operator. However, unlike the Proposed Action with private land ownership, retention of land ownership by the Federal government would not contribute any additional revenue to Kern County through real property taxes. Lessees of the mineral rights under the first scenario would have to pay property taxes for any personal property used to produce the oil and gas on NPR-1. The amount of such additional review cannot be projected as the value of such property is unknown at this time, but would not be expected to be significant.

Public Services and Utility and Service Systems

Alternatives to the Proposed Action would involve similar demands for these service as the Proposed Action and would not directly or indirectly significantly affect the level of demand for public services.

Mitigation

Alternatives to the Proposed Action are not expected to result in the need for any socioeconomic mitigation measures.

4.9.4. NPR-2 Impacts

DOE has identified a Recommended Action and two alternative actions for NPR-2. The Recommended Action is the transfer of NPR-2 to BLM for management in accordance with the Federal Land Policy and Management Act and possible additional leasing under the Mineral Leasing Act, except for 16.7 acres of surface rights in Ford City, which are recommended for sale. The alternatives to the recommended action are: No Action (continued DOE ownership and operation of NPR-2); and sale of all right, title and interest in NPR-2 subject to the existing leases.

Under the economic analyses for the Recommended, Alternative, and No Action options, the current level of development at NPR-2 is not expected to differ from current operations because all production activity at the site is currently being performed by the commercial sector under long-term leases. In addition, NPR-2 (as well as NPR-1) is nearing the end of its productive life. Consequently, this analysis assumes that there are no incremental economic effects to consider that are different from the No Action Alternative. Each option involves continued commercial development at the site; however the ownership of NPR-2 would change. Because the site is currently being developed commercially, any incremental development associated with the Proposed and Alternative Actions, as well as impacts on economic growth, are expected to be negligible. The value of NPR-2 has been estimated to be less than

$1 million, so if all of NPR-2 were sold, Kern County would gain some additional tax revenues, but the amount would be less than $12,000, which would not significantly impact economic growth. Sale of the Ford City lots would also add to the tax roles, but would only add negligible tax revenues.

4.9.5. Cumulative Impacts

The cumulative impacts of NPR-1 and NPR-2 are equal to the total estimated impacts for NPR-1 because of the negligible impacts attributable to NPR-2.

4.9.6. References

"Elk Hill's Sale Boon for Taxing Agencies," *The Bakersfield Californian*, (missing date).

U.S. Department of Commerce, 1992, "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)," Bureau of Economic Analysis, May.

U.S. Department of Energy, Chevron and Bechtel, 1995, Naval Petroleum Reserves in California, FY 1995 Long Range Plan, Vol. 1 & 2.

4.10. HAZARDS RISK ASSESSMENT

Following a summary of impacts associated with oil spills, fire and other hazards at NPR-1, this section discusses the methodology used to identify direct and indirect impacts for the various hazards, impacts from hazards at NPR-1 and NPR-2, and cumulative impacts for all combinations of actions.

4.10.1. Summary of Impacts for NPR-1

As discussed in Section 3.10, there are certain hazards associated with petroleum production operations. The two major types of hazards that are the focus of this analysis are: (1) spills (which threaten primarily the environment); and (2) blowouts, fires, and explosions (which threaten primarily personnel and property and, secondarily, the environment). Addtional hazards include other accidents and other occupational injuries. Because the hazards of dealing with large quantities of oil, gas and natural gas liquids are well recognized at petroleum-production facilities, standards and precautions to prevent spills and accidents are highly developed, as are the capabilities of coping with such events should they occur.

With respect to oil spills at NPR-1, it is expected that there could be an increase in the incidence of oil spills corresponding to increased production levels for other government and commercial development. However, the majority of such incidents would continue to be small in size and are readily contained through extensive on-site prevention measures (i.e., secondary containment) which would be required regardless of whether the facility is Federally-owned or privately-owned. In addition, on-site and local/regional recovery and response capabilities are sufficient to deal with anticipated risk levels. This level of preparedness essentially would remain unchanged under private ownership. Finally, a lack of perennial watercourses and other vulnerable receptors in the vicinity of tank and pipeline settings effectively limits the impact that uncontained oil spills could have on the surrounding environment. As such, oil spill risk levels are not considered to be significant even under the upper bound of the commercial development case.

Similarly, the rate of blowouts, fires and explosions would be expected to increase slightly from current NPR-1 rates until production and associated activities begin to drop off following the year 2002. Like DOE, private entities assuming ownership of NPR-1 are expected to have comprehensive accident prevention programs to minimize the occurrence of such risks and address their consequences in order to avoid losses of valuable product and costs of mandatory cleanup. Consequently, a change in NPR-1 ownership is not expected to interfere with emergency response plans or emergency evacuation plans, which otherwise would lead to a finding of a significant effect on the environment according to Appendix G of the State CEQA Guidelines. Although such accidents are considered likely occurrences according to the classification scheme in Table 4.10-4, the severity of such events is minor (i.e., small level of public risk, with at most a few minor injuries).

One notable difference between the No Action Alternative and the Proposed Action and Alternative to the Proposed Action for NPR-1 is the fact that if ownership is transferred to the private sector, staffing levels could be expected to decrease 30 percent or more from current levels (a decrease of 250-350 jobs). As the number of personnel drop the number of vehicle miles traveled and associated accidents would also be expected to fall.

Finally, there are less than significant cumulative impacts associated with any combination of outcomes. This is true because NPR-1, NPR-2 and other nearby oil fields not owned or operated by DOE

are geographically separate sites, and oil spills and accidents are discrete events that are limited in the extent of their impact.

4.10.2. Methodology

In assessing hazard risks associated with the various alternatives for NPR-1, an analysis of past and current operations was first conducted, as well as an assessment of applicable regulations and measures in place, to help control such risks (See Section 3.10). Because the alternatives would result in varying degrees of the same basic activities (e.g., production, temporary storage,and transport of oil), the types of risks associated with future operations would be similar to those of current operations. However, because the level of activity would vary under different alternatives, the magnitude of risks may differ slightly. For purposes of the analysis, historical oil spill and accident data were analyzed to determine spill or accident rates associated with particular activities (e.g., production of a barrel of oil, remedial actions, new wells drilled, etc.). In general, experiences over the past five years or so are particularly applicable and, where available, such data are used to determine spill and accident rates. These rates were then applied to the production levels under the various alternatives for purposes of comparison.

For NPR-2, only a qualitative assessment of spill and accident risk is provided, given the declining activity levels and the already minimal nature of risk present at this site.

4.10.3. NPR-1 Impacts

It is generally predictable that oil spills, pipeline and tank leaks, fires and explosions, well blowouts, vehicle accidents and other common types of industrial accidents will occur. A discussion of the most significant risks and mitigation measures is presented in this section, including an analysis of direct and indirect effects. To facilitate discussion of the impacts associated with each alternative, Table 4.10-1 presents projections of various impacts and is followed by a discussion of the definition and use of standards of significance. Specific discussions of relevant data, impacts and mitigation measures for the No Action Alternative, the Proposed Action and Alternative to the Proposed Action are presented in 4.10.3.

Table 4.10-1
Summary of Estimated Number of Spills, Blowouts, Fires and Explosions, and Vehicle Accidents at NPR-1, 1997 - 2034

	Spills	Blowouts	Fires and Explosions
	Average Annual	Total	Average Annual
Reference Case	180	2.16	8.5
Government Case (Lower Bound)	164	1.12	8.2
Government Case (Upper Bound)	272	2.25	9.3
Commercial Case (Lower Bound)	230	2.18	8.9
Commercial Case (Upper Bound)	386	2.38	10.3

Impacts resulting from system safety hazards are characterized by their magnitude (severity of consequences) and frequency of occurrence. As suggested by the CEQA guidelines, and based on U.S. EPA Guidelines, system safety hazards can be classified by the severity of the impacts and frequency of their occurrence as indicated in Table 4.10-2 and Table 4.10-3, respectively. The severity classification describes the level of public risk for a fatality, injury or oil spill size. There are no actual relationships between the description of public safety hazard and spill size in Table 4.10-2; these two columns present two separate sets of thresholds.

Table 4.10-2
Severity of Impacts

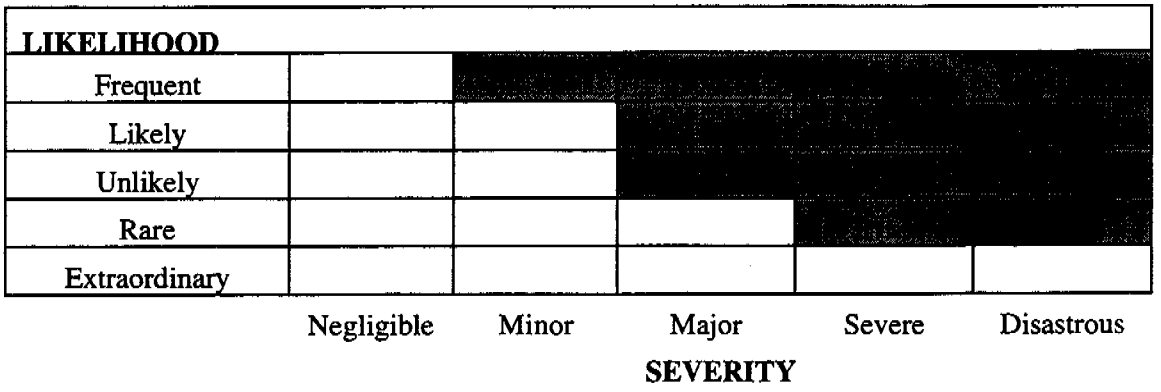
Classification	Description of Public Safety Hazard	Spill Size
SEVERITY		
Negligible	No significant risk to public, with no minor injuries.	Less than 10 bbl (420 gal)
Minor	Small level of public risk, with at most a few minor injuries.	10 - 238 bbl (420 - 10,000 gal)
Major	Major level of public risk, with up to 10 severe injuries.	238 - 2,380 bbl (10,000 - 100,000 gal)
Severe	Severe public risk, with up to 100 severe injuries or up to 10 fatalities.	2,830 - 357,142 bbl (100,000 - 15,000,000 gal)
Disastrous	Disastrous public risk involving more than 100 severe injuries or more than 10 fatalities.	Greater than 357,142 bbl (15,000,000 gal)

Table 4.10-3
Frequency of Occurrence

Type	Frequency	Description
LIKELIHOOD		
Extraordinary	Less than once in one million years.	An event whose occurrence is extremely unlikely.
Rare	Between once in ten thousand years and once in one million years.	An event that almost certainly would not occur during the project lifetime.
Unlikely	Between once in a hundred and once in ten thousand years.	An event that is not expected to occur during the project lifetime.
Likely	Between once a year and once in one hundred years.	An event that probably would occur during the project lifetime.
Frequent	Greater than once a year.	An event that would occur more than once a year on average.

Table 4.10-4 describes the relationship between the frequency of a hazard occurring and the severity of that hazard's consequence. The shaded areas in the matrix show the combinations of accident likelihood and severity that have been defined as significant with respect to public safety.

Table 4.10-4
Hazard Scenario Risk Ranking Matrix



4.10.3.1. No Action Alternative

The No Action Alternative is characterized by continued DOE ownership and maintenance of the operations at NPR-1, and the No Action Alternative is composed of the Government Development Case between lower and upper bounds.

Impacts

Using the Reference Case as a point of comparison, the frequency and magnitude of oil spill risks could be expected to be very similar to those that characterize the current situation at NPR-1. Although aging equipment and facilities could increase the risk of oil spills slightly, this risk would be offset somewhat by declining oil production and concomitant site activities in the future. Similarly, blowouts, fire and explosion hazards and vehicle accidents would be expected to continue at current NPR-1 rates until production and associated activities began to drop off significantly following the year 2001.

With respect to the lower bound of the Government Development Case, the risk of oil spills and accidents are expected to be slightly lower than for the Reference Case given correspondingly lower activity levels. For the upper bound of the government case, the frequency of oil spills would be slightly higher, corresponding to higher production levels. Table 4.10-1 shows an average of 272 spills on an annual basis over the period 1997-2034. However, the vast majority of such spills are minor (e.g., less than 100 barrels). For minor spills and occasionally those in excess of 100 barrels, nearly 80 percent of spilled volume is recovered on average. Releases from tanks are unlikely to escape secondary containment in significant quantities. Spilled oil that is not contained within secondary containment facilities would almost certainly be contained within NPR-1 site boundaries by use of berms and diversions. Also, additional resources, (i.e., response/cleanup contractors) have been identified as a backup mechanism in the event spills escape secondary containment and exceed on-site response equipment/resources. Additional discussion of mitigating factors for addressing oil spills under current NPR operations is presented in Figure 4.10-1 below.

The presence of these preventive measures at tank areas and the lack of perennial watercourses in the vicinity of tank settings effectively limits the direct impact of oil spills associated with the No Action

cases. In addition, there are no appreciable indirect impacts associated with the expected spill levels for the upper bound of the Government Development Case in Table 4.10-1.

Figure 4.10-1
Additional Mitigating Factors for Oil Spills and Accidents at NPR-1

- Spill Prevention Control and Countermeasures (SPCC) Plan and program.
- EPA 90 Facility Response Plan (FRP) and response resources.
- DOE Orders and other requirements providing for formal reporting systems, internal investigations, and development and implementation of corrective actions for occupational accidents and near misses, vehicle accidents, fires/explosions and unusual occurrences.
- DOE Orders and other requirements providing for formal independent investigations, and development and implementation of corrective actions for any of the forgoing incidents that are particularly significant.
- DOE Orders and other requirements providing for periodic formal Technical Safety Appraisals, Environmental Surveys and Tiger Team Assessments (safety and environmental) sponsored by DOE headquarters, and development and implementation of corrective actions.
- DOE Orders and other requirements providing for internal inspections, audits and vulnerability assessments of all operational, safety and environmental activities to determine the level of compliance with requirements and to develop and implement appropriate corrective actions.
- Comprehensive quality assurance and quality control programs, pursuant to DOE Orders, including, among other things, a Performance Indicator System that tracks/trends safety and environmental performance indicators. A Comprehensive Corrective Action System to track completion of all identified corrective actions is also in place.

The approximate number of blowouts under the upper bound of the Government Development Case is expected to be similar to the number predicted under the Reference Case, i.e., two to three blowouts over the period 1997-2034. This estimate is based on a rate of 0.00042 blowouts per activity (where activity is defined as the number of new wells drilled plus the number of remedial/workover actions) that was calculated using historical data for NPR from 1974-1996. As discussed in Section 3.10, NPR's rate is slightly better than the expected blowout rate of 0.00055 per activity (0.8 blowouts per 1,000 wells and 0.3 blowouts per 1,000 remedial/workover actions) calculated using data from the 1979 EIS (DOE 1979). Referencing Table 4.10-4, such events are likely but are minor in severity resulting in a non-significant impact. This fact, in conjunction with improved safety and operation programs at NPR-1 (see Section 3.10.) would result in effective management of risks in all of the above categories.

Mitigation

Under the No Action Alternative, mitigation of less than significant impacts caused by spills, blowouts, fire and explosion hazards, and vehicle accidents would continue to be addressed by existing containment, response and safety capabilities. In addition, a lack of perennial watercourses and other vulnerable receptors in the vicinity of tank and pipeline settings effectively would limit the impact that uncontained oil spills could have on the surrounding environment.

4.10.3.2. Proposed Action

The proposed action is characterized as the sale of NPR-1 to the private sector. The proposed action would involve minor changes in the manner in which the facility is operated and major changes in the levels of oil, gas and natural gas liquid production at NPR-1. The Commercial Development Cases (upper and lower bound) are analyzed under this alternative. There are no differences in impacts associated with the various sale scenarios under the Proposed Action.

Impacts

The upper bound of the Commercial Development Case would entail an elevated level of production and corresponding site activity. In fact, production levels could approach the peak for NPR-1, which occurred during the early 1980's but then would quickly decline to levels below current production. Along with increased production and throughput would be an increased incidence of oil spills. As shown in Table 4.10-1, the number of oil spills is expected to average 386 spills per year over the period 1997-2034. The expected number of spills peaks around 2001 when production is expected to reach its highest levels, and then declines with falling production levels. As discussed in Section 3.10, the vast majority of these spills are minor in nature (i.e., less than 100 barrels). Moreover, historic recovery rates for oil spills have approached 80 percent.

For the most part, spilled oil would be captured within secondary containment facilities or contained within NPR-1 site boundaries through the use of berms and diversions. The presence of these preventive measures at tank areas and lack of perennial watercourses in the vicinity of tank settings effectively limits the impact of oil spills from tank settings. Releases from tanks are unlikely to escape secondary containment in significant quantities. With the exception of road crossings, the great majority of pipelines at NPR-1 run above ground and are supported by structural members where necessary. This minimizes corrosion and generally adds to the useful life expectancy of pipelines. In the unlikely event that uncontrolled spills result from tank settings or pipelines, adequate containment measures exist to prevent extensive horizontal migration over land.

Under the proposed action, the commercial entity that assumes ownership of NPR-1 operations would not be subject to DOE orders but would need to comply with all applicable Federal, state and local regulations including the Federal SPCC and FRP regulations. A major component of several of these regulations is the requirement to address prevention and response measures for oil spills through comprehensive planning.

An Oil Spill Contingency Plan (OSCP) would be prepared by the new owner and such a plan would receive approval by appropriate Federal, state and local agencies (including the Department of Fish and Game, Office of Spill Prevention and Response) prior to operations. The final OSCP would provide a list of emergency service providers. The plan would also specify measures to be taken in emergency scenarios. The OSCP would identify the responsible parties for incident command and the supporting organizations and agencies. Normally, the fire department commanders would remain the incident commander until relieved by other authorities legally able to assume responsibility for the incident. The final commanding organization would be selected depending on the nature of the damage and the resource being affected.

It is anticipated that the new owner would enter into a contractual agreement with a regional spill response contractor that would serve as the system emergency response contractor with primary responsibility for containment, cleanup and health and safety. The OSCP also would list third-party contractors providing human resources and equipment such as vacuum trucks, boats, skimmers,

absorbent and skirted booms, dump trucks, portable tanks, absorbent materials, dispersants, steam cleaners, hydroblasters, cranes and forklifts. The plan would detail how such entities would interact with local emergency response providers. Thus, although some spills in excess of 238 barrels (i.e., major spills according to the severity classification in Table 4.10-2) are likely to occur periodically, the majority of spilled oil would be contained and recovered through a combination of physical barriers and pre-arranged equipment and human resources, thus minimizing any direct impacts. In addition, there are no appreciable indirect effects associated with the somewhat elevated spill levels under the upper bound of the Commercial Development Case.

A similar statistical increase in number of blowouts, fires and explosions is likely to occur under the upper bound of the Commercial Development Case. Given that the occurrence of such events is so rare, this does not necessarily translate into a greater number of blowouts expected over the period 1997-2034. If blowout data and experience data is applied to the activities comprising the upper bound of the Commercial Development Case (e.g., rate of new well development and remedial and workover actions, etc.) then two to three blowouts could be expected over the period 1997-2035. A similar analysis of the frequency of incidents involving fire and explosion under the upper bound (based on projected natural gas production levels) indicate that an average of approximately ten fires or explosions per year could be expected over a similar period as compared to eight under the reference case. The expected number of fires or explosions peaks around 2002 when natural gas production is expected to reach its highest level. Private entities assuming ownership of NPR-1 are expected to have comprehensive accident prevention programs to minimize the occurrence of such risks and address their consequences. Although such accidents are considered likely occurrences according to the classification scheme in Table 4.10-3, the severity of such events is minor (i.e., small level of public risk, with at most a few minor injuries).

With respect to injuries and deaths, rates under private ownership are not expected to differ significantly from those currently encountered under DOE ownership. Recordable occupational injury rates at NPR-1 (DOE, contractors and subcontractors) for the period 1982-1995 are provided in Table 3.10-2. Injuries per 200,000 man-hours worked during this period range from 1.88 in 1993 to 8.50 in 1982. Data available on private sector petroleum industry injury and illness rates over the years 1986-1994 (API Petroleum Industry 1996) indicate that rates are slightly higher than NPR rates; however, they remain below those for the oil and gas extraction industry as recorded by BLS. The most hazardous activities at NPR-1 are those associated with drilling operations.

There have been a total of five fatalities at NPR-1 since 1979, the last of which occurred in July 1988. Fatality incidents are reported to Cal-OSHA, Kern County, and DOE Emergency Operations Center.

NPR-1 reported an average of 311 vehicles in use and 2,839,500 miles of travel during the period 1989-1995.[1] One major change between the No Action Alternative and the Proposed Action (both upper and lower bound of commercial development) is the fact that if ownership is transferred to the private sector, staffing levels could be expected to decrease 30 percent or more from current levels. Along with this drop in the number of personnel, the number of vehicle miles traveled and associated accidents are expected to fall.

Risks associated with the lower bound of the commercial case fall between levels anticipated for the lower bound of the government case and the upper bound of the commercial case and therefore are not quantified further as part of this analysis.

[1] Figures were not available for 1988.

Mitigation

Under the Proposed Action, mitigation of less than significant impacts caused by spills, blowouts, fire and explosion hazards, and vehicle accidents would be addressed by the new owner. Under private ownership, containment, response and safety capabilities would be established in compliance with all applicable Federal, state and local regulations, including SPCC and FRP requirements. An Oil Spill Contingency Plan would be prepared by the new owner and approved by Federal, state and local agencies. It is also anticipated that a regional emergency response contractor would have containment, cleanup, and health and safety responsibilities. In addition, a lack of perennial watercourses and other vulnerable receptors in the vicinity of tank and pipeline settings effectively would limit the impact that uncontained oil spills could have on the surrounding environment.

4.10.3.3. Alternative to the Proposed Action

Impacts

Each of the scenarios considered under the alternative to the proposed action would be expected to be identical to either the upper bound or lower bound of the Commercial Development Case under the proposed action in terms of the factors that influence risk (e.g., productions levels). Furthermore, there are no additional or unique risks created as a result of an alternative sale arrangement. Thus, this alternative is expected to result in similar impacts (ie., less than significant) to those associated with the proposed action.

Mitigation

No mitigation is required because impacts are not significant.

4.10.3.4. Comparison of Impacts

As shown above in section 4.10.3.1-3, those scenarios resulting in the highest levels of production and associated activities (e.g., upper bound of the Commercial Development Case followed by upper bound of the Government Development Case) are expected to be characterized by slightly elevated risk levels as compared to other more moderate production scenarios. (See Table 4.10.1.) However, these increases in risk are expected to be minimal and are considered to be less than significant for purposes of this analysis. Consequently, no mitigation measures would be required because impacts are not significant.

4.10.4. NPR-2 Impacts

As discussed previously, only a qualitative assessment of spill and accident risks is provided given the declining activity levels and the already minimal nature of risks for NPR-2.

It is expected that small spills (less than one barrel) would continue to occur at NPR-2 under the recommended action or alternatives to the recommended action case (i.e., sale of NPR-2) at an expected rate of 36 per year under current production levels, and decrease significantly thereafter as the number of wells and total oil production decrease over the next 20 years. These small spills and their cleanups affect much less than one acre of land and are quickly cleaned up, having no effects on surface water or groundwater.

Spills greater than one barrel would also be expected to occur on an infrequent basis; for example, only one such spill occurred during a recent two-year period (March 1991-March 1993). Based on experience at NPR-2 and other similar facilities, the scenario most likely to result in the largest potential release of oil at NPR-2 is a spill from a pipeline. While storage tanks could deliver a greater volume more quickly, they are provided with secondary containment, which would prevent release of oil to the environment should a catastrophic tank or tank pipe failure occur. The likelihood of a pipeline spill at NPR-2 exceeding 100 barrels is low because the pipelines at NPR-2 are gravity-fed, aboveground (except at crossings), and inspected routinely. Such a spill would be detected early because of routine monitoring and would be promptly cleaned up by trained personnel. Less than five acres of habitat would be expected to be disturbed by the spill and associated cleanup efforts. The spill might enter a drainage channel but would not be expected to travel more than 1.2 miles (2 km). As a result, cleanup efforts would be very effective in removing the oil from the channel. Although unlikely, groundwater could be affected by a pipeline spill. Should a pipeline spill be suspected of infiltrating the soil, the visibly contaminated soil would be removed promptly, and the remaining soil tested to assure that it is clean. It is unlikely that cleanup efforts would affect threatened or endangered species because, at the earliest opportunity during a cleanup, the area is surveyed for potential habitat to avoid negative effects to the species.

Future risks of fire or explosion from drilling activities for the Proposed Action and Alternative to the Proposed Action are expected to be lower than current risks because of the continuing depletion of the reservoir and reduction in total number of oil wells. As a result, no fires or explosions are expected at NPR-2 as a result of the proposed action or alternative.

4.10.5. Cumulative Impacts

As discussed in Section 2.4 of this report, not just Federal but all other oil and gas activities in the immediate vicinity of NPR-1 and NPR-2 operations were considered for purposes of assessing cumulative impacts associated with spill and accident risks. There are no appreciable cumulative impacts associated with the expected spill levels for any combination of the various scenarios, even those resulting in elevated production levels and associated activities. This is largely because the various oil fields under consideration are geographically distinct sites that share no common surface water receptors other than the California aqueduct, which is well protected from intrusion by spilled oil. Moreover, as most spills are expected to be relatively small and quickly contained, there is little possibility of any cumulative impacts resulting from spills occurring at different areas.

One mechanism through which oil from various areas could accumulate involves groundwater. Prolonged unrecovered deposits of spilled oil (e.g., undetected leaks from storage tanks) could percolate over time into groundwater. Cumulative impacts to human health or the environment associated with such contamination are expected to be insignificant. First, the groundwater in the vicinity of this production region is not used as drinking water. Water from the first groundwater layer is used primarily for injection. Water from the much deeper second layer is used for agriculture. Second, because detected spills are quickly remediated at all sites, the potential for appreciable contamination is quite small.

4.10.6. References

American Petroleum Institute, 1996, Petroleum Industry Environmental Performance (PIEP) Fourth Annual Report, May.

U.S. Department of Energy, 1979, 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 Report DOE/EIS-0012, Washington, DC, August.

4.11. ENERGY CONSERVATION

4.11.1. Summary of Impacts for NPR-1

The NPR-1 is both a large producer and large consumer of energy; the energy being produced significantly exceeding the energy being consumed. There were 131 Bcf of natural gas, 3.9 MMB of gas condensate (propane, butane and natural gasoline) and 22 MMB of oil produced in 1996. Under the Reference Case, these numbers are expected to rise slightly till FY 2000 and begin to decline after that date. The Department of Energy sells the government's share of the oil and gas production at the NPR-1 facility. However, only 18 percent of the natural gas is sold. The remainder is either reinjected to maintain reservoir pressures, used in field operations, or converted to another usable form of energy as natural gas liquids. Total energy produced varies significantly both between the government and commercial development and within the range of possible results for each. Table 4.11-1 provides a summary of production projections with energy equivalents of total energy consmption for all development cases. The range of production for each case is shown in Table 2.2-4 in Chapter 2. Locally-produced NPR-1 crude oil is also used as a diluent facilitating the low-cost pipeline transportation of heavy crude to refineries.

The facility produces 47 megawatts of electricity from the cogeneration plant on site. NPR-1 was originally a net purchaser of electricity until the cogeneration plant was built. The cogeneration plant made the facility self-sufficient and a net producer of excess electricity that is sold to the local utility, Pacific Gas & Electric. Electric power usage is projected to rise to 44 MW by the year 2000 and then begin to decline as production declines.

The Proposed Action and the Alternative to the Proposed Action are expected to have a significant, positive impact on the production of energy, as the privatization of NPR-1 is expected to result in the fullest possible development of the reserve. Otherwise, valuable energy resources may be lost if adequate capital investment is not made in the development of the Reserve.

Table 4.11-1
NPR-1 Summary of Production Projections with Energy Equivalents of Total Energy Consumption for all Development Cases

	Production Projections Total 1997 End of Field Life (MMBOE)	Energy Equivalent[a] of Total 1996 Energy Consumption[b] (days)
Reference Case Total Hydrocarbon Production	856	31.13
Government Case - Lower Bound Total Hydrocarbon Production	582	21.16
Government Case - Upper Bound Total Hydrocarbon Production	1,089	39.60
Commercial Case - Lower Bound Total Hydrocarbon Production	918	33.38
Commercial Case - Upper Bound Total Hydrocarbon Production	1,433	44.55

[a] = Energy equivalent calculated using the conversion equation bbl = 5.800mmbtu and with the statistic 1996 Total US Energy Consumption =58.214 quadrillion btu.
((Case amount MMBOE * 5800000 btu per bbl) / 58.214 quad btu per year) * 365 days

[b] = The 1996 Total US Energy Consumption estimate was referenced from the EIA/DOE website for petroleum and natural gas consumption in the United States

The major sources of energy consumed at the NPR-1 facility are petroleum products; gasoline, diesel fuel and natural gas. The electricity used at the facility is produced on site and is fueled by natural gas. Conservation of energy at the NPR-1 facility is approached in three ways; minimal use of equipment and facilities that consume energy as a fuel or energy source, continuous redesign of equipment and facilities to conserve fuel and resources as an energy source, and the design of new projects with conservation of energy as a major consideration.

Most of the energy used at the NPR-1 is nonrenewable, such as gasoline and diesel fuel for vehicles, and natural gas for compressor engine fuel. Natural gas is also used as an energy source for pressure maintenance within the oil reservoirs to provide a more efficient recovery of oil and condensate. This form of energy is conserved by cycling the gas through the reservoirs several times. The natural gas can be sold or used as fuel after it is used for pressure maintenance. Under commercial development, it is assumed that there will be an increase, compared to the Reference Case, in the consumption of nonrenewable energy at the NPR-1 facility for some activities. The adoption of either the Proposed Action or either of the alternatives is expected to have a less than significant impact on energy conservation.

4.11.2. Methodology

To establish and evaluate the impact of future operation of NPR-1, three cases were developed to contrast future possible oil and gas production operations. The Reference Case represents the continued operation of the NPR under the 1995 Long Range Plan (DOE 1995). This case is the baseline for establishing impacts that would result from increased oil and gas activity under the alternatives. The Government Development Case represents the future activity if the NPR-1 operation were fully funded to engage in low-risk exploratory activity such as infill drilling and horizontal drilling to increase production. The Commercial Development Case represents the future activity if the NPR-1 reserve were sold to commercial interests under the proposed action and production activity were increased to include both low risk and high risk exploratory activity. The government and commercial cases are presented with an upper and lower bound of production as an indication of the reasonably possible future of activity that would create environmental impacts. From these estimates the amount of additional energy consuming equipment needed to support these activities was projected and the energy consumption calculated.

According to Appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will: encourage activities which result in the use of large amounts of fuel, water or energy; or use fuel, water or energy in a wasteful manner.

4.11.3. NPR-1 Impacts

4.11.3.1. No Action

Impacts

Under the No Action Alternative, it is assumed that there could be an increase for some activities, compared to the Reference Case, in the consumption of nonrenewable energy at the NPR-1 facility. This includes fueling additional drilling, remedial well warehouses, reservoir workovers and production activities under the upper bound of commercial development. It is also assumed that there will be a reduction in energy consumption associated with general, everyday activities such as less vehicle use as the number of personnel at NPR-1 is scaled back. As the existing transmission lines and associated facilities were developed to support higher levels of electricity use on NPR-1 before the

installation of the on-site cogeneration facility, these facilities are adequate to handle any future needs for the delivery of electric power to the site in excess of the capacity of the cogeneration plant without the need for any significant new construction that might impact the surrounding environment.

The use of electric power by the NPR-1 facility is estimated to be 29 MW annually, out of 47 MW generated every at the reserve. Electric power usage is projected to rise to 44 MW by the year 2000. This increase is for planned projects to expand waterflood operations, gas-lift compression and the addition of electric powered oil pumping units on existing wells. Additional wells to be drilled under the upper bound of the Government Development Case would require another increase in electric consumption that could equal the increase now projected for the existing wells. The largest increase in electric power consumption will be for electric motors that are scheduled to replace the 105,000 horsepower produced by 60 internal combustion powered gas compressors engines. This is to be completed by FY 1999 and could require an additional 78 MW of electric power.

Mitigation

For the No Action alternative, mitigation measures will not be required.

4.11.3.2. Proposed Action

Impacts

Under the Proposed Action, it is assumed that there will be an increase, in consumption of nonrenewable energy at the NPR-1 facility for some activities compared to the Reference Case. This increase will fuel additional drilling, remedial well and reservoir workovers and production activities. It is also assumed that there will be a reduction in energy consumption associated with general, everyday activities, including vehicle use associated with a reduction in personnel at the NPR-1 site. This will be offset, somewhat, by the increase in vehicles used for field work. The incremental difference in energy consumption between the different cases is not considered to be significant.

The Proposed Action (Commercial Development Case) would increase levels of energy consumption, overall, because of the expected rise in oil and gas production. Drilling activity would increase the need for diesel fuel for the engines that power the rigs, pumps and portable electric generators. This is expected to be in the order of 96,600 gallons of diesel fuel to power two or three drilling rigs and three or four remedial workover rigs needed to drill 150 new wells and perform the additional workover maintenance on the existing wells projected in the upper bound of commercial development.

It is projected that the personal and company vehicles associated with drilling and remedial operations would increase gasoline consumption by 1,500 gallons/per year, which would be offset by, as much as twice that amount due to less people working at the NPR facility. This would result in a net reduction in gasoline use.

The upper bound of commercial development would also result in an increase in electric power as a result of the conversion of gas powered compressor engines to electric motors to address air quality impacts. The use of natural gas as a nonrenewable energy source is projected to be reduced as gas fueled compressor engines are replaced with electric motors. The increase in diesel fuel use for field well

activity will take place over several years, 1998 to 2010 or longer and is expected to have minimal impact to the environment.

4.11.3.3. Alternative to the Proposed Action

The Alternative to the Proposed Action would involve the same energy consumption and production as the Proposed Action.

4.11.3.4. Mitigation

Because impacts are not expected to be significant, no mitigation measures are warranted.

It should be noted that in developing the Government and Commercial Cases, annual production rates are assumed to be based on maximum efficient rates, but under different conditions. The Reference Case is based on development at the maximum efficient rate (MER) under existing funding, while the upper bound of government and commercial development assume MER production with no funding constraints, which permit full development of the facility. In the event that a private owner begins to produce at rates greater than the these occuring under existing finding, to an extent that would threaten the structure of the oil and gas reservoirs and the loss of energy resources, DOGGR has the authority through the well permit process, to initiate mitigation. The Conservation Committee, at DOGGR direction, monitors the operations, calculates MER rates and assembles and evaluates production and reservoir data from onshore, state tidelands and OCS areas for the NPR-1. In the event the Conservation Committee determines that extraction exceeds the maximum efficient rates, DOGGR could decline to issue future required permits until the practice is ended.

4.11.4. NPR-2 Impacts

NPR-2 is not a large producer or consumer of energy. NPR-2 produced about 1 MMB of oil from government and non-government leases in 1996, compared to the 22 MMB produced on NPR-1 in the same year. Approximately one-third of NPR-2 is owned by DOE and leased to private oil and gas operators, who pay royalties to DOE. The other two-thirds of NPR-2 either has no oil and gas production, or the production is owned and operated by other private oil companies. The administrative responsibility for the DOE's NPR-2 leases is maintained by agency staff at the NPR-1 facility. There are no oil or gas processing facilities on the reserve since the last plant (owned by Texaco) was dismantled in 1996. All oil and gas production, on from DOE leases, is transported by pipeline or truck by the operators, off the reserve, to NPR-1 or adjacent oil field processing facilities. NPR-2 production consists of primary recovery; there are no enhanced oil and gas recovery operations on the NPR-2 DOE leases, and therefore no gas or water injection and cycling operations that require an extraordinary energy consumption. The plan for future production on NPR-2 is to operate the field under natural reservoir forces until depletion, sometime after FY 2000.

4.11.5. Cumulative Impacts

All of the projects concerned with the conservation of energy are designed to reduce the environmental impacts associated with increased operations at NPR-1 and NPR- 2. The future operation of the two facilities is not expected to result in an expansion of environmental impacts when consolidated with the impact on the environment from production activities at adjacent oil and gas fields. NPR-1 production is generally in decline (although a temporary increase is currently projected) and is not expected to return to past levels of production. Any future activity (new wells, enhanced recovery projects...etc.) would impact only the immediate area and would not have an environmental influence

outside the boundary of the reserve. NPR-2 production is also on decline. There are no enhanced oil recovery activities (water or gas floods, horizontal drilling, etc.) on the government leases and no projects are planned for the future.

The oil produced at the NPR-1 reserve is one of the few sources of light oil in California. The Stevens zone produces a 36° (API) crude and the shallow oil zone (SOZ) produces a slightly heavier 26° crude. Most of the oil produced in California outside of the NPR-1 reserve is a 15° or heavier oil. Heavy crude oil is processed by refineries; however, it does not produce as many (of the lighter, more valuable, products as can the lighter oils) products. Some of the refineries and smaller, independent oil producers in the area around Elk Hills depend on the sale of NPR-1 crude to blend with heavier crude produced outside of NPR-1to make a more valuable, salable product and remain in business.

The DOE sells crude oil produced at the NPR-1 reserve to the highest bidder, with no more than 20 percent being sold to any one bidder. There are (usually) more than 70 different entities bidding for the NPR-1 oil at each sale. This process results in a volume of light crude being made available to blend with the heavier crude that comes from other local sources. It provides for the production and use of an energy source that otherwise might be lost. Given this unique situation, an interruption or reduction in the sale of NPR-1 crude, could cause a reduction in the total volume of oil produced in California, which would have a severe adverse impact on what is now a high level of energy resource conservation; without NPR-1's light oil contribution not all of the heavy oil would be produced.

The NPR-1 sales process was designed to mitigate the possible adverse impact to heavy oil producers by dividing NPR-1 into an operating interest and several smaller non-operating interests so that multiple buyers could bid for future NPR-1 production. Companies that need access to the NPR-1 lighter crude can assure future access by successfully bidding for one of these interests, either alone or in a joint venture with other companies.

4.11.6. Reference

U.S. Department of Energy, Chevron USA and Bechtel, 1995, Naval Petroleum Reserves in California, FY 1995 Long Range Plan, Vol. 1 & 2.

4.12. ENVIRONMENTAL JUSTICE

4.12.1. Summary of Impacts

In Section 3.12, analysis showed that minority and low-income populations live in the vicinity of the Reserve. Because no significant impacts are expected to result from the Proposed Action and that the expected impacts either are confined within the boundaries of NPR-1 or migrate off site in a random manner, the Proposed Action is not expected to result in any incremental activities that would have a disproportionately high and adverse impact on minority or low-income residents surrounding the site.

4.12.2. Methodology

To comply with the intentions of Executive Order 12898, this analysis first considered the characteristics of the nearby community. The resident population surrounding the Reserve was characterized by race and household income level. The purpose of this analysis was to determine whether minorities or low-income residents surround the site, and if so, whether they could be disproportionately affected by off site impacts. Because no new activities will be performed at the site and only the scale of operations could change under the Proposed Alternative, DOE believes that the proposed sale will not result in any additional off site impacts affecting nearby residents. This analysis complies with the Executive Order; CEQA does not provide any guidance, nor does it explicitly mention discussing environmental justice concerns.

As the first step in its analysis, DOE characterized the resident population surrounding the site by racial characteristics and household income level. To do this, DOE developed a Geographical Information System (GIS) model that combined U.S. Census data with a boundary map of the Elk Hills Petroleum Reserve and estimated the total number of residents living within a one-, five-, and ten-mile radius of the site by racial identity and household income. The results of these analyses are presented in Tables 3.12-1 and 3.12-2.

Table 3.12-1 showed that no minority populations lived within a five-mile radius of the Reserve (with the exception of one Native American) out of a total population of 112 individuals, that a total population of 12,567 resided within a ten-mile radius of the site, and that 13 percent of these residents claimed minority status. On average, about 30 percent of the residents within the State of California and Kern County claim minority status. This indicates that proportionately fewer minorities live in close proximity to the site than are found within the county or state on average.

Table 3.12-2 listed the income characteristics of resident households surrounding the site. The exhibit showed that while Kern County has a larger percentage of households in the State's lowest household income quartile, a smaller percentage of these county households are found surrounding the site than would be expected, based on the county's total percentage of households in that quartile.

4.12.3. Environmental Justice Impacts

Sections 4.1 through 4.11 discussed the potential impacts and mitigation measures for the Proposed Action for different environmental media. It has been determined that while no significant impacts are expected to result from the Proposed Action, some less than significant impacts may occur. Impacts are expected to affect biological, water, cultural and other resources, as well as air quality.

Of the impacts that could result from the Proposed Action, only a few have the potential to migrate beyond the boundaries of the Reserve and potentially affect nearby residents. Based on the information previously presented, off site impacts could result from increased air emissions and frequency of oil spills resulting from an increase in production activity on the site. Section 4.3 discussed how ambient air standards for nitrous oxides, sulfur dioxides, and particulate matter could be exceeded

on site, but is not expected to incrementally affect off site air standards. Section 4.10 discussed how the Proposed Action could result in an increase in the probability of an oil spill, which would be roughly proportional to the increase in oil production. The analysis suggested that oil spills are unlikely to reach any body of water and consequently increase the likelihood that such a spill could migrate off site. In the event of such an occurrence, the spill would be mitigated in accordance with the owner or operator's Spill Prevention, Control and Countermeasure (SPCC) Plan. Section 4.9 also suggests that the Proposed Action may result in a decrease in the level of employment at the Reserve. These job losses are expected to take place mainly in the middle management positions and would therefore not discriminate against low-income households. Minorities in middle management positions also would not likely be discriminated against in such downsizing.

In summary, because off site environmental impacts are not expected to occur in an orderly and predictable manner, and socioeconomic impacts would not have a discriminatory effect, the Proposed Action would not have a disproportionately high and adverse impact on minority and low-income populations. This conclusion is further supported by the fact that relatively few minorities or low-income households surround the site.

4.12.4. Mitigation

Because no significant environmental justice issues were found, based on the above analysis, no mitigation measures will be necessary.

4.12.5. References

Executive Order 12898, 1994, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,", February 11.

U.S. Department of Commerce, Bureau of the Census, 1990 U.S. Census.

5. UNAVOIDABLE ADVERSE IMPACTS

5.1. NO ACTION ALTERNATIVE

Unavoidable, adverse impacts under the No Action Alternative are presented as follows:

- Some soil erosion would occur, especially in areas of new construction if major storms were to occur before soil stabilization measures take effect. Common erosion control, revegetation, and soil stabilization practices should reduce other erosion effects to short-lived and localized.
- There is some potential for subsidence as the result of withdrawal of oil, gas, and water from underlying geologic structures. However, the greatest potential for subsidence at NPR-1 has already passed with the peak production period and proper construction and monitoring of subsidence effects on structures would reduce the impacts to levels below significance.
- Future development of NPR-1 could result in exceedances of ambient air standards for nitrous oxides, sulfur dioxides, and particulate matter on site, but not off site. This exceedance was estimated for the upper bound of the Commercial Development Case, using conservative air emissions models. Any exceedance of air standards would require mitigation to reduce emissions to permissible levels. No significant air quality impacts are anticipated under the No Action Alternative.
- Future development would require increased water demand for waterflood enhanced oil recovery and increased produced waters requiring disposal. The demand for additional water as well as the small risk of contamination to groundwater supplies from produced water disposal are both significant potential impacts. These impacts, which would be roughly proportional to oil production levels, can be mitigated through the ongoing NPR-1 program to treat produced waters for use in waterflood projects and through compliance with California Division of Oil, Gas, and Geothermal Resources standards for underground injection disposal of produced waters.
- Under continued Government Development, there would be unavoidable adverse impacts associated with habitat loss, fragmentation, and alteration resulting from disturbance to approximately 303 to 600 acres, over 40 years. These acreages constitute approximately one percent of NPR-1's 47,769 total acres. Adding this loss to prior disturbances (6,467 acres) results in a total of about 16 percent of NPR-1 habitat being disturbed, much of which would be required to be returned to its natural condition.
- Loss of habitat and impacts from construction, operational, and exploratory activities would result in the death, injury, or displacement of some plants and animals. Of particular concern are incremental impacts to the six species listed as Federally or state endangered or threatened and 28 species of concern that occur or may occur on NPR-1. However, ongoing NPR-1 research and conservation activities targeting threatened and endangered species may counteract some of these impacts.

5.2. PROPOSED ACTION

The unavoidable, adverse impacts from the Proposed Action would be similar to the No Action Alternative and would occur at slightly higher levels with the following exceptions:

- Under the Proposed Action, there would be unavoidable adverse impacts associated with habitat loss, fragmentation, and alteration resulting from disturbance to approximately 557 to 766 acres over 40 years for commercial development. This constitutes approximately one percent of NPR-1's 47,985 total acres. Adding this loss to prior disturbances (6,467 acres) results in a total of about 16 percent of NPR-1 habitat being disturbed, much of which would be required to be restored to its natural condition.
- Loss of the affirmative Federal obligations under the Endangered Species Act to protect, conserve and help recover threatened and endangered species, the most significant of which are the cessation of applied research and monitoring programs. In addition, at the end of the field's productive life under government ownership, the government would more likely convert it to wildlife habitat than a private owner. Private ownership would also result in some loss of protection of threatened and endangered plants from habitat loss, damage or destruction. These impacts could be mitigated to less than significant by the Federal and State endangered species act permit processes.
- NPR-1 development may disturb archaeological sites eligible for the National Register. The potential impacts cannot be fully determined until ongoing work to identify their scope is completed in consultation with the California State Historic Preservation Officer. When these studies are completed, DOE will enter into a Memorandum of Agreement with the State Historic Preservation Officer, as to the extent of the impacts and what mitigation, if any, will be required. This effort is expected to be completed before the Record of Decision for the SEIS/PEIR. In general there is greater potential for significant impacts to cultural resources and lower potential for mitigation under the Proposed Action than under No Action or the Alternative to the Proposed Action, for the same reasons as for impacts on biological resources. Commercial development would result in earlier and more intense impacts and in the loss of the affirmative Federal obligation to mitigate impacts on cultural resources under the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act. Mitigation measures designed to reduce impacts on biological resources, described previously, would reduce the potential for disturbance of prehistoric archaeological sites under any of the alternatives, although some prehistoric and many historic sites could be destroyed in returning the land to its predevelopment condition.

5.3. ALTERNATIVE TO THE PROPOSED ACTION

The unavoidable adverse impacts from the Alternative to the Proposed Action would be similar to the No Action Alternative and the Proposed Action with the following exceptions:

Under the Alternative to the Proposed Action, there would be unavoidable adverse impacts associated with habitat loss, fragmentation, and alteration resulting from disturbance to the same acreage as under the Proposed Action. However, the potential impacts to threatened and endangered species are lower because the affirmative Federal obligation to protect, conserve, and help recover threatened and endangered species would be retained. The same would be true of cultural resources.

6. RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Given the extensive loss of wildlife habitat in the San Joaquin Valley over the past several decades, the best long-term utilization of NPR-1 would probably be as wildlife habitat (or some other compatible human use). This was the primary use of the site prior to beginning hydrocarbon extraction in the early part of the century, and it has continued to be an important use even while hydrocarbon extraction has been carried out, especially during the time when petroleum production activities were comparatively limited.

Under the Proposed Action, the primary short-term use of NPR-1 would be for hydrocarbon extraction, which has been the case for most of this century, and especially since government production began in the mid-1970's. This is expected to continue for 50-80 years, depending on economic conditions and technological advancements. As explained in the previous sections of this document, under the Proposed Action NPR-1 would continue to be an important ecological resource even while production activities are being carried out. Most of the site would continue to be undisturbed. With the long-term application of requirements under both Section 10 of the Federal Endangered Species Act and a 2081 Permit under the California Endangered Species Act, endangered species protection would continue under commercial operation through basic measures such as take avoidance and habitat compensation. The loss of Federal agency obligation to protect, conserve, and enhance biological diversity could be a significant impact on long-term productivity. This loss would include applied research and monitoring programs. In addition, land uses after oil and gas extraction activities are completed may not result in the restoration of the area as wildlife habitat, as was contemplated in the 1993 SEIS. Under private ownership, future land use options would be available and could result in substantial impacts to biological diversity and threatened and endangered species. The proposed action could result in permanent, or long-term changes in the quality of the habitat which could affect the productivity of the site for use by wildlife (e.g., wildlife populations could change). Of particular concern would be any impacts on the habitat that would adversely affect its use by the endangered San Joaquin kit fox.

Adverse long-term impacts to groundwater quantity and quality are not expected to be significant as a result of increased oil and gas production activities on NPR-1. The water required for production activities at NPR-1 is derived from three main sources, of which the most important is on-site groundwater extraction from five active wells on NPR-1. The water extracted from the wells has high levels of dissolved solids and is not potable. Much of the produced water is reinjected into the Tulare reservoir to maintain reservoir pressure and extraction efficiency. Moreover, annual water requirements for injection activities at NPR-1 are continuously expected to decrease after 1999 and 2004 for the upper bounds of the Government Development Case and the Commercial Development Case, respectively. In addition, oil and gas production is generally past its peak in the Elk Hills region, resulting in declining levels of activity and water needs. The potential relative increase of water consumption projected for the first years of future operation at NPR-1 is not expected to change the regional downward trend. Therefore, the potential for long-tern impacts to groundwater quantity are expected to be less than significant.

Regarding potential long-term impacts to groundwater quality, most of the produced water on NPR-1 is injected into the Tulare Zone through several permitted wastewater disposal wells. The Tulare Zone is an exempt aquifer which does not have any beneficial uses other than as a potential source for oil-field waterflood operations. Hydrogeologic conditions in the NPR-1 region indicate that the Tulare Zone is able to absorb the impacts caused by injection of produced water. Groundwater migration between the Tulare Zone, where wastewater is injected, and the alluvium, from which higher quality

water is extracted for agricultural, municipal, and industrial purposes, is prevented by a clay barrier. The alluvium is geohydrologically isolated from the Tulare formation, and the potential for groundwater quality impacts outside NPR-1 due to the injection of produced water should be minimal.

NPR-1 development may disturb archaeological sites eligible for the National Register of Historic Places. The potential impacts cannot be fully determined until ongoing work to identify their scope is completed in consultation with the California State Historic Preservation Officer. Commercial development would result in earlier and more intense impacts and in the loss of the affirmative Federal obligation to mitigate impacts on cultural resources under the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act. Potential mitigation measures may reduce impacts to the sites eligible for the National Register to a less than significant level. Mitigation measures designed to reduce impacts on biological resources, described previously, might reduce the potential for disturbance of prehistoric archaeological sites under any of the alternatives, although some prehistoric and many historic sites could be destroyed in returning the land to its predevelopment condition.

7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

As stated in Section 6 under the No Action Alternative and the Alternative to the Proposed Action, the short-term commitment of NPR-1 to petroleum production as proposed would not necessarily preclude concurrent use of the site for other purposes, such as wildlife habitat (the principal predevelopment use). Also, the site could largely be returned to predevelopment uses and/or other human uses through proper reclamation activities as oil operations decelerate and eventually come to an end. Thus, NPR-1 land resources would not necessarily be irreversibly or irretrievably committed by implementation of any of the alternatives .

The Proposed Action would result in a short-term commitment to continued or expanded oil and gas development and the loss of Federal agency stewardship obligations. The Proposed Action would result in the commitment (through sale) of Federally-owned wildlife habitat to the private sector where requirements for protection, management, and enhancement of biological diversity — especially threatened and endangered species — would be substantially less than if at least the surface rights to NPR-1 were to remain in public ownership. In addition, some cultural resources would lose protection under private ownership and would not necessarily be recovered. Thus, NPR-1 resources could be irreversibly and irretrievably committed by the implementation of the proposed action.

Three significant irreversible and irretrievable commitments of resources would occur with implementation of the proposed action: (1) consumptive use of energy (i.e., electricity and fossil fuels) for construction and operation of production facilities; (2) extraction, sale, and consumptive use of oil and natural-gas products from NPR-1; and (3) consumptive use of fresh water. A portion of the equipment and materials used in fabrication of project operating and transport facilities would also be lost, but much could be salvaged as these facilities were phased out over time. The commitment of extracted fossil fuels to sale and ultimate consumption would, of course, render them irretrievable for use in the future.

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Kern County Airports

Kern County Air Pollution Control District

Kern County Administrative Officer
Fiscal Analysis

Kern Co. Engineering and
Survey Svs/ Floodplain

Kern Co. Environmental Health Services

Kern County Library/Administration

Kern County Library – Beale Branch
Public Review Copy

Kern Co. Engineering & Survey Services

Kern County Planning/Special Projects

Kern Co. Resource Management
Agency/Fiscal

Kern County Waste Mgmt. Department
Special Districts

Kern County Library
Taft Branch
27 Emmons Park Drive
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Kern County Parks and Recreation

Kern County Museum

Kern Co. Roads Dept./Transit

Kern Co. Sheriff's Department
Fiscal Analysis

Kern County Roads Department

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Solid Waste

Kern Co. Waste Management Dept.
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GLOSSARY

alluvium	The materials eroded, transported, and deposited by streams
anticline	A fold of layered rock strata where the layers are inclined down and away from the axes
aquifer	A permeable body of rock or soil capable of yielding quantities of groundwater to wells and springs
artificial lift	Aids to lifting oil from the reservoir to the surface, generally by mechanical means (e.g., downhole pumps and gas lift)
bed	The smallest division of a stratified rock series that can be well differentiated from its neighbors above and below
biodiversity	Biodiversity can be defined as "the variety of organisms considered at all levels, from genetic variants belonging to the same species through species to arrays of genera, families, and still higher taxonomic levels." Biodiversity also includes "the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live" (E.O. Wilson, 1992, The Diversity of Life, W.W. Norton & Co., New York, NY). According to DOE, "ecological organization, and therefore biodiversity, is a hierarchically arranged continuum, and reduction of diversity at any level will have effects at the other levels." (DOE, 1994, Incorporating Biodiversity Considerations Into Environmental Impact Analysis Under the National Environmental Policy Act).
booster pump	A pump used to assist the flow of water or oil that is flowing under natural differential pressure
cathodic protection	The placement of electrically active metal rods, along a pipeline, to attract naturally occurring electric currents and decrease the corrosion potential along the pipelines
closed-loop gas lift system	A system to compress gas to pressures sufficient to provide gas lift for wells that use it as a means of artificial lift
condensate pipelines	Pipelines that transport naturally liquefied gas produced from the gas wells
confined layer	A permeable layer bounded above and below by impermeable beds

connate	Entrapped in sediments at the time of their deposition
consolidation	Processes by which loose earth become coherent and firm, such as in the case of increased load application
crestal gas injection	Gas injection along the highest geologic area of an oil producing reservoir to maintain a high level of production
criteria pollutants	Any of six substances (lead, carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter (of 10 microns or smaller), and ozone) specified under the Clean Air Act as pollutants for which the ambient air concentrations must meet national ambient air quality standards
development drilling	The drilling, redrilling, deepening, completion, recompletion, and testing of wells that are needed to enhance the drainage of known hydrocarbon producing reservoirs
diluent	A lighter grade crude oil used to facilitate the transportation of heavier crude oil
downdip	A position parallel to or in the direction of the dip of a stratum or bed
drainage pattern	Configuration of a natural or artificial system for collection and carrying of water, such as a river and its tributaries
endangered species	A species which is in danger of extinction throughout all or a significant portion of its range
erosion	Wearing away of the land by rain, running water, or wind
exploratory drilling	The drilling, redrilling, deepening, completion, recompletion, and testing of wells to discover new reserves, and to obtain new geologic information which could ultimately be used to design new programs for the same purpose
fault	A fracture in rock along which the adjacent rock surface is differentially displaced in a direction parallel to the fracture
floodplain	Valley floors adjacent to rivers which are subject to overflow
gas flood	Gas injection into an oil producing reservoir to "push" the oil to the producing wells (See *gas injection* and *crestal gas injection*)

gas injection	Introduction of gas under high pressure into a producing reservoir through an input or injection
gas injection compression	The operation used to inject portions of the processed gas back into producing reservoirs as needed to maintain reservoir pressures for the purpose of enhancing oil recovery
gas lift	Gas injection, at various levels, along the production tubing to lighten the oil column and create a higher differential pressure, to move oil from the reservoir to the surface
gas to oil ratio	Volume of gas produced along with each barrel of oil
gas-lift compression	The operation used to reinject produced gas back into some oil wells to stimulate their production of oil
groundwater	Subsurface water
gully	A narrow ravine usually formed by erosion of soil by running water
hydrostatic testing	Test of strength and leak-resistance of a pipe by internal pressurization with a test liquid, usually water in the case of oil pipelines
infill drilling	Drilling more wells in a field that is already developed
integrity	The quality held by an archaeological site if it has not been disturbed. Many sites at NPR-1 lack "integrity" because the ground on which they lie has been disturbed by such things as road construction, the passage of equipment, or erosion. Some sites that were used over a long period of time are comprised of deposits that extend below surface in layers, or "strata." If the strata have been disturbed, the sites lack "stratigraphic integrity," which makes them less likely to yield useful information
mudflow	A moving mass of soil made fluid by rain or melting snow
NGL products	Natural gas liquids. A family of liquids, some only under pressure, rendered from wet gas; it includes propane, gasoline, mixed butane, and isobutane
offset well	A well drilled on one tract of land to prevent the drainage of oil or gas to an adjoining tract of land, on which a well is being drilled or is already in production

perched aquifer	An aquifer that is separated from another permeable bed with water by an impermeable layer
permeability	Capacity of a porous rock, soil, or sediment for transmitting a fluid (usually groundwater)
Pleistocene	An epoch of geologic time of the Quaternary period, following the Tertiary and before the Holocene
produced water	Wastewater produced with oil during oil field production activities
Quaternary	The second period of the Cenozoic geologic era, following the Tertiary and including the last 2-3 million years
runoff	The water from rain or melted snow that flows over the surface
sales gas compression	The operation used to transport gas not needed for pressure maintenance to gas sales facilities
saturated layer	A subsurface layer where water completely fills the voids and is under pressure greater than atmospheric pressure
sheet erosion	Erosion of thin layers of surface materials by continuous sheets of running water
siltation	Deposition of sediment carried by water
species of concern	Species that may be declining, but for which additional information is needed to establish their conservation status
steamflood injection	A method to recover heavy oil by injecting steam into the ground
step-out drilling	Drilling adjacent to a proven well but located in an unproven area. A well drilled a "step-out" from proven territory in an effort to ascertain the extent and boundaries of a producing formation
stratigraphy	Form and arrangement of layers of rocks formed by consolidated sediment deposited in layers
strike-slip	Displacement whose direction of movement is parallel to the fault's plane
subsidence	A sinking down of a part of the earth's crust

sump	A pit which receives and stores drainage or liquid waste
threatened species	A species which is likely to become an endangered species within the foreseeable future
trough	A narrow, elongate depression in the surface of the earth
wastewater disposal injection	Injection of wastewater from a well for the disposal of used water from waterflood
water production	The production (extraction) of water along with crude oil from the ground
waterflood injection	One method of secondary recovery, in which water is injected into an oil reservoir for the purpose of washing the oil out of the reservoir rock and into the bore of a producing well.
waterflooding	Technique of increasing recovery of oil from a reservoir by injection of water into the formation to drive the oil toward producing wells
well casing	A special tubing (usually of steel) lowered into a borehole to prevent entry of loose rock, gas or liquid into the borehole or to prevent loss of circulating liquid, such as oil, into the well surroundings
well cellar	An excavation into the ground for providing additional height between the rig floor and the wellhead to accommodate various well components and provide a place for collecting drainage water and other fluids for subsequent disposal
well remediation	Any work done in a well after it is completed and in service

APPENDIX A
NPR-1 OPERATIONS AND FACILIITES

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A. NPR-1 OPERATIONS AND FACILITIES

This appendix provides additional information about the ongoing operations and facilities at NPR-1 that form part of the Reference Case against which the impacts of the Proposed Action and Alternative are measured. As the facilities and operations were developed to support the higher level of production that occurred in the early 1980s, it is expected that, with a few exceptions noted in the discussion of impacts, these operations and facilities will remain essentially the same for both the Government and Commercial Development Cases.

A.1. DESCRIPTION OF NPR-1 OPERATIONS

Operations at NPR-1 consist of all activities needed to ensure Maximum Efficient Rate (MER) production as required by the Naval Petroleum Reserves Production Act. Generally, this involves (1) locating reserves and drilling wells, (2) withdrawing oil, gas and water from wells and (3) processing and distributing these withdrawals for sale, injection and other disposition.

Operations are carried out by a staff of approximately 1,000 government, Chevron U.S.A. (CUSA), contractor and subcontractor personnel. Revenues were approximately $400 million and the total expenditures are about $128 million for FY 1996 (DOE 1996).

A.1.1. Operational Overview

Operations are generally divided into four major areas: (1) operations and maintenance (O&M), (2) exploratory drilling, (3) development drilling and (4) facilities development.

A.1.1.1. Operations and Maintenance

Operations and maintenance (O&M) includes:

- All administrative activities such as general management, planning, legal, financial management, procurement, contracts, personnel management, inventory control and audits.
- All geology and engineering activities, such as reservoir engineering and geology, production engineering, facility engineering, corrosion engineering and process engineering.
- All technical assurance activities, such as environmental support (including endangered species and cultural resources), health and safety, quality assurance, emergency preparedness and security.
- All operations and maintenance activities and projects, such as operating, maintaining, repairing and replacing surface facilities; well maintenance/stimulations, such as remedial projects and workovers; and environmental remediation and restoration.
- Processing third-party requests for permits to install, operate and maintain facilities on NPR-1 lands and monitoring these activities for compliance with permit requirements.

A.1.1.2. Exploratory Drilling

This area consists of the drilling, redrilling, deepening, completion, recompletion and testing of wells to discover new reserves and obtaining new geologic information, which ultimately could be used to design new programs for the same purpose.

A.1.1.3. Development Drilling

Development activity consists of the drilling, redrilling, deepening, completion, recompletion and testing of wells needed to enhance the drainage of known hydrocarbon producing reservoirs (such as hydrocarbon production offset and infill wells, gas injection wells, waterflood injection wells and steam injection wells); water wells that are needed to provide a source of water for waterflood operations; and water injection wells that are needed for disposal of produced wastewater.

A.1.1.4. Facilities Development

Development activity also requires the design, construction, installation and start-up of new surface facilities or modifications to existing facilities to meet changing conditions: changes in environmental, safety and health laws and regulations; changes in economic conditions; technological advances; changes in reservoir conditions; and enhancements in reservoir information. Examples of facilities that are affected include gas plants, compressors, tank settings and artificial-lift equipment.

A.1.2. Summary of Operational Activities

The operational activities for the Reference, Government Development and Commercial Development Cases include the implementation of all activities that make up O&M, development drilling, exploratory drilling and development facilities needed to ensure projected production. These include activities intended to achieve MER production goals for individual production zones. The various elements of the Proposed Action are summarized as follows:

- Remediations, workovers, abandonments and other operational and maintenance activities needed to ensure that approximately 2,697 existing and future wells produce at rates consistent with MER and other requirements. Production in NPR-1 is from four geologic zones located at various depths beneath the surface (Figure A.1-1). Approximately 82 percent of all production is from the Stevens Zone, 17 percent from the Shallow Oil Zone (SOZ) and one percent from the Carneros Zone and the Dry Gas Zone (DGZ).
- Operation and maintenance of existing collection, injection and distribution systems and shipping facilities for oil, gas, natural gas liquid products (NGLs) and water (potable, fire, waste and waterflood source waters).
- Operation and maintenance of the existing gas-processing facilities (estimated current capacity of 370 MMCFD).
- Operation and maintenance of existing storage tanks, process equipment, lease automatic custody transfer meters (LACTs) and loading facilities for crude oil and NGLs.
- Operation and maintenance of existing gas-injection compression plants (estimated current capacity of 345 MMCFD).
- Operation and maintenance of electric power distribution system.
- Operation and maintenance of existing waterflood source water facilities and injection plants (estimated current capacity of 200,000 barrels/day).
- Operation and maintenance of existing Shallow Oil Zone (SOZ) steam injection facilities, currently injecting approximately 3,100 barrels/day of water as steam.
- Operation and maintenance of existing facilities for collecting, storing, treating, injecting and disposing of produced wastewater, which is currently approximately 95,000 barrels/day.

- Operation and maintenance of a myriad of existing support facilities and infrastructure such as cathodic protection facilities, communication systems, vehicle fleets, roads, fresh water systems, chemical treatment facilities and buildings.
- Environmental investigation and remediation initiatives such as clean-up and closure of abandoned waste sites; groundwater characterization/monitoring initiatives; sump reduction/elimination projects; drainage restoration projects; soil erosion repair and prevention activities; air quality enhancement projects; secondary containment projects; etc.
- Endangered species activities, including monitoring, pre-activity surveys, habitat restoration/reclamation and biological/reclamation research studies.

A.1.3. Personnel Requirements

Currently, staff requirements are approximately 600 full-time personnel employed by the government, CUSA and contractors. In addition, up to approximately 400 to 500 subcontractor and vendor personnel are on site each day conducting maintenance, construction and a wide variety of other services.

Staffing requirements for the Government Development Case would not change significantly from the current levels. Under commercial development, employment changes significantly. Personnel levels can be predicted to fall to 650 to 750, compared to the current employment of 1,000 to 1,100, as government personnel would no longer be located on site.

Abnormal conditions (e.g., oil spills, fires) could occur periodically. In addition to their other duties, site operations and maintenance staff are trained to expect and prevent or mitigate the full range of potential abnormal conditions.

A.1.4. Land Requirements

Typical unit values of disturbance and volume of earthwork are listed in Table A.1-1. Preparation of new sites generally follows a sequence of stripping and stockpiling topsoil; cutting and filling; and watering and compacting to stabilize the site. Site preparation activities required for any new facilities would involve varying amounts of land disturbance and volumes of surface earthwork.

Site preparation activities for well pads, access roads and similar facilities generally require about seven days/site. Site modifications (e.g., for tank setting modifications) at existing facilities require an order of magnitude less earthwork than for a new facility.

For typical site preparation projects lasting seven days (eight hours/day), the following items of equipment would be used for the periods indicated: two bulldozers (300 horsepower each) or a front loader (days one to six); one compactor (75 horsepower) (days one to six); one 4,000 gallon heavy-duty diesel water truck (15 trips, average one-way distance of three miles) (days two to seven); and one motor grader (75 horsepower) (day seven). An average of three site preparation projects are in progress at any one time at the NPR-1 site.

Figure A.1-1
NPR-1 Generalized Geologic Cross Section

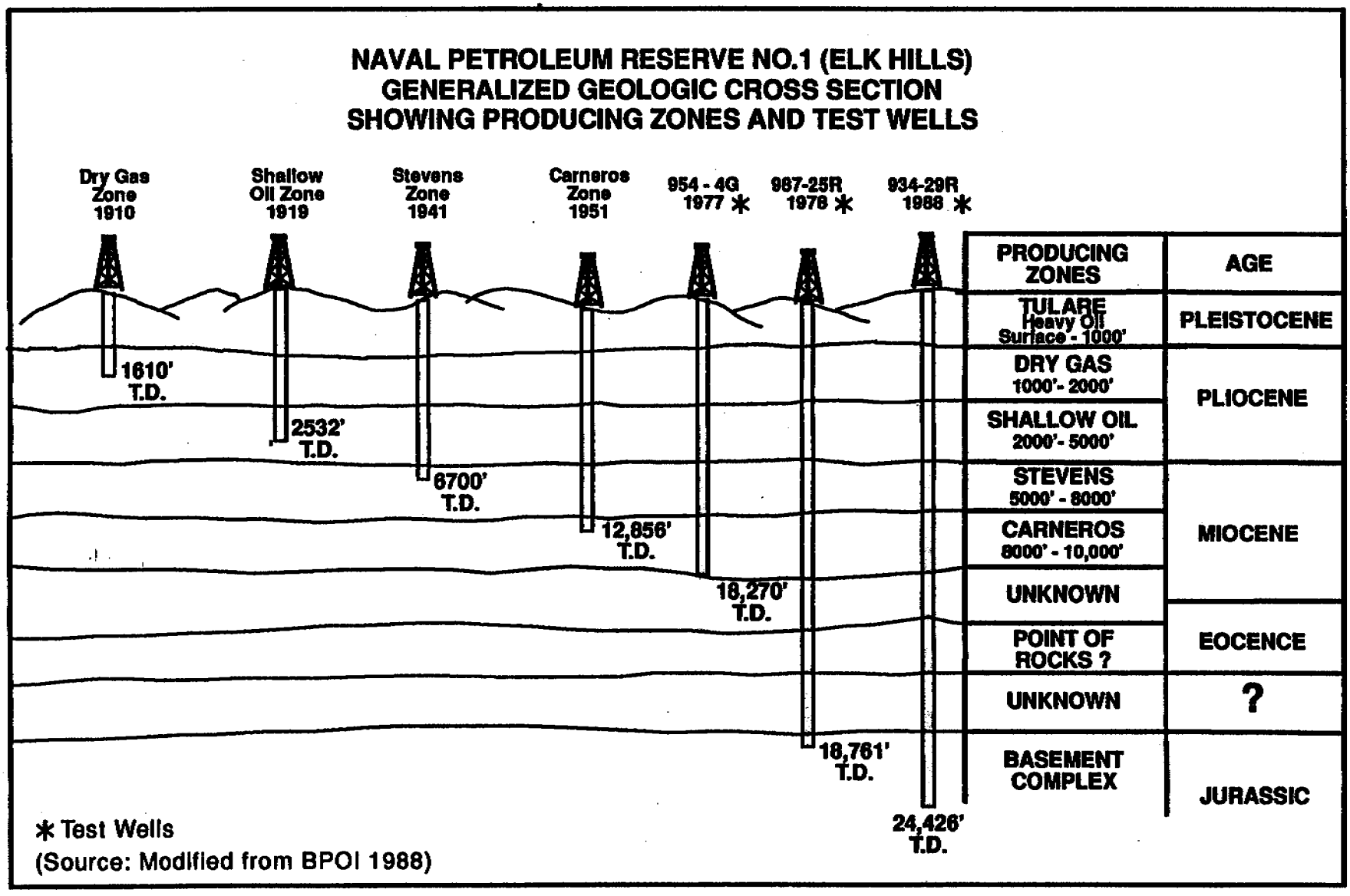


Table A.1-1
Typical Unit Values for Land Disturbance and Earthwork Volumes Associated with Site-Preparation Activities

Site Preparation	Volume of Earthwork (cubic yd)	Area of Disturbance (acres)
Well pad	3,000(a)	1.0(b)
Well pad access	1,000	0.2
Steam generation units	400	0.5
Tank settings (modifications)	400	0.2

(a) for new pads; at existing pads, volumes would be much less.
(b) "permanent" disturbance
Source: Jackson 1988

A.1.5. Erosion Control and Contemporaneous Revegetation

Where land disturbance is unavoidable, the extent of disturbances are minimized as a matter of policy. This includes implementation of sound erosion and sediment control practices and reclamation during and after the various construction activities. New construction project design and specifications would include erosion control and reclamation measures. Culverts would be installed and appropriate stabilization methods would be implemented at construction crossings of drainageways. Areas of temporary disturbance would be contemporaneously revegetated. Topsoil would be conserved and stockpiled for use in future reclamation efforts. Disturbed areas would be stabilized and reclaimed consistent with the surrounding terrain. Natural drainageways would be reestablished. Annual reclamation plans would be prepared for abandonment of access roads, well pads and other facilities. Site development and reclamation plans would include (1) salvaging and protecting topsoil for use in site reclamation, (2) revegetating disturbed areas with native and naturalized perennial and annual grasses and shrubs, (3) applying erosion controls, (4) minimizing damage to on-site and off-site hydrologic regimes and (5) minimizing the extent of disturbance to natural habitat.

A.1.6. On-Site Prevention and Emergency Response Capabilities

As required by the regulation (i.e., 40 CFR Part 112) in recognition of the potential for spills, NPR-1 developed and implemented an Spill Prevention Control and Countermeasures (SPCC) Plan in 1989 which, among other things, led to the installation/enhancement of prevention and containment facilities throughout the site. The SPCC Plan was recently updated (October 1995) to reflect improvements in the areas of spill prevention and response, including upgrades to secondary containment.

Because major spills can result in serious environmental impacts, large tanks (usually 10,000 barrels or larger) at NPR-1 are individually diked to limit the extent that oil could spread in case of a spill and to facilitate cleanup and recovery. Many smaller tanks are afforded the same protection. Containment provisions are based on Division of Oil and Gas regulations and requirements set forth in the Porter-Colope Water Quality Act and 40 CFR 112. Some smaller tanks (usually less than 1,000

barrels) are currently protected by contingency catch basins located in drainage channels downgrade of tank settings.

Contingency catch basins also are located strategically throughout NPR-1 to contain oil spills from sources other than tank settings, including drilling operations, broken pipes and leaking valves. All diked areas at NPR-1 meet the 100-year rainfall capacity requirements. Where capacity is limited, two or more catch basins may be placed in a drainage channel in series.

Studies completed in the early 1990s recommended enhancing secondary containment at certain tank settings. As the result of these recommendations, a project was recently completed to enhance secondary containment at approximately 25 tank settings.

With the exception of road crossings, the great majority of pipelines at NPR-1 run above the ground and are supported by structural members where necessary. Pipelines typically transport various liquid and gaseous hydrocarbons and water at pressures ranging from vacuum up to 3,500 pounds psig. At road crossings, pipelines are installed underground and are protected against corrosion and damage from vehicles or other heavy equipment. Pipelines are labeled at strategic locations to assist in responding to accidents and emergencies, such as ruptures that can cause pipelines to oscillate out of control causing additional damage and/or the release of flammable hydrocarbons. Plans are to study the feasibility of enhancing the existing pipeline labeling system so that risks are more immediately obvious following accidents and during emergencies. To mitigate oil spill risks, NPR-1 also has ongoing corrosion control and pipeline monitoring/inspection/replacement programs.

The nature and frequency of inspection procedures in the SPCC Plan are presented in Table A.1-2. More specific details about inspection procedures can be found in the appendices to the SPCC Plan. For example, written procedures and inspection requirements for corrosion protection are located in Appendix F3 to the SPCC Plan. The Corrosion Control Program (CCP) seeks to identify problems at NPR-1 facilities before they occur. The CCP program flowchart (Figure 1 of Appendix F3), shown in Figure A.1-2, outlines the steps in identifying and controlling corrosion. The process relies heavily on routine procedures conducted by the Corrosion Engineer, including:

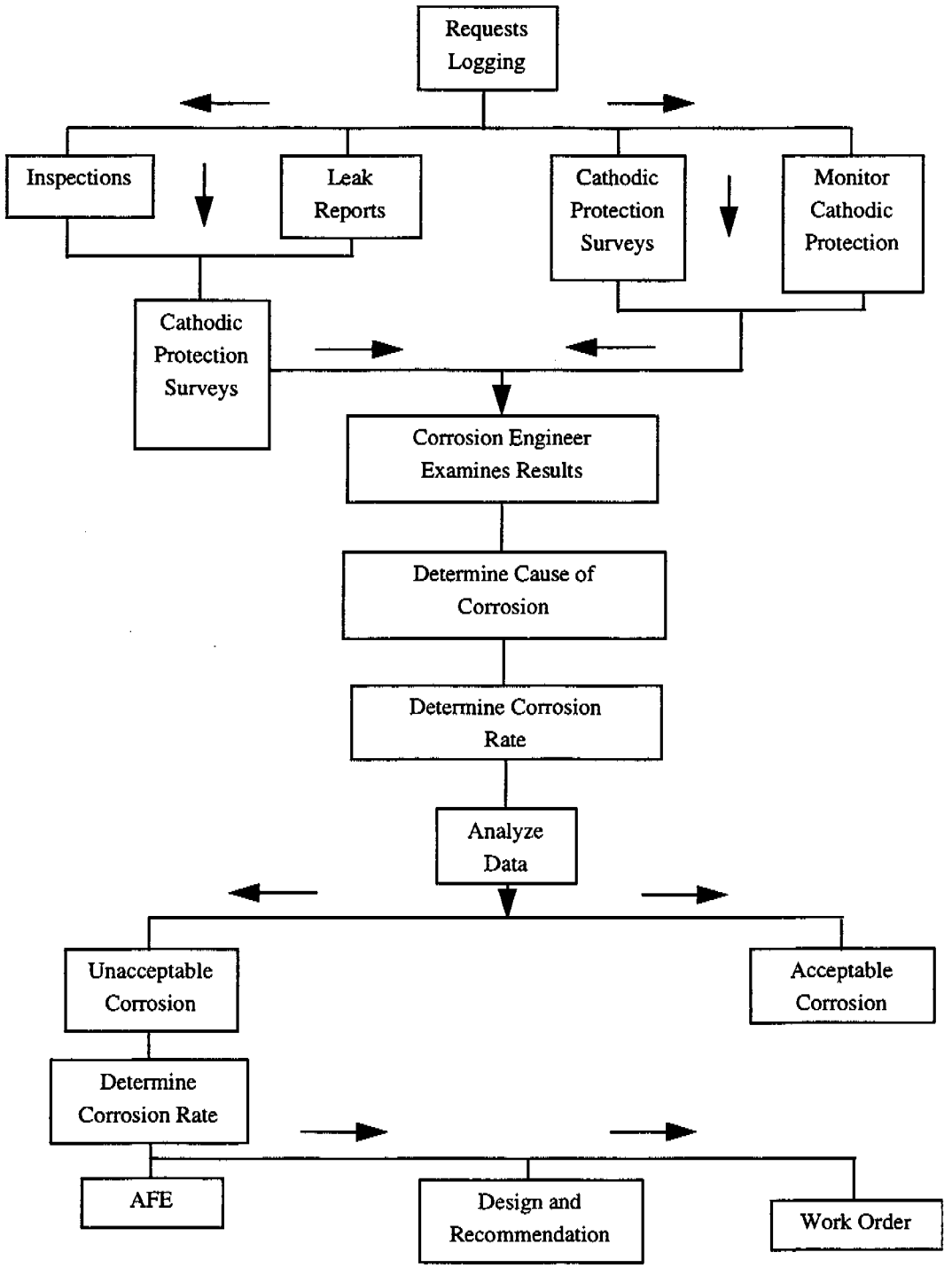
- Periodic rectifier and loop resistance checks;
- Periodic structure-to-soil readings at pipeline and tanks;
- Periodic readings at sacrificial anode stations;
- Interference tests;
- Corrosion inhibitor batch treatment;
- Corrosion coupon monitoring; and
- Waste water and water injection monitoring.

The results of these procedures, as well as additional external and internal corrosion surveillance conducted by the Corrosion Engineer and other departments, provide the data for a comprehensive corrosion data base. The data base retrieves records, tabulates results and provides the graphics necessary to establish trends, examine results and determine corrosion reactions.

Table A.1-2
Frequency of Inspection Procedures at NPR-1

Location	Frequency of Inspection(s)
Oil Production Operations	
Active oil pumping units	At least once per day
Major pipelines (e.g., North and South Flank Shallow Oil Zone (SOZ)); Major SOZ collection lines	Daily; corrosion coupons are collected on 60-day cycles
All distribution oil pipelines	Annual
Pipelines (sacrificial)	Annual effectiveness surveys for cathodic protection
Pipelines (impressed)	Semi-annual effectiveness surveys for cathodic protection
Navy 10" and 12" pipeline	Quarterly effectiveness surveys for cathodic protection
Flow lines	Periodic
Tank setting locations	Daily; irregular visits by construction crews, engineers and other personnel
Tanks (internal)	Quarterly; semi-annual effectiveness surveys for cathodic protection
Tanks (external)	Annual; semi-annual effectiveness surveys for cathodic protection
Dehydration/shipping facilities (including wastewater tanks)	At least three times per day
Gas Operations	
Low Temperature Separation (LTS) utility storage tanks and product storage vessels	At least three times per day; Quarterly comprehensive fugitive emissions program; During complete shutdown
LTS plants	Surveyed 24 hours a day
High Pressure Injection (HPI) plant	At least three times per day
All distribution gas pipelines	Annual
Aboveground valves and pipelines, including flange joints, valve glands and bodies, catch pans, pipeline support, locking of valves and metal surfaces	Daily; Corrosion coupons are collected on 60-day cycles for inlet pipelines
Tank trucks	Checked for leakage before loading or departure

Figure A.1-2
Corrosion Control Program Flowchart



The presence of these preventive measures at tank/pipeline areas and lack of perennial watercourses in the vicinity of tank settings effectively limits the impact of oil spills from tank settings. Releases from tanks are unlikely to escape secondary containment in significant quantities. Moreover, adequate backup measures exist to prevent extensive horizontal migration over land in the unlikely event that spills do escape secondary containment.

In addition to an SPCC Plan, NPR-1 has developed a facility response plan to meet Federal requirements at 40 CFR 112.20 and 21 for oil spill response plans. This document is designed to focus largely on procedures and equipment necessary to respond to a range of discharge scenarios. The plan identifies potential spill sources and pathways, vulnerable receptors and equipment, personnel and procedures to respond to spills.

Through such planning, NPR-1 has procedures in place to follow in the event of an unplanned/unpermitted release of air emission, wastewater discharge, or spill of hazardous material into the environment. Contingency plans have been developed for all accidental, unplanned release, or discharge of potential contaminants into the environment.

NPR-1 maintains a 24-hour emergency telephone and radio service providing a central control point for all emergency communication, referred to as the Emergency Reporting Service. The Service has access to all NPR-1 radio channels and can dispatch police, fire and ambulance services. Kern County assumes primary responsibility for fire suppression activities at NPR-1. In addition, the Service maintains home phone numbers of all NPR-1 personnel with emergency response involvement, and can call out subcontractor services.

The Environmental Services Department (ESD) at NPR-1 is notified of all unplanned releases, spills and discharges. ESD provides technical and administrative guidance in responding to spill events. In addition, ESD tracks new regulatory requirements and incorporates them into standard operating procedures as well as updates the SPCC plan on an annual basis. A Spill Control Team is activated when a major spill (100 barrels or more) takes place. The Spill Control Team provides overall supervision and guidance of spill control, containment and cleanup efforts. The team approach ensures that response to a spill is efficient, effective, and in compliance with all applicable safety, health and environmental regulations. The Safety Coordinator makes certain that spill response activities are conducted in a manner to protect the health and safety of all participants, including maintenance of NPR-1 response equipment and personal protection equipment (Table A.1-3). NPR-1 plans and procedures place a strong emphasis on coordination with state and local officials during emergencies. In addition, use of the Incident Command System is stressed.

A.1.7. Ongoing Non-Federal Actions

NPR-1 routinely receives requests for permits, easements, rights-of-way and cooperation/assistance for third-party pipelines and other facilities and actions on NPR-1 lands. These requests come from parties not associated with the main activities at NPR-1, (i.e. DOE, CUSA, the management and operating contractor, or other DOE contractors and subcontractors) and typically are carried out by the third party at its own expense. These third-party projects are routine activities considered to be part of continuing development of NPR-1. Activities include:

- Constructing, operating, maintaining and replacing equipment and facilities, including new pipeline, utility distribution lines and roads;
- Abandoning, storing, disassembling and salvaging equipment and facilities;

Table A.1-3
NPR-1 On-Site Response Equipment

Equipment	Type	Quantity	Capacity	Storage Location
Vacuum Trucks	Various models and years	18	2,000,000 gallons/day 1389 gallons/minute	35R Gate 4
Sorbents	Loose Clay	Approx. 5,000 lb	660 gallon	35R Warehouse
Hand Tools	Shovel	100	Not applicable	Unit and S/C Vehicles
	Rake	20		
	Squeegee	10		
	Hoe	25		
Communications	Cellular phone	20	Not applicable	Various, used in day-to-day operations
	Mobile radio	279		
	Handheld alarm	22		
Fire Fighting	Fire monitor	43	500 gallons per minute	35R- Various Locations
	Brush fire truck	1	250 gallon water capacity with foam	36R
	Fire hydrant	93	Not available	Throughout facility
	Portable fire extinguisher	1200		Throughout facility
Other	Front end loader	3	Not available	Day-to-day use
	Grader	2		Day-to-day use
	Bulldozer	2		Day-to-day use

- Conducting regulatory compliance activities, including reclamation of habitat, archeological and natural resource surveys, facility closure and site cleanup;
- Performing agricultural activities, including pesticide spraying; and
- Conducting engineering evaluations, including geophysical surveys.

The management and operating contractor reviews these requests on behalf of DOE, including environmental, safety and engineering requirements. The larger requests may require an Environmental Assessment. After review, the permit is issued, which usually includes technical, environmental, safety and security requirements as well as other legal terms and conditions. Third-parties must revegetate all disturbed areas not required for permanent facilities as a standard requirement. Third-party activities are monitored for compliance with the permit terms.

The 1993 SEIS estimated that three to four third-party projects and geophysical surveys would occur each year. The projects were estimated to disturb 23 acres per year (total for both on and off NPR-1 sites). Geophysical surveys would affect approximately 226 acres per year (both on and off NPR-1 sites). Revegetation activities were estimated to cover 14 acres per year. That level of activity is assumed to continue under all development cases except as noted in the discussion of environmental impacts (Chapter 4).

The current active permits are listed in the Permit Transfer Implementation Plan. These permits would be terminated as part of the transfer of property to the new owner as discussed in the Proposed Action.

A.1.8. Endangered Species Program

The NPR-1 Endangered Species and Cultural Resources Program consists of the following major elements: 1) endangered species monitoring, 2) pre-activity surveys, 3) habitat revegetation and management, 4) ecological field studies, 5) routine reporting and scientific publication and 6) establishment and management of an endangered species conservation area.

Endangered species monitoring conducted through Fiscal Year 1996 included specific activities to gather information about kit fox population size, sources of mortality, reproductive success, prey availability, diet and predator abundance. Populations of the endangered blunt-nosed leopard lizard and giant kangaroo rat were also tracked. Endangered or threatened plant species were monitored, and a multi-year site-wide survey for special-status plants was also conducted.

The scope of endangered species monitoring and research activities conducted over the entire site was reduced beginning in Fiscal Year 1997 and will continue to be unless there is a compelling scientific basis to expand them. Monitoring of listed species would be limited to gathering information on population trends every five years beginning in Fiscal Year 1997 for kit foxes and beginning in Fiscal Year 1999 for other listed species. In addition, monitoring of kit fox and langomorph trends over a limited area of NPR-1 is continuing. Research would not be conducted as part of an overall program at NPR-1, but would be considered for specific habitat management, conservation and species recovery issues (see discussion below on the endangered species conservation area).

Pre-activity surveys are conducted prior to all construction, maintenance and operations activities that could affect endangered or threatened species or their habitat. Qualified biologists survey areas where activities are proposed and provide recommendations to ensure that species or their habitat are

avoided to the maximum extent possible. In certain cases, qualified biologists periodically monitor progress at construction sites to ensure that recommendations are carried out.

Revegetation of disturbed sites is conducted after the sites have been abandoned or are no longer needed. Revegetated sites are monitored to evaluate their success. A study was recently completed which examined the effectiveness of revegetation treatments compared to natural rates of recovery.

Ecological field studies have been conducted on threatened and endangered species at NPR-1 to address as number of questions. Presently, the following projects have been concluded or are nearly conclusion:

- A study to describe factors influencing kit fox distribution and abundance on NPR-1 and NPR-2;
- An assessment of ecological effects of a well blow-out; and
- A kit fox life table analysis.

Future studies may be required to support the establishment and subsequent management of an endangered species conservation area to be established within three years as discussed below.

Numerous publications are in progress to report on the results of monitoring activities and field studies conducted at NPR-1. In FY96, eight manuscripts were completed and submitted for publication. In FY97 through FY98, it is expected that an additional 15 papers will be submitted for publication. Technical and progress reports are prepared as required. An annual program review meeting incorporates presentations on activities at Elk Hills and presentations from researchers working on similar issues in the southern San Joaquin Valley.

A commitment made by DOE during its recent consultation with the U.S. Fish and Wildlife Service, Department of Interior (FWS) is the establishment of an endangered species conservation area consisting of 7,075 acres of NPR-1. This endangered species conservation area provides compensation for habitat lost as a result of developments evaluated in the 1993 SEIS and the 1995 FWS Biological Opinion. The conservation area is to be established by November, 1998, (after the date set for sale of NPR-1). During the prior consultation, DOE and FWS agreed that research may be required to determine optimal future management practices of the conservation area, and that monitoring of listed species would be more intensive in this area compared to the level of effort on other portions of NPR-1.

A.1.9. Cultural Resources Program

Cultural resources compliance involves all activities necessary to ensure that DOE complies with provisions of the National Historic Preservation Act and other Federal laws protecting the cultural, historical, pre-historical and paleontological resources occurring at NPR-1. Present activities include conducting pre-project surveys, preparing a cultural resources management plan and completing a Programmatic Agreement between DOE, the State Historic Preservation Office (SHPO) and the U.S. Advisory Council on Historic Preservation (ACHP).

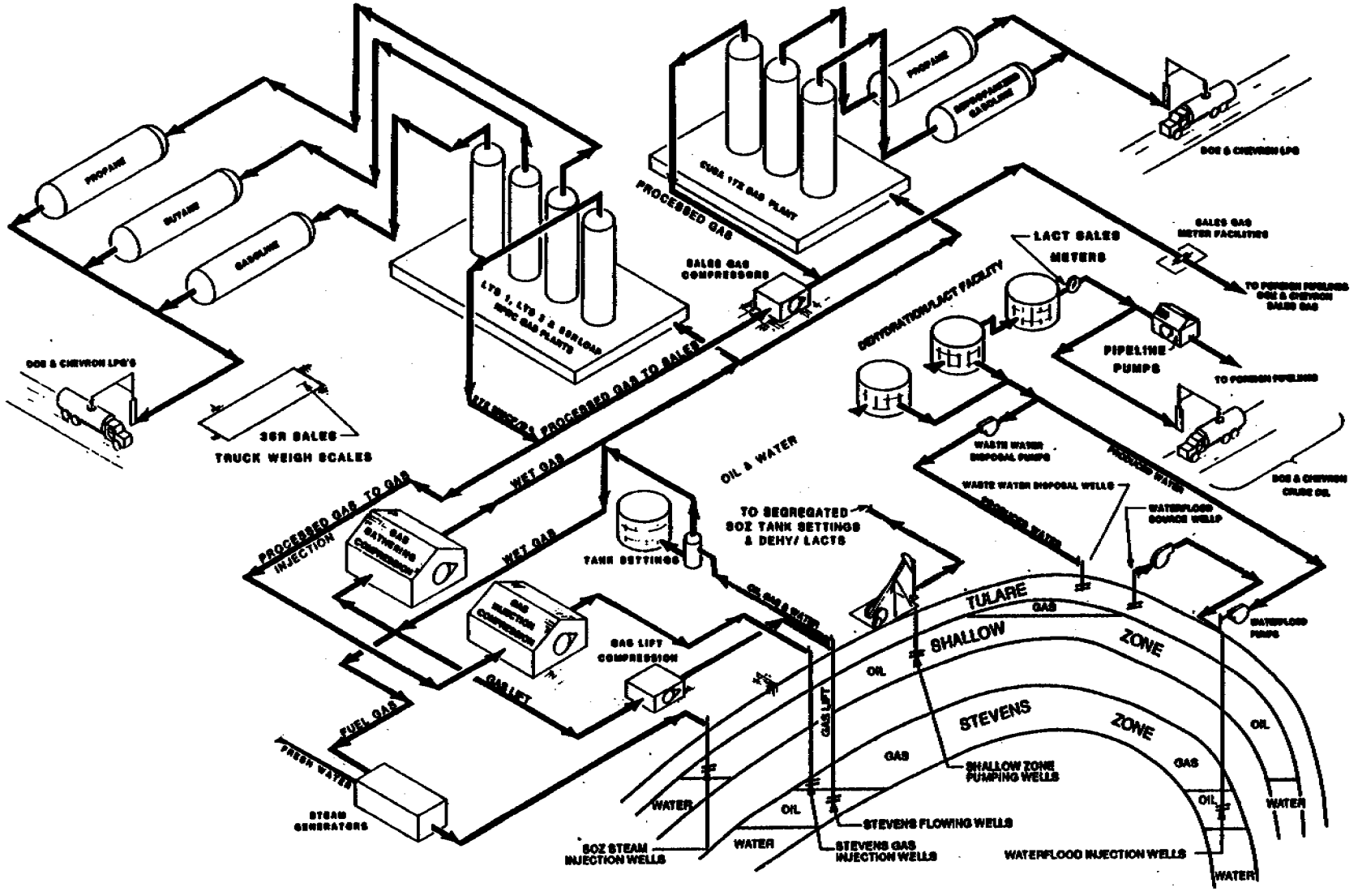
A.2. DESCRIPTION OF NPR-1 FACILITIES

A.2.1. Facilities Summary

The major facilities at NPR-1 are shown in Figure A.2-1. These facilities, which support operations under the Reference Case and are also included in both the Government and Commercial Development Cases include:

- Approximately 1,150 (1997 Annual Operating Plan) active wells for hydrocarbon production (flowing, pumping and gas lift), waterflood source water production, gas injection, waterflood injection, wastewater disposal injection and steam injection.
- Approximately 1,368 existing wells that are shut-in (idle) or abandoned (1012 shut-in and 356 abandoned) (1995 Annual Report).
- One hundred thirty tank settings used to separate produced gas from produced oil and water, and to meter individual well oil, water and gas production.
- Three LACT facilities used to separate oil and water, inject wastewater into disposal wells, and measure and transfer oil to CUSA and DOE purchaser pipelines and trucks.
- One crude oil tank farm.
- Numerous gas-gathering compressor plants used to deliver gas separated at the tank settings to the gas plants for further processing.
- Three gas-lift compressor facilities used to reinject produced gas back into some oil wells to stimulate their production of oil.
- Four gas-processing plants used to separate NGL products from gas, three of which are owned and operated by NPR-1 and located on NPR-1; the other is a CUSA gas plant which is located off-site in Section 17Z, a portion of which can be utilized by NPR-1 under a gas processing agreement.
- Four gas-injection compressor plants used to inject portions of the processed gas back into producing reservoirs as needed to maintain reservoir pressures for the purpose of enhancing oil recovery.
- One sales gas compressor facility utilizing four compressors at the 3DR compressor station, used to transport gas not needed for pressure maintenance to gas sales facilities.
- Four (one abandoned, uneconomical) sales gas facilities used to measure and transfer gas to CUSA and DOE purchaser pipelines; three of these are located on NPR-1 and the other is located at CUSA's 17Z plant approximately three miles west of the NPR-1 western boundary.
- Three NGL storage and loading facilities for measuring and transferring NGL product to CUSA and DOE purchaser trucks, one of which is located at CUSA's 17Z plant.
- One booster pump plant used to deliver water from three to six waterflood source water wells to two waterflood plants, which inject water into the Stevens Zone to enhance oil recovery.
- Several emergency wastewater sumps (lined and unlined); two landfill/waste handling facilities, one of which contains a permitted hazardous waste unit that is in the process of being formally closed; a scrap/recycling yard; and numerous old abandoned waste sites that are in the final stages of remediation.

Figure A.2-1
NPR-1 Surface Facilities Flow Diagram



- Oil, gas, water, NGL and condensate pipelines, some of which are pipelines that have been installed, and are operated and maintained by outside third parties at their expense for the purpose of connecting to NPR-1 facilities (such as oil and gas sales facilities), or to traverse NPR-1 lands for other purposes that are not related to NPR-1 operations.
- Four building complexes for offices, maintenance, storage and warehousing.
- Communications systems; air monitoring equipment; vehicle fleets including fuel depots; electrical distribution systems; fire water systems; fresh water systems; road systems; and a wide variety of supporting infrastructure.

A.2.2. Gas Gathering Compression

There are 13 compressor stations with 52 compressors totaling 46,980 horsepower in service for gas gathering at the NPR-1 reserve. The compressors range in size from 250 horsepower to 2,000 horsepower per unit. The purpose of this system is to lower the pressure at the wellhead and recover more gas to flow from the lower-pressure reservoirs.

A.2.3. Closed-Loop Gas-Lift Facilities

The function of closed loop gas lift systems is to compress gas to pressures sufficient to provide artificial crude oil lift at wells that use this technology. There are three gas lift stations at NPR-1 consisting of two to four engines each, ranging in horsepower from 1,000 to 1,750. Each has a suction pressure of approximately 50 psig and a discharge pressure of approximately 1,700 psig. The combined capacity for the three units is about 60 MMCFD.

A.2.4. Gas Operations Expansion

Contracting to process gas for others would improve the economics of the gas processing complex by spreading fixed costs over larger volumes of natural gas, maintaining economies of scale and providing incremental revenue. These factors would improve the economic life of the plants. Facilities that would need to be constructed include a pipeline and metering equipment.

A.2.5. Butane Isomerization

Due to the passage of the 1990 Clean Air Act, the market for isobutane has increased substantially while the market for normal butane has declined. The Clean Air Act requires the use of oxygenates such as Methyl-Tertiary-Butyl Ether (MTBE) to produce cleaner-burning gasolines while prohibiting the blending of normal butane in reformulated gasolines. The construction of a butane isomerization plant to convert all of the NPR-1 mixed butane stream to isobutane would cost $34 million, have a payout of 4.5 years, a rate of return of 20 percent and a net payback of $18.7 million, based on a conservative price differential of $0.20 per gallon. Construction time would be 2 to 2.5 years from approval to start-up.

A.2.6. Abandoned Waste Site Closure and Facility Decommissioning

NPR-1 contains two Class II-1 waste disposal sites. One is located in Section 27R and the other in Section 10G. The 27R disposal site is comprised of 32 areas where solid waste such as drilling mud and sediment from tank clean-out is disced and bulldozed into the soil. This facility also recovers waste crude oil. T he 10G disposal site is comprised of about 26 acres that uses the same process to handle solid waste, with one exception—it does not recover waste crude oil.

A program is in place to identify, review, investigate, characterize, evaluate, remediate and formally close all abandoned unneeded waste disposal sites in accordance with applicable regulations and DOE orders, including wastewater sumps, chromium spill sites, two arsenic contaminated sites and landfills.

Project facilities and equipment that become inoperable or unnecessary at the end of their useful life or upon depletion of the oil reservoirs would be decommissioned and removed. For the period FY 1996 to 2025, it is anticipated that another 900 wells would be abandoned in accordance with applicable regulations.

A field-wide program to remove all asbestos—almost all of which was installed on pipes and process vessels at the 35R gas plant in the 1950's—has been modified to adopt the approach of safely managing asbestos already in place. This is accomplished through labeling, worker training and encapsulating in place. Asbestos is removed only if warranted, as when it becomes friable or must be removed for repairs, maintenance or facility modification. This program would continue.

A.2.7. Power Supply

The Proposed Action includes the construction, operation and maintenance of all planned and existing power systems. Electric power at 115 kilovolts is currently purchased from Pacific Gas and Electric Company (PG&E), primarily at the 35R substation. Total connected capability is approximately 80 MW. The electricity and steam generating plant has a nominal rating of 42 MW and supplies all of NPR-1's electricity needs. Current running load is approximately 24 MW, which is distributed through major substations at 35R, 18G, 33S, 3G, 4G and 17R by 115-kilovolt, 12-kilovolt and 4160-volt transmission systems to gas compressor stations, waterflood pump stations, well pumps, cathodic protection facilities, gas plants and buildings. Planned projects to expand waterflood injection, gas-lift compression, well electrifications and other projects would increase running load to approximately 50 MW. Land disturbances for these projects would be minimal since the necessary system capability is already in place.

Another significant source of power at NPR-1 is produced natural gas which is commonly used as a source of fuel for well pumps, compressors and process equipment such as heaters and boilers. Quantities of natural gas consumed as fuel increased from approximately 20 MMCFD in FY 1990 to 32 MMCFD in FY 1995.

A.2.8. Water Supply and Sewer System

NPR-1 owns a fresh water distribution system using water purchased from the West Kern Water District. The pumping station at Section 5M has three electric turbines that can supply NPR-1 with 35,000 barrels per day, with average use about 31,000 barrels per day. Water for the 5M station is pumped to 16,000 barrel and 5,000 barrel storage tanks at Section 28R (the highest elevation at NPR-1), 10,000 barrel and 5,000 barrel tanks at 32S and a 10,000 barrel tank at 35S. The system is automated to maintain water in the tanks using pumps at 5M, 32S and 35S. Water is provided to the field by gravity flow from the tanks.

Sewage treatment facilities at NPR-1 are composed of septic tanks with leach fields. Twelve septic systems currently are in use. Additional septic systems could be constructed, if necessary. The septic systems are emptied regularly by a subcontractor, and the wastes are hauled off-site for disposal. Timing varies from twice a month at 11G to one to two times a year at all other sites.

A.2.9. Fire Protection

Fire fighting facilities are provided at buildings, gas plants and LACT stations. Fresh water is provided from the main lines of the field-wide fresh water system. In the event of a major fire, fresh water would be diverted from production operations in order to ensure adequate water for fire fighting.

Each gas plant is provided with a reserve water tank, main water pump and a backup pump. A total of 25,000 barrels of water is stored at the 35R gas plants for fire protection. The main pumps are electrically driven and the back-up pumps are diesel driven. The 18G and 24Z LACT stations have reserve water tanks and pumps while the 10G and 25S LACT stations are provided with fire hydrants.

Current fire protection activities include: coordination with the Kern County Fire Department, which has primary fire fighting responsibility; the operation, maintenance and construction of all existing and planned fire water systems and fire prevention/protection/fighting equipment; personnel training; and fire drills. One noteworthy activity is the maintenance of a 12 to 20-foot wide firebreak around the periphery of the site. The fire break is disced 12 inches deep to remove revegetation annually or as needed to prevent the spread of fires.

A.2.10. Roads

1. Currently there are over 1,000 miles of primary, secondary and tertiary (unpaved access) roads. No new primary or secondary roads are planned; however, unpaved access roads would be needed for new wells and new facilities located in areas not currently served by roads.
2. Primary Roads - About 22 miles of primary roads are provided as main arteries. Skyline Road is the main east-west artery running about 17 miles along the crest of NPR-1. The North-South Access Road is about 5 miles in length on the eastern portion of NPR-1. The southern tip connects to State Highway 119 near the 11G Headquarters building. Primary roads are about 22 feet wide, consisting of asphalt/cement surface and a base of fill-type road construction material.
3. Secondary Roads - About 90 miles of secondary roads provide access from primary roads to major facilities and areas of high well densities throughout NPR-1. Secondary roads are about 18 to 30 feet wide and are surfaced with gravel/asphalt emulsion material. The base of these roads is of native material.
4. Tertiary Roads - About 800 miles of tertiary roads provide access to wells, tank settings, pipelines and numerous other small facilities. These roads are about 12 to 15 feet wide and consist of graded native material. Abandoned roadways would be reseeded and reclaimed as part of the ongoing restoration program. Unpaved roads would be watered to minimize fugitive dust in accordance with applicable requirements, as appropriate.

A.2.11. References

Jackson, B.J., 1988, County of Kern, 1987-88, Summary of Budget and Tax Data, Kern County Auditor-Controller's Office, Bakersfield, California.

U.S. Department of Energy, 1996, Notice of Preparation of a Draft Program Environmental Import Report and Initial Study for the Sale of Naval Petroleum Reserve No. 1 (Elk Hills), Kern County, California, December.

APPENDIX B
NPR-1 EXPLORATION AND PRODUCTION

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B. NPR-1 EXPLORATION AND PRODUCTION

B.1. INTRODUCTION

This appendix provides additional information about the ongoing oil and gas exploration and production activities at NPR-1 that form part of the Reference Case against which the impacts of the proposed action and alternative are measured. As noted in Chapter 1, peak production at NPR-1 occurred in the early 1980s (see Table B.1-1). Nonetheless, there remains substantial quantities of recoverable oil and gas at NPR-1 and it is expected that production will continue for more than 50 years. This appendix also explains how the future production projections both the Government and Commercial Development Cases were calculated along with the associated onsite exploration and development activities. These calculations form the basis for the quantitative analysis of the environmental impacts of the proposed action and alternatives.

Recovery of oil and gas depends on the ability of petroleum fluids to flow through the geologic formation to the well. This flow is dependent on the porosity (the relative volume of the pore spaces between mineral grains as compared to the total rock volume) and permeability (a measure of the resistance offered by rock to the movement of fluids through it) of the formation. The recovery of oil and gas is most efficient when a steady rate of flow (depletion) is maintained.

To understand the relationship between oil and gas development rates and reservoir characteristics, it should be noted that most oil and gas wells do not flow freely and require an artificial system to force (technically described as "lift") the oil and gas to the surface.[1] The method of artificial lifting is dependent on several variables, including: depth of the well, characteristics of the sand, gas-to-oil ratio, viscosity of the oil and cost considerations.[2]

Lifting methods and machinery are categorized as either surface or subsurface. Examples of lifting methods include: free flow, standard beam rig, hydraulic pumping, submersible electric pumping and gas lift. These methods constitute primary recovery (the initial production of oil and gas from a well or field). During the primary recovery, approximately 25 percent of the oil and gas can be recovered.[3] At NPR-1, a majority of the gas produced is used for reservoir pressure maintenance and gas lift.

When primary recovery methods have been exhausted, enhanced recovery techniques are to used to replace or enhance the natural reservoir drive with an artificial or induced drive. Several methods of enhanced recovery are used. For the waterflooding technique, a well or series of wells are drilled on the perimeter of the reservoir and water is injected under pressure. Hydrocarbons remaining in the formation are forced out by the increased pressure. Using CO_2 flooding is a more expensive method of increasing reservoir pressure.

The appendix begins with a discussion of how each of the cases were developed from the NPR-1's existing plans and then goes into a more detailed description of the oil and gas development and production activities involved in each of the cases.

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[1] "Modern Petroleum, A Basic Primer of the Industry." Bill D. Berger and Kenneth Anderson. The Petroleum Publishing Company. Tulsa, OK. 1978.

[2] Ibid.

[3] Ibid.

Table B.1-1
NPR-1 Production FY 1976-1996

			Natural Gas Liquids			
Fiscal Year	Crude Oil (million bbl)	Natural Gas (bcf)	Propane (million gal)	Gasoline (million gal)	Mixed Butane (million gal)	IsoButane (million gal)
1976	3.8	0.8	0.7	0.5	0.4	n/a
1977	37.0	19.5	13.1	8.7	12.5	n/a
1978	43.5	34.4	20.5	19.4	16.4	n/a
1979	52.6	53.3	40.1	35.1	21.1	n/a
1980	58.3	60.6	54.3	40.5	38.1	n/a
1981	62.6	101.0	75.9	48.9	60.7	n/a
1982	60.7	119.5	100.1	63.3	72.9	n/a
1983	57.4	121.3	96.3	61.6	79.5	n/a
1984	50.5	129.0	89.3	64.1	74.6	n/a
1985	47.7	134.8	96.7	80.7	71.9	n/a
1986	42.2	127.4	93.1	69.0	68.9	n/a
1987	39.8	125.3	89.5	71.0	69.9	n/a
1988	39.3	131.4	89.5	75.7	71.7	n/a
1989	35.2	134.8	86.8	75.9	68.8	n/a
1990	29.9	125.6	74.1	65.0	58.7	n/a
1991	27.2	120.7	66.4	59.1	49.7	4.1
1992	25.4	114.3	56.6	55.4	40.0	8.9
1993	23.9	117.8	52.4	54.9	37.4	10.8
1994	24.2	123.4	52.3	53.2	34.9	11.2
1995	23.1	119.2	60.5	53.4	34.2	10.9
1996	21.8	130.8	57.7	53.3	38.2	11.0
Total	806.0	2144.8	1365.9	1108.5	1020.3	56.8

B.2. REFERENCE CASE ("MAXIMUM EFFICIENT RATE")

The Reference Case is based on continued production of NPR-1 at under the maximum efficient rate in compliance with the requirements of the Naval Petroleum Reserves Production Act. MER is defined in this 1976 legislation as "the maximum sustainable daily oil and gas rate from a reservoir which will permit economic development and depletion of that reservoir without detriment to the ultimate recovery." DOE has interpreted this to mean that MER reservoir determinations are to be made and updated on a regular basis taking into account the "unique characteristics of each reservoir," and "sound engineering practices designed to maximize both economic return and ultimate recovery" (DOE 1985b). Stated in other words, MER is dependent on an evolving understanding of reservoir characteristics; sound engineering practices as these change with technological advancements; the economic return of competing development strategies as economic conditions fluctuate over time; and the impact of competing strategies on ultimate recovery. These characterizations result in MER determinations that are in a constant state of change and this has broad implications in planning future activities and establishing the proposed action, which is the subject of this document.

This requires activities that are based on the unique characteristics of the reservoirs (as this understanding matures with time), technological advancements and economic conditions. Given that these variables are difficult to predict, it is correspondingly difficult to determine future activities with precision. However, a range of possibilities has been described in general terms in the NPR-1 1995 Long Range Plan (LRP).

The LRP describes four development scenarios through the year 2034: a "Proved Developed Case," a "Proved Case," a "Proved + Probable Case" and an "Expected Development Case." The "Expected Development Case," also called the "Total Development Case," assumes the implementation of all ordinary oil-field hydrocarbon recovery techniques (including steamflooding) needed to enhance recovery and operational efficiency in accordance with MER requirements. This scenario corresponds to the proposed action in the 1993 SEIS (called the "Full Development Case" in the 1993 SEIS and the FY 1988-1995 Long Range Plan on which the SEIS was based), updated for actual development that has occurred since that date and any changes in reservoir development plans. This SEIS/PEIR uses the "Total Development Case" or "MER" as the "Reference Case" because as the successor plan to the proposed action in the 1993 SEIS, it forms the baseline against which the impacts of the proposed action and alternatives will be measured.

The principal elements of the Reference Case include: (1) the continuation of current oil and natural gas production at NPR-1 (LRP "Proved Developed Case"), with implementation of additional activities to enhance recovery and efficiency, such as infill drilling, well remediation, artificial lift, gas-lift, gas injection and water injection; (2) the future application of enhanced recovery technology; and (3) various other development projects required to maintain MER.

The 1995 Long Range Plan includes the following NPR-1 reserves under its Total Development Case:

- Proved Developed Reserves (the location of the petroleum is well defined and is being produced); plus
- Proved Undeveloped Reserves (the location is well defined but is not being produced); plus

- Probable Unproved Reserves - Risked at 50 Percent, (well tests to define the extent of the reserves have not been conducted but seismic testing, geologic testing and comparisons to similar fields indicate the probability of reserves; a risk factor of 50 percent has been assigned based on the probability of successful production).

There is one difference between the Reference Case in this SEIS/PEIR and the proposed action case of the 1993 SEIS. Both the 1989 and the 1995 LRPs discuss but do not include in there MER cases any of the possible reserves at NPR-1 (no well tests to define the extent of the reserves but seismic tests indicate strong similarity to producing fields; reserves considered to have 10 percent or less certainty level; no production, revenue, expense or capital stream have been developed). That is, although possible reserves are discussed, there are no specific plans to develop those reserves included in the LRP and they are not included in the yearly production projections. However, in this SEIS/PEIR, the most promising of the possible reserve projects in the LRP with a risk factor (50%) applied to the reserves based on the probability of success have been included in the out years (after 2034) of the Reference Case, to more accurately reflect the differences between the development cases.

Table B.2-1 shows the yearly through 2034 and the total projected production under the Reference Case.

Table B.2-1
Production Projections for the Reference Case

Year	Oil (MB)	Gas (BCF)	NGL (MGal)	Total (MBOE)	Water (MB)
1997	29,673.3	143.7	209,919.9	58,710.1	42,191.8
1998	29,647.2	146.6	212,017.9	59,240.4	45,877.6
1999	28,327.4	145.1	200,744.5	57,462.9	49,314.4
2000	26,156.3	152.8	212,825.3	56,852.9	48,951.2
2001	25,216.8	171.0	226,620.5	59,397.2	50,851.1
2002	22,279.7	148.7	205,484.8	52,128.9	50,994.9
2003	19,854.3	134.0	189,356.2	42,868.5	51,158.8
2004	17,574.6	125.6	178,198.8	42,868.5	51,319.7
2005	15,348.4	116.4	167,290.1	38,828.4	50,189.0
2006	13,523.3	106.2	159,107.9	35,049.9	48,271.6
2007	11,815.0	90.8	143,156.3	30,337.1	45,014.0
2008	10,170.9	68.7	109,613.9	24,202.6	38,578.7
2009	8,876.3	51.3	81,997.6	19,367.5	33,718.7
2010	7,843.5	42.9	70,536.6	16,647.0	29,511.3
2011	7,025.5	36.6	62,260.6	14,563.8	26,511.3
2012	6,279.8	33.1	58,632.9	13,131.8	26,057.7
2013	5,771.4	29.4	54,383.9	11,900.1	20,916.0
2014	5,059.3	24.7	48,326.0	10,245.9	16,162.9
2015	4,232.5	17.1	39,272.9	7,925.0	12,540.7
2016	3,942.0	15.2	35,343.3	7,223.2	11,285.1
2017	3,718.3	12.6	30,410.7	6,466.7	9,357.1
2018	3,520.4	10.6	26,167.6	5,831.4	8,783.4
2019	3,381.0	7.4	21,641.9	5,046.2	8,428.9
2020	3,283.2	4.9	18,451.8	4,466.9	7,678.9
2021	3,187.5	4.6	17,487.2	4,288.2	7,394.2
2022	3,090.8	3.5	15,197.9	3,972.8	7,208.4
2023	3,024.4	3.5	14,837.3	3,883.1	7,196.7
2024	2,959.8	3.2	14,131.0	3,759.5	7,189.0
2025	2,899.6	3.0	13,507.1	3,648.3	7,191.2
2026	2,843.4	2.7	12,940.7	3,545.7	7,200.4
2027	2,789.7	2.6	12,452.0	3,453.0	7,218.2
2028	2,722.2	1.7	10,585.7	3,205.9	7,124.1
2029	2,675.8	1..7	10,375.1	3,147.8	7,169.7
2030	2,632.4	1.6	10,179.9	3,093.4	7,217.9
2031	2,594.1	1.6	9,999.2	3,045.2	7,269.3
2032	2,553.5	1.6	9,832.4	2,995.7	7,322.6
2033	2,514.9	1.5	9,678.3	2,948.6	7,378.5
2034	2,610.8	0.9	5,189.6	2,848.7	7,270.8
Total (97-34)	351,619.2	1,869.1	2,928,155.3	732,560.6	885,015.8
2035-?	103,722.6	96.0	176,549.4	123,721.5	302,984.3
Total (1997-?)	455,341.8	1,965.1	3,104,704.7	856,282.1	1,188,000.1

B.3. GOVERNMENT DEVELOPMENT CASE

The Government Development Case under the No Action Alternative consists of the ongoing NPR-1 operations and facilities and the reflects a different range of operational philosophies than the current NPR-1 plans. P.L. 104-106 revised the basic operating strategy for NPR-1. DOE has interpreted P.L. 104-106 as removing certain constraining factors in the MER philosophy as established by the Naval Petroleum Reserves Production Act. Section 3412(h) of P.L. 104-106 requires that, until the sale of Elk Hills is completed, DOE "continue to produce the reserve at the maximum daily oil or gas rate from a reservoir, which will permit maximum economic development of the reservoir consistent with sound oil field engineering practices in accordance with Section 3 of the unit plan contract." The unit plan contract is the agreement between DOE and CUSA under which NPR-1 is operated.

DOE has interpreted this legislation as removing the restriction on production in the MER definition of the Naval Petroleum Reserves Production Act to a sustainable rate that permits economic development and depletion. This permits accelerated government development that maximizes the economic value to the Government consistent with sound engineering practices and sustainable production even if the ultimate recovery of hydrocarbons is reduced. An example of this might be a decision to produce more gas rather than reinjecting it and using the additional revenues to increase exploratory activities to develop possible reserves.

However, although P.L. 104-106 permits production from the NPR-1 reservoirs at a "maximum economic development rate," it also reduces the funds available to the NPR to pursue development opportunities. The LRP Plan has not yet been modified to determine how operations should be amended in order to shift NPR-1 from MER to an accelerated development. The development of Elk Hills under this new strategy may proceed at a different pace, and may consist of a different mix of facility development and operational projects than was analyzed in the 1993 SEIS. For the purposes of NEPA analysis, the SEIS/PEIR assumes that sufficient funds would be appropriated to achieve accelerated government development of NPR-1 (i.e., the upper bound); otherwise development is likely to be closer to the lower bound of the Government Development Case.

Like the Reference Case, the Government Development Case would involve four basic activities: (1) drilling new wells; (2) withdrawing oil, gas and water from new and existing production wells; (3) injecting gas, water and steam into new, converted, or existing injection wells as needed to maintain MER production (gas and water are injected into selected wells to dispose of wastewater, to reduce the possibility of subsidence, to restore reservoir pressure losses from production withdrawals, and as part of recovery operations to ensure that the desired MER is achieved); and (4) selling, delivering and otherwise distributing oil, NGLs and gas not needed for injection.

As discussed earlier, numerous factors will impact the amount of production at NPR-1, including oil and gas prices, development of oil and gas field technology, increased understanding of the nature of the reservoirs, availability of funds for capital investment, and management operating philosophy. Just as these variables are difficult to predict, so too are future activities. To reasonably predict the consequences of future government development, DOE analyzed a range of outcomes for the Government Development Case. However, the ranges used in this SEIS/PEIR were developed to conservatively estimate the environmental impacts of the alternatives and should be viewed as estimating all possible development outcomes up to the upper bound of the ranges.

The upper bound of the Government Development Case is significantly above the Reference Case. The development and production of the upper bound were developed from the Reference Case (or the 1995 LRP "Total Development Case") plus:

- The most promising of the possible reserve projects in the LRP with a risk factor (75%) applied to the reserves based on the probability of success.
- The remainder of the possible reserve projects in the LRP with a higher risk factor (50%) applied.

In developing the upper bound of the Government Development Case it was also assumed that the activities in addition to the Reference Case would not occur as rapidly as commercial development due to current fiscal constraints. Thus production from new development is assumed to occur later in the Government Development Case compared to the Commercial Development Case. Estimated production by product type and total barrel of oil equivalent, as well as year-by-year estimates through 2034, are shown in Table B.3-1.

The lower bound of the Government Development Case was calculated from the Reference Case adjusted for actual 1995 and 1996 production, which has been lower than the 1995 LRP Plan projections. Under the lower bound estimate, it is assumed that expenditures are not made to fully to develop the field and that by the year 2034, production levels are so low that the field is no longer economic (production revenues are less than the cost of maintaining the operation) and so the filed is shut in and the possible reserves never explored and developed. Estimated production by product type and total barrel of oil equivalent year-by-year through 2034 are shown in Table B.3-2.

Table B.3-1
Government Case - Upper Bound

Year	Oil (MB)	Gas (BCF)	NGL (MGal)	Total (MBOE)	Water (MB)
1997	29,673.3	143.7	209,919.9	58,710.1	42,191.8
1998	29,647.2	146.6	212,017.9	59,240.4	45,877.6
1999	28,327.4	145.1	200,744.5	57,462.9	49,314.4
2000	26,156.3	152.8	212,825.3	56,852.9	48,951.2
2001	25,216.8	171.0	226,620.5	59,397.2	50,851.1
2002	25,467.2	152.2	210,227.0	56,005.2	52,651.1
2003	25,855.9	142.6	197,800.6	54,034.9	58,740.9
2004	26,450.0	135.2	191,752.6	53,667.7	67,076.3
2005	25,510.9	126.2	181,355.5	50,965.1	71,674.3
2006	24,010.2	115.7	173,296.8	47,456.4	72,989.7
2007	22,979.5	100.2	157,912.0	43,410.8	73,108.5
2008	21,236.5	83.9	133,853.4	38,371.1	65,902.5
2009	19,089.5	70.7	112,961.9	33,542.4	59,422.6
2010	16,868.4	59.1	97,173.0	28,996.3	52,007.9
2011	15,109.2	50.4	85,771.7	25,494.2	46,721.0
2012	13,505.5	45.6	80,774.1	22,945.0	45,921.6
2013	12,412.0	40.5	74,920.6	20,855.1	36,860.4
2014	10,880.6	34.0	66,575.1	18,025.7	28,484.0
2015	9,102.6	23.6	54,103.3	14,189.4	22,100.5
2016	8,477.7	20.9	48,689.8	12,997.9	19,887.8
2017	7,996.6	17.4	41,894.2	11,782.9	16,490.1
2018	7,571.1	14.5	36,049.1	10,754.8	15,479.0
2019	7,271.2	10.1	29,814.4	9,565.3	15,479.0
2020	7,060.9	6.8	25,419.7	8,691.5	13,532.6
2021	6,855.2	6.3	24,090.8	8,371.5	13,030.8
2022	6,647.2	4.9	20,937.0	7,862.2	12,703.4
2023	6,504.3	4.8	20,440.2	7,687.3	12,682.8
2024	6,365.4	4.4	19,467.2	7,467.1	12,669.2
2025	6,235.9	4.1	18,607.7	7,267.3	12,673.1
2026	6,115.0	3.8	17,827.4	7,082.5	12,689.3
2027	5,999.6	3.5	17,154.2	6,913.4	12,720.7
2028	5,854.4	2.4	14,583.1	6,520.8	12,554.8
2029	5,754.7	2.3	14,293.0	6,404.8	12,635.2
2030	5,661.3	2.3	14,024.1	6,296.4	12,720.1
2031	5,578.8	2.2	13,775.1	6,200.3	12,810.7
2032	5,491.7	2.2	13,545.4	6,100.8	12,904.7
2033	5,408.5	2.1	13,333.1	6,006.0	13,003.2
2034	5,614.9	1.2	7,149.3	5,942.6	12,813.4
Total (97-34)	529,963.1	2,055.1	3,295,375.1	950,062.1	1,249,702.5
2035-?	119,292.0	94.3	151,159.6	138,562.0	281,301.7
Total (1997-?)	649,255.1	2,149.3	3,446,534.7	1,088,624.1	1,531,004.2

Table B.3-2
Government Case - Lower Bound

Year	Oil (MB)	Gas (BCF)	NGL (MGal)	Total (MBOE)	Water (MB)
1997	24,332.1	136.5	199,423.9	51,917.0	40,082.2
1998	24,903.6	139.3	201,417.0	53,017.2	43,583.7
1999	24,361.6	139.3	192,714.7	52,331.7	47,341.8
2000	23,017.6	146.6	204,312.3	52,486.3	46,993.2
2001	22,695.1	165.9	219,821.9	55,850.1	49,325.6
2002	20,497.3	144.2	199,320.3	49,451.0	49,465.1
2003	18,663.1	131.3	185,569.1	45,099.5	50,135.6
2004	16,520.1	123.1	174,634.8	41,308.1	50,293.3
2005	14,427.5	114.1	163,944.3	37,437.9	49,185.2
2006	12,711.9	104.1	155,925.7	33,807.9	47,306.2
2007	11,106.1	89.0	140,293.2	29,257.8	44,113.7
2008	9,560.7	67.3	107,421.6	23,311.7	37,807.1
2009	8,343.7	50.3	80,357.6	18,625.1	33,044.3
2010	7,372.9	42.1	69,125.9	16,000.3	28,921.1
2011	6,604.0	35.9	61,015.4	13,991.5	25,981.1
2012	5,903.0	32.4	57,460.2	12,618.0	25,536.5
2013	5,425.1	28.8	53,296.2	11,431.2	20,497.7
2014	4,755.7	24.2	47,359.5	9,838.6	15,839.6
2015	3,978.6	16.0	38,487.4	7,597.2	12,289.9
2016	3,705.5	14.9	34,636.4	6,921.0	11,059.4
2017	3,495.2	12.4	29,802.5	6,188.7	9,170.0
2018	3,309.2	10.3	25,644.2	5,574.0	8,607.7
2019	3,178.1	7.2	21,209.1	4,810.1	8,260.3
2020	3,086.2	4.8	18,082.2	4,246.2	7,525.3
2021	2,996.3	4.5	17,137.5	4,075.0	7,246.3
2022	2,905.4	3.5	14,893.9	3,769.7	7,064.2
2023	2,842.9	3.4	14,540.6	3,684.5	7,052.8
2024	2,782.2	3.1	13,848.4	3,566.0	7,045.2
2025	2,725.6	2.9	13,237.0	3,459.3	7,047.4
2026	2,672.7	2.7	12,681.9	3,361.1	7,056.4
2027	2,622.3	2.5	12,203.0	3,272.4	7,073.8
2028	2,558.8	1.7	10,374.0	3,032.9	6,981.6
2029	2,515.3	1.7	10,167.6	2,977.8	7,026.3
2030	2,474.4	1.6	9,976.3	2,926.3	7,073.5
2031	2,438.4	1.6	9,799.2	2,880.5	7,123.9
2032	2,400.3	1.5	9,635.8	2,833.7	7,176.1
2033	2,364.0	1.5	9,484.7	2,789.0	7,230.9
2034	2,454.2	0.8	5,085.8	2,687.3	7,125.4
Total (97-34)	318,706.7	1,813.8	2,844,341.6	688,433.5	861,689.6
2035-?	-	-	-	-	-
Total (1997-?)	318,706.7	1,813.8	2,844,341.6	688,433.5	861,689.6

B.4. COMMERCIAL DEVELOPMENT CASE

As it will not be possible to predict how a commercial owner or owners would develop NPR-1, for the purposes of characterizing the potential environmental impacts of commercial operation, like the Government Development Case, the Commercial Development Case will include upper and lower bounds. Also like the Reference Case and the Government Development Case, the Commercial Development Case would involve the same oil field activities.

The upper bound of the Commercial Development Case encompasses the Reference Case plus all the projects under consideration by the government for the development of NPR-1's "possible reserves." Commercial development would likely include one or more of a combination of the following actions, where economically justified:

- Eventual phase-out of gas injection and the disposition of gas previously reinjected. Preliminary government studies have indicated that some reservoirs are approaching a stage of depletion in which incremental recovery from gas injection may be marginal. Reducing the volumes of gas reinjected would make more gas available for sale. The ultimate level and timing of increased gas sales could have significant implications on the California gas market and on the environmental impacts of divestiture.
- Accelerated depletion of the shallow oil zone. The shallow oil zone is a low-pressure reservoir producing under slow, hyperbolic decline. Better understanding of the reservoir characteristics, aggressive acceleration of remedial activity on existing wells, and alternative development approaches (e.g., gas or water injection) could dramatically increase and/or accelerate oil recovery from this reservoir.
- More extensive development of the siliceous shales. Preliminary government studies indicate that these reserves could be significantly understated. Recovery from shale reservoirs to date has been relatively low because of their geologic complexity and greater focus on the sand reservoirs. Better understanding of the characteristics of these formations and the application of state-of-the-art extraction technologies could result in increased recovery, though the investment and activity required to develop and produce them could be extensive.
- Pattern waterflood of the Stevens sand reservoirs. To date, the Stevens reservoirs at Elk Hills have primarily been produced under peripheral waterfloods. An industry review panel has recommended that pattern waterfloods in at least parts of these reservoirs should be thoroughly considered, because reconfiguration of these waterfloods could potentially result in increased recovery.
- Application of enhanced oil recovery processes. Numerous studies have indicated that a variety of enhanced oil recovery (EOR) techniques are technically feasible at Elk Hills. If economically feasible, the application of these types of recovery processes could result in a significant increase in reserves, but a substantial investment and increase in the intensity of field development would be required to implement them.

Estimated production by product type and total barrel of oil equivalent, as well as year-by-year estimates through 2034, are shown in Table B.4-1.

Table B.4-1
Commercial Case - Upper Bound

Year	Oil (MB)	Gas (BCF)	NGL (MGal)	Total (MBOE)	Water (MB)
1997	29,673.3	143.7	209,919.4	58,710.1	42,191.8
1998	29,647.2	146.6	212,017.9	59,240.4	45,877.6
1999	35,000.0	153.6	217,977.2	65,932.4	60,930.5
2000	38,000.0	167.6	241,575.6	71,813.6	71,116.5
2001	40,750.0	190.0	264,033.0	78,920.0	82,174.8
2002	40,250.0	162.8	259,680.5	73,503.9	92,126.1
2003	39,086.9	152.9	245,327.3	70,348.2	100,715.4
2004	37,710.6	146.0	237,890.1	67,623.3	110,119.0
2005	35,352.5	137.5	228,517.8	63,591.1	115,601.9
2006	32,391.0	126.5	214,393.2	58,431.8	115,619.7
2007	31,508.7	111.2	199,055.0	54,583.3	120,045.6
2008	30,559.4	95.8	184,669.8	50,659.3	115,912.8
2009	29,000.0	86.0	160,891.0	46,951.4	110,163.6
2010	25,625.7	71.9	138,402.9	40,697.6	96,417.4
2011	22,953.3	61.2	122,164.2	35,867.9	86,616.0
2012	20,517.0	55.4	115,046.1	32,265.5	85,134.1
2013	18,855.9	49.2	106,709.0	29,373.4	68,335.4
2014	16,529.3	41.3	94,822.5	25,441.0	52,806.4
2015	13,828.3	28.6	77,059.0	20,195.9	40,972.2
2016	12,879.1	25.4	69,348.6	18,539.5	36,870.0
2017	12,148.0	21.1	59,670.1	16,893.3	30,570.9
2018	11,501.7	17.7	51,344.6	15,494.5	28,696.6
2019	11,046.2	12.3	42,464.5	13,936.5	27,538.4
2020	10,726.6	8.3	36,205.1	12,795.7	25,088.0
2021	10,414.1	7.6	34,312.4	12,339.7	24,157.9
2022	10,098.1	5.9	29,820.5	11,646.6	23,550.8
2023	9,881.1	5.8	29,112.9	11,389.1	23,512.6
2024	9,670.0	5.3	27,727.0	11,075.9	23,487.4
2025	9,473.3	4.9	26,502.9	10,790.7	23,494.6
2026	9,289.6	4.6	25,391.5	10,526.8	23,524.7
2027	9,114.3	4.3	24,432.6	10,283.8	23,582.8
2028	8,893.7	2.9	20,770.7	9,753.8	23,275.4
2029	8,742.3	2.8	20,357.4	9,581.5	23,424.4
2030	8,600.3	2.8	19,974.4	9,420.5	23,581.9
2031	8,475.1	2.7	19,619.9	9,277.8	23,749.8
2032	8,342.8	2.6	19,292.6	9,129.6	23,923.9
2033	8,216.4	2.6	18,990.2	8,988.4	24,106.6
2034	8,530.0	1.4	10,182.7	8,952.8	23,754.7
Total (97-34)	753,281.8	2,269.0	4,115,672.1	1,224,966.7	1,092,768.3
2035-?	178,938.0	141.4	256,540.1	208,339.3	715,752.0
Total (1997-?)	932,219.8	2,410.4	4,372,212.2	1,433,306.0	2,808,520.3

The lower bound of the Commercial Development Case includes: the lower bound of the Government Development Case (which reflects actual 1995 and 1996 production) plus the most promising projects identified in the 1995 Long Range Plan for the development of NPR-1's "possible reserves," with a risk factor applied to the reserves based on the probability of success (75%), but excluding projects that could be clarified as "higher economic risk," such as CO_2 injection projects, because of the high cost of logistics and supplies.

Estimated production by product type and total barrel of oil equivalent, as well as year-by-year estimates through 2034, are shown in Table B.4-2. Table B.4-3 shows a summary comparison of the exploration and production assumptions of the three development cases.

Table B.4-2
Commercial Case - Lower Bound

Year	Oil (MB)	Gas (BCF)	NGL (MGal)	Total (MBOE)	Water (MB)
1997	29,673.3	143.7	209,919.9	58,710.1	42,191.8
1998	29,647.2	146.6	212,017.9	59,240.4	45,877.6
1999	28,500.0	145.5	201,296.1	57,715.6	49,614.9
2000	26,250.0	152.8	212,821.0	56,945.9	49,126.5
2001	26,450.0	171.1	226,622.4	60,630.7	53,338.0
2002	26,250.0	152.8	211,195.8	56,928.8	60,082.3
2003	24,819.5	138.5	195,635.2	52,690.0	63,952.6
2004	23,313.5	130.6	185,254.7	49,608.9	68,077.9
2005	21,127.9	121.6	174,752.7	45,655.3	69,087.8
2006	18,592.3	110.9	166,145.8	41,071.0	66,365.4
2007	16,882.6	95.6	150,642.2	36,373.4	64,321.4
2008	15,122.0	75.2	119,954.0	30,477.4	57,358.4
2009	14,000.0	61.3	97,866.5	26,521.6	53,182.4
2010	12,371.0	51.2	84,187.5	22,878.3	46,546.3
2011	11,080.9	43.7	74,309.8	20,078.1	41,814.6
2012	9,904.8	39.5	69,980.1	18,082.8	41,099.2
2013	9,102.8	35.1	64,908.8	16,417.6	32,989.5
2014	7,979.7	29.4	57,678.5	14,170.0	25,492.7
2015	6,675.7	20.4	46,873.4	11,082.8	19,779.7
2016	6,217.5	18.1	42,183.3	10,133.6	17,799.3
2017	5,864.6	15.1	36,296.1	9,145.0	14,758.4
2018	5,552.5	12.6	31,231.8	8,310.8	13,853.5
2019	5,332.6	8.8	25,830.2	7,320.1	13,294.4
2020	5,178.3	5.9	22,022.8	6,591.1	12,111.5
2021	5,027.5	5.4	20,871.5	6,341.2	11,662.4
2022	4,875.0	4.2	18,139.1	5,927.6	11,369.4
2023	4,770.2	4.1	17,708.8	5,795.1	11,350.9
2024	4,668.3	3.8	16,865.8	5,622.8	11,338.8
2025	4,573.3	3.5	16,121.1	5,466.9	11,342.2
2026	4,484.6	3.3	15,445.1	5,322.9	11,356.7
2027	4,400.0	3.1	14,861.8	5,191.7	11,384.8
2028	4,293.5	2.1	12,634.3	4,870.9	11,236.4
2029	4,220.4	2.0	12,383.0	4,783.7	11,308.3
2030	4,151.9	2.0	12,150.0	4,702.2	11,384.3
2031	4,091.4	1.9	11,934.3	4,629.9	11,465.4
2032	4,027.5	1.9	11,735.3	4,555.3	11,549.5
2033	3,966.5	1.8	11,551.3	4,484.2	11,637.7
2034	4,117.9	1.5	9,207.0	4,539.9	11,467.8
Total (97-34)	447,557.0	1,966.0	3,118,221.8	848,875.5	1,181,970.8
2035-?	59,646.0	47.1	74,757.6	69,267.4	157,521.4
Total (1997-?)	507,203.0	2,013.1	3,192,979.3	918,142.9	1,339,492.2

Table B.4-3
Summary of Potential Development Characterizations for NPR-1 Through the Year 2034

Reference Case	Government Development Case		Commercial Development Case	
Maximum Efficient Rate (MER)	**Lower Bound of Expected Case**	**Upper Bound of Expected Case**	**Lower Bound of Expected Case**	**Upper Bound of Expected Case**
1995 Long Range Plan Total Development Case Includes: Proved Developed Reserves Proved Undeveloped Reserves Risked Unproved Probable Reserves After 2034: Most promising 1995 LRP Possible Reserves projects reduced by a risk factor(50%)	1995 Long Range Plan Total Development Case Adjusted for: Actual 1995 and 1996 Oil and Gas Production	1995 Long Range Plan Total Development Case plus: Most promising 1995 LRP Possible Reserves projects reduced by a risk factor (75%) plus the remainder of the possible reserves adjusted by a higher risk factor (50%)	Lower Bound of Government Development Case plus: Most promising Possible Reserves projects identified in the 1995 LRP reduced by a risk factor(75%)	1995 Long Range Plan Total Development Case plus: All Possible Reserves projects identified in the 1995 LRP

Development Key:

Proved Developed Reserves - development and production of petroleum with greater than 90 percent probability; the location of the petroleum is well defined and is being produced

Proved Undeveloped Reserves - reserves considered to 90 percent or more certainty that require capital for development

Risked Unproved Probable Reserves - no well tests to define the extent of the oil reserve, but seismic testing, geologic testing and comparisons to similar oil fields indicate the probability of oil; a risk factor of 50 percent to the reserve based on probability of success has been assigned

Unrisked Unproved Probable Reserves - total unproved probable reserves; a risk factor has not been assigned

Unproved Possible Reserves - no well tests to define the extent of the reserves but seismic tests indicate strong similarity to producing fields; reserves considered to have 10 percent or less certainty level; no production, revenue, expense or capital stream have been developed

B.5. COMPARISON OF RESERVOIR DEVELOPMENT PLANS

The following discussion summarizes reservoir-by-reservoir plans for all development cases. The source of this information is the FY 1995 Long Range Plan, which uses the term "proved developed case" to refer to the plans for producing NPR-1's proved developed reserves. This term is used below to assist in cross-referencing the FY 1995 Long Range Plan. The reservoir management strategy for the Reference Case includes the "proved developed case" plus additional activities. Except where noted below, the reservoir management strategy for government development includes the Reference Case plus an increase in drilling and remedial activities as NPR-1's budget allows. The reservoir management strategy for the lower bound of the Commercial Case includes the Reference Case plus an increase in drilling and remedial activities as might be proposed by the new operator of the NPR-1 under the buyer's internal budget restraints and/or regulatory considerations. The management strategy for the upper bound of the Commercial Case includes all the advanced production techniques that can be properly and economically be employed by the new operator of the NPR-1 reserve.

B.5.1. Stevens Zone

Main Body B (MBB)/Western 31S (W31S). The management strategy for this reservoir includes the proved developed case plus continued pressure maintenance in each of the seven reservoir management sectors through peripheral water injection. Aggressive remedial and drilling programs will be continued to optimize waterflood performance. See pages 27-37 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include CO_2 (tertiary oil flood) for enhanced oil recovery and/or pattern waterflood in the main production area.

24Z Sands. The management strategy for this reservoir includes the proved developed case plus development drilling. The proved developed case includes peripheral water injection, gas injection and remedial actions (such as artificial-lift installations, stimulations, recompletions and conversions). Development activities include optimization of peripheral water injection (will replace 118 percent of liquid voidage) and crestal gas injection (will replace 100 percent of free gas voidage) to obtain the highest recovery possible by tracking pressure and performance on a sublayer/flank basis and adjusting injection and completions accordingly. See pages 39-46 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include additional horizontal drilling, additional artificial lift installations and increased waterflood activity.

2B Sands. The management strategy for this reservoir is the proved developed case, which includes well stimulations and recompletions and installation of artificial-lift equipment, plus augmentation of the current operations with water injection from the north and east to enhance recovery. See pages 47-52 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include additional waterflood activity as an enhancement to future production.

29R/24Z Shales. The management strategy for this shale formation includes the proved developed case plus accelerated step-out, infill drilling and remedials, optimization of 'A' Sand gas injection, and quantification of gas reserves in unconventional reservoirs. See pages 53-61 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include CO_2 (tertiary oil flood) for enhanced oil recovery and/or pattern waterflood in the main production area.

26R Sands. The strategy for this reservoir includes the proved developed case and a horizontal drilling project. The proved developed case emphasizes remedial activities, such as stimulation and recompletions. Production would continue under gas injection assisted by gravity drainage. Development would involve horizontal drilling that would improve recovery efficiency, which might sustain production for an extended period. See pages 63-68 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include replacing all vertical wells with horizontal wells, N_2 injection to replace natural gas for pressure maintenance and increased gas sales.

31S C/D Shales. The management strategy includes the proved developed case, plus accelerated infill drilling and stimulation of producing wells with acid or hydraulic fracturing. Reservoir energy will be conserved by shutting-in high gas-to-oil ratio (HGOR) wells, and quantifying gas reserves in unconventional reservoirs. In addition, the expansion of a pilot gas injection cycling project will be evaluated. See pages 69-76 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include CO_2 (tertiary oil flood) for enhanced oil recovery and/or, additional horizontal drilling, remedial work on the existing wells and increased gas injection for pressure maintenance and gas lift.

31S N/A Shales. The management strategy for this reservoir consists of the proved developed case, plus accelerated remedial activities such as stimulations and recompletions. Investigation of new reservoir strategies for probable reserves, quantification of gas reserves in unconventional reservoirs and evaluation of the Restart Gas Cycling Project are also planned. See pages 77-83 in the 1995 LRP for more information. For this reservoir the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include CO_2 (tertiary oil flood) for enhanced oil recovery and/or increased gas injection for pressure maintenance and gas lift.

Northwest Stevens (NWS) A1-A2 Sands. The total development strategy for this reservoir includes the proved developed case plus a horizontal drilling project. The proved developed case consists of maintaining reservoir production and pressure by gas injection to balance voidage and by conducting isolation remedial projects. In addition, two horizontal wells are planned. See pages 85-89 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include expanded horizontal drilling, waterflood activity and the possibility of converting the reservoir for gas storage use.

NWS A3-A6 Sands. The strategy for development of this reservoir consists of the proved developed case and a development drilling project. The proved developed case includes remedial actions (recompletions and stimulations) and continued peripheral water injections to support reservoir pressure and improve production recovery. Development drilling would include two vertical wells in FY 1996 and one in FY 1997 and one in FY 1998. See pages 91-97 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include a pattern waterflood in the A6 reservoir and additional artificial lift installations.

NWS T Sands and N Shales. The reservoir development strategy is to continue producing under pressure depletion. Under this recovery mechanism, the operating strategy is to maximize drawdown on all producers using rod pumps. Remedial programs would also improve production in wells believed to be performing below expectations. Numerous acid stimulations and recompletions, as well as a waterflood feasibility study, are planned for the future. See pages 91-94 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include waterflooding, infill drilling and stimulation and fracturing remediation on the existing wells.

B.5.2. Asphalto

This reservoir is nearly 70 percent depleted. The management strategy consists of the proved developed case only—continued primary production to the economic limit. Routine remedial activity will be performed and water disposal capability will be maintained to maintain production. Asphaltenes at the tank setting facilities will be decreased to minimize plugging of water injectors. See pages 113-117 in the 1995 LRP for more information. No activity to advance production is anticipated under the Government Case or the Commercial Case.

B.5.3. Shallow Oil Zone

The total development management strategy for the SOZ is a combination of the proved developed case plus three production enhancement projects. The proved developed case includes well remedial actions to facilitate production, which consists of gravity drainage in the eastern SOZ and gravity drainage with gas expansion in the western SOZ. Production enhancement projects include drilling of fifteen replacement wells/year from FY 1998 to FY 2007. Test horizontal drilling, low pressure gas injection and water injection are also planned. See pages 105-111 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound the could include the possibility of a steam flood, surfactant polymer flood, horizontal drilling and an increase in waterflooding activity.

B.5.4. Carneros Zone

This is mainly a gas reservoir and is nearly depleted. The total development strategy consists of the proved developed case, which includes a project to install more compression. It is planned to increase gas deliverability and ultimate recovery by adding compression to lower the abandonment pressure by 40 psi. Artificial lift, including velocity string installations, are anticipated to maintain production. See pages 119-124 in the 1995 LRP for more information. No increased future recovery is anticipated under any of the other cases.

B.5.5. Dry Gas Zone

The development strategy for this reservoir consists of continued pressure depletion of the existing reserve base and development of additional proved reserves through well recompletions, followed by installation of wellhead compression to lower the gathering system pressure from 85 to 35 psig. Eighteen million cubic feet per day deliverability will be maintained. See pages 125-129 in the 1995 LRP for more information. For this reservoir, the Government Case, Upper Bound and the Commercial Case, Upper and Lower Bound could include recompletion of all 40 wells to prove 45 new production zones in shallow reservoirs. Additional infill drilling is also possible.

B.6. PRODUCTION QUANTITIES

B.6.1. Reference Case

DOE estimates that the production anticipated for the Reference Case would result in the production quantities, through FY 2034, shown in Table B.6-1 at the end of this discussion. Figures B.6-1 through B.6-4 are a graphical representation of this data. Reservoir by reservoir data supporting the table and figures follow. This table illustrates that, as the field matures, oil production and gas sales would decline; however, gas production, produced water, gas injection and water injection would increase. This has major implications for the level of drilling and remedial activity as discussed in the following sections and the 1995 LRP. The total barrel of oil equivalent (BOE) production for the reference case is 856.3 million BOE.

B.6.2. Government Development Case

DOE estimates that continued production anticipated for this case would result in the production quantities, through FY 2034, shown in Tables B.6-2 and B.6-3 and graphically illustrated in Figures B.6-1 to B.6-4. The upper bound table illustrates that oil and gas production would increase as field operations are redesigned to produce oil and gas at an accelerated rate. Water production would increase as part of the effort to produce the reserves faster. The lower bound table illustrates that oil and gas production would decrease as field operations are reduced due to budget constraints. This has major implications for the level of drilling and remedial activity. The total barrel of oil equivalent production for this case of 688.4 million BOE for the lower bound and 1,088 million BOE for the upper bound compares to the total reference case of 856.3 million BOE.

B.6.3. Commercial Development Case

The estimated production anticipated for the Commercial Cases would result in the production quantities, calculated yearly through FY 2034, shown by Tables B.6-4 and B.6-5 and graphically illustrated in Figures B.6-1 to B.6-4. This table illustrates that oil production and gas sales would increase significantly as field operational management is changed to implement a more aggressive production philosophy. Water production would increase, along with the higher rates of oil and gas. Injection of water and gas would be increased as part of the effort to produce the reserves at a higher level. This has major implications for the level of drilling and remedial activity. The total barrel of oil equivalent production of 1,433 million BOE for the upper bound of the Commercial Case and 918.1 million BOE for the lower bound of the Commercial Case compares to the total Reference Case of 856.3 million BOE.

Figure B.6-1
Oil Production under the Cases Through 2034

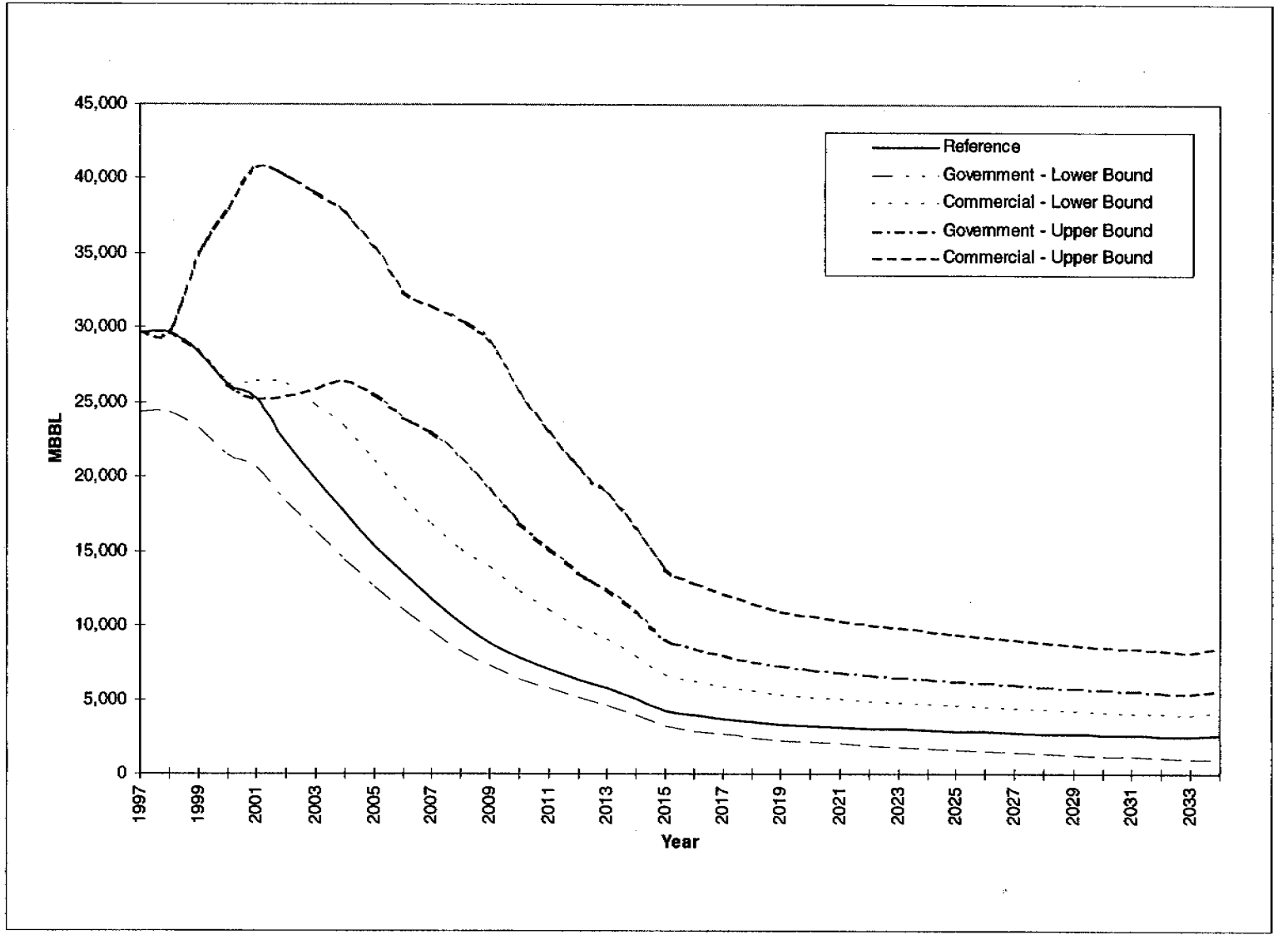

Figure B.6-2
Gas Production under the Cases Through 2034

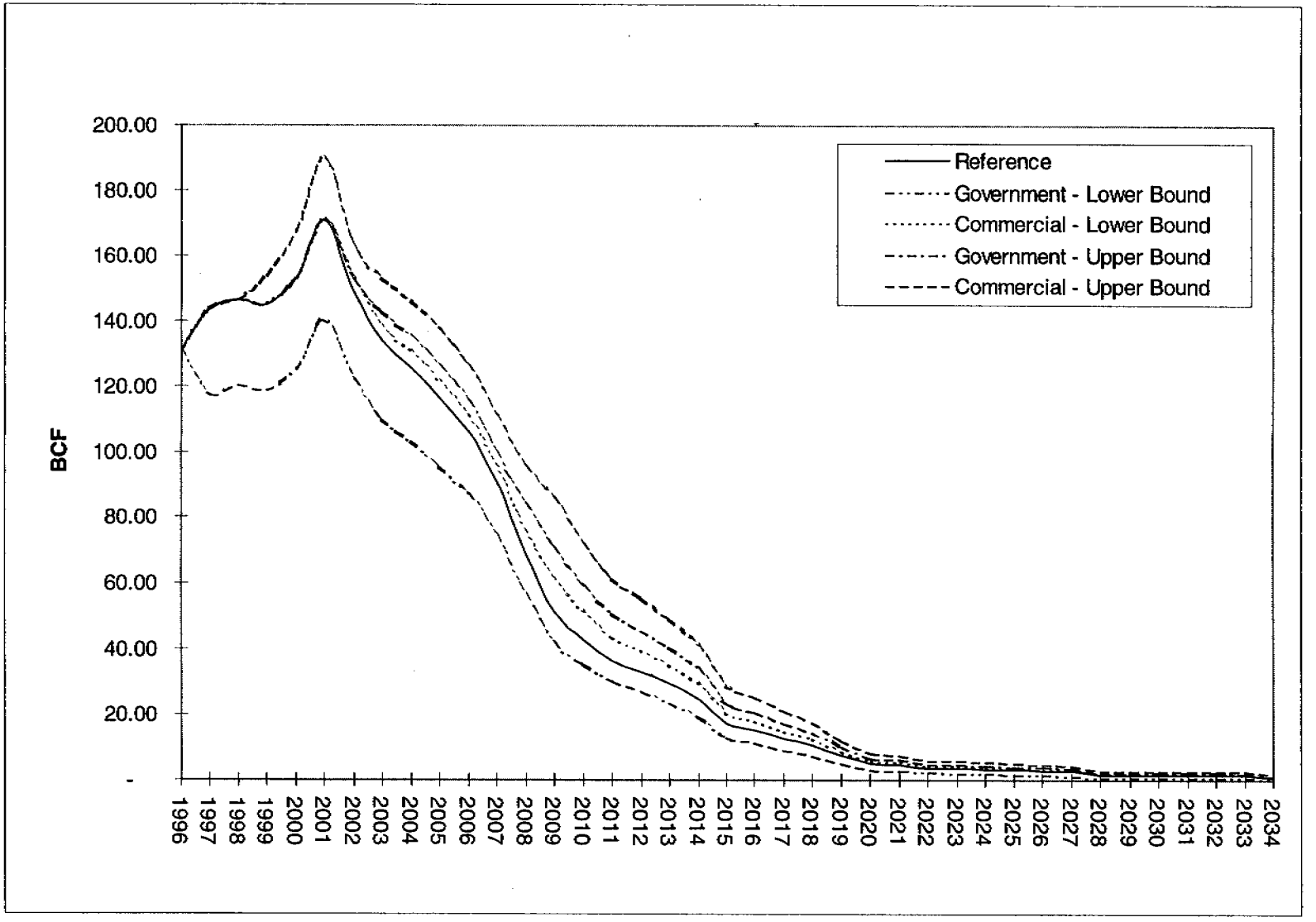

Figure B.6-3
NGL Production under the Cases Through 2034

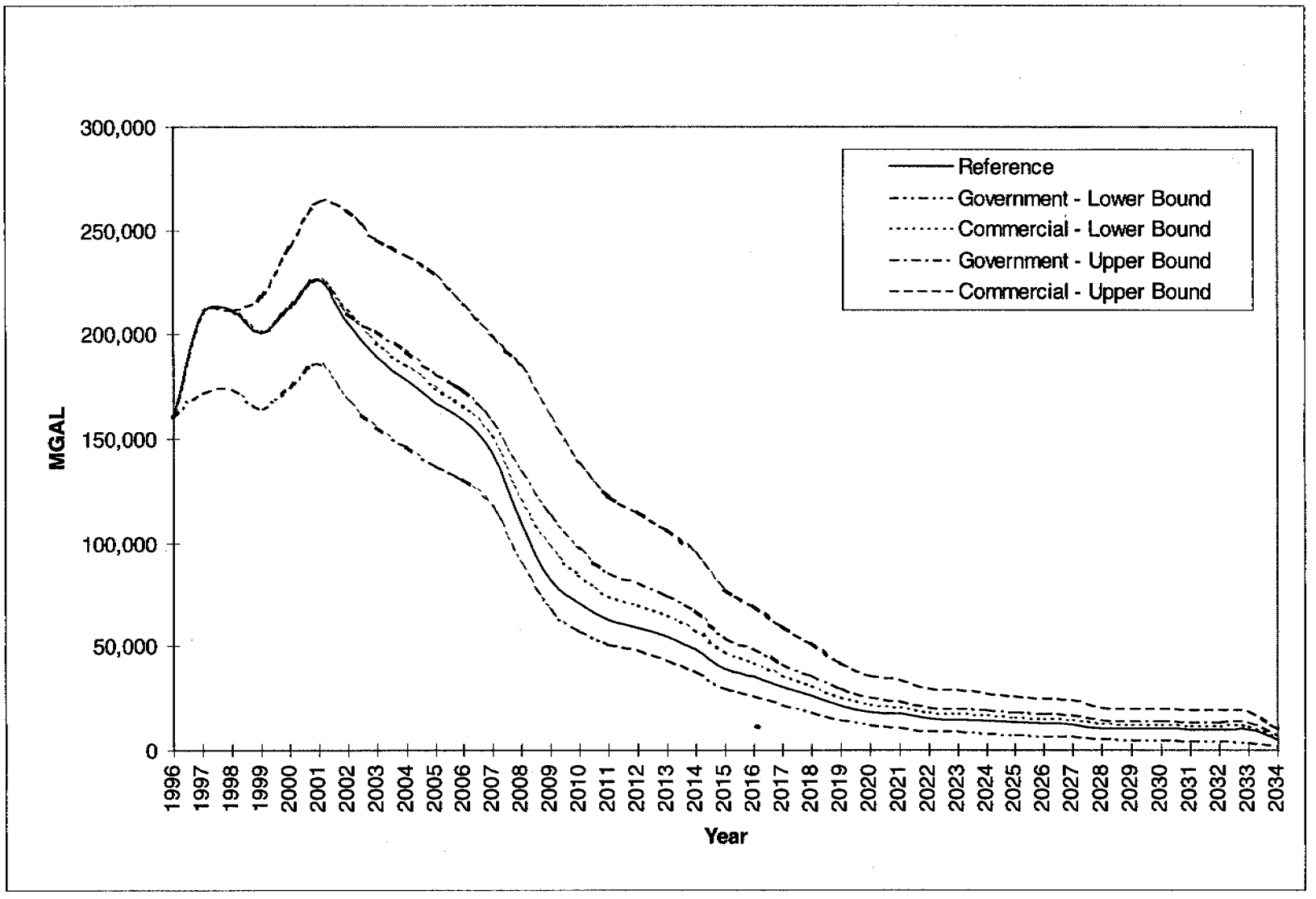

Figure B.6-4
Water Production under the Cases Through 2034

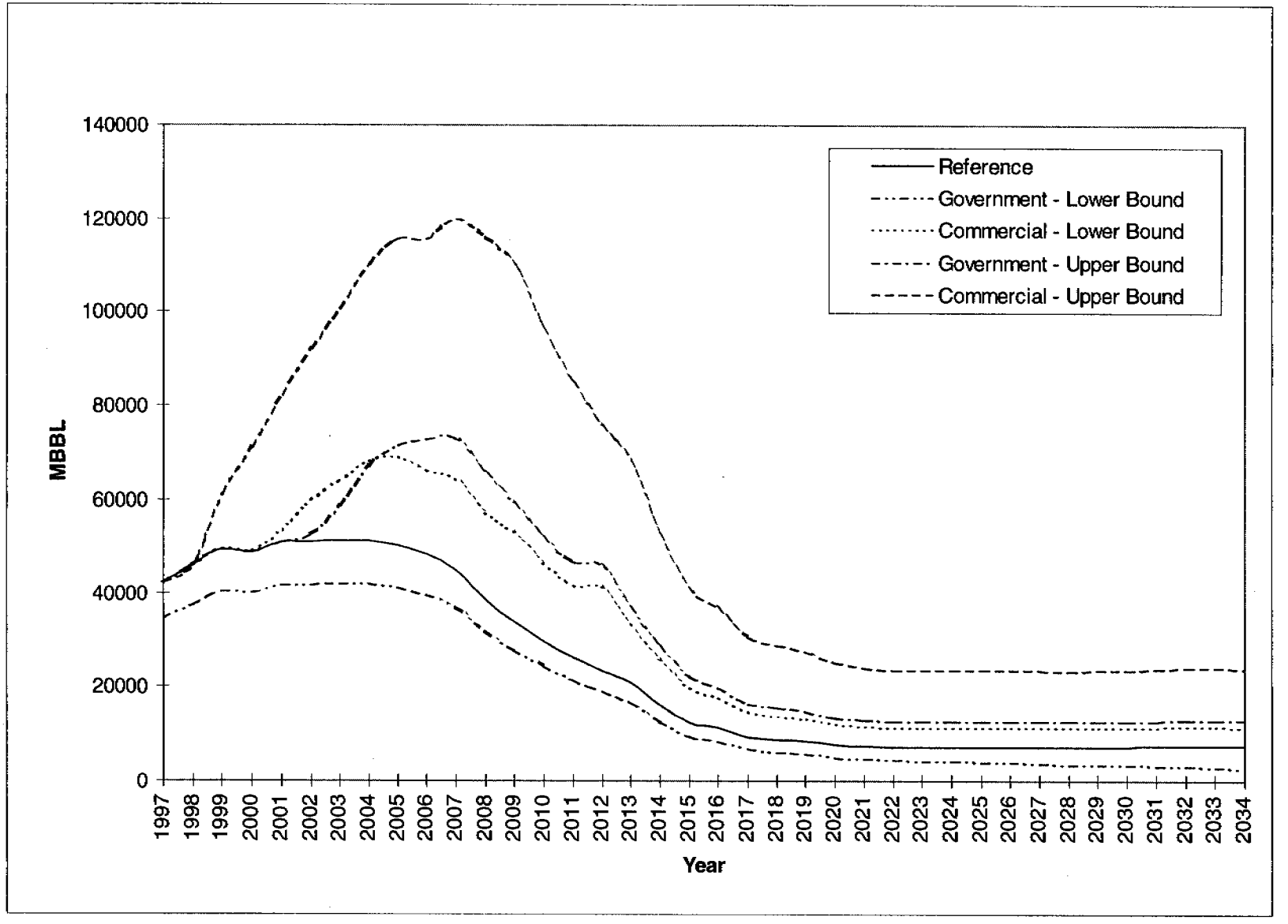

Table B.6-1
Production Quantities for Reference Case

		1997	1998	1999	2000	2001	2002	2003
Remedial	**Reservoir**	152	144	137	140	176	153	143
	Artificial Lift	14	11	10	9	6	4	2
	Wells	124	120	120	117	108	98	98
	Rig Days (1)	2030	1925	1869	1862	2030	1785	1701
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	290	275	267	266	290	255	243
	DF Waste (4)	191,400	181,500	176,220	175,560	191,400	168,300	160,380
Development Drilling		74	61	65	45	35	35	34
	Rig Days (5)	2220	1830	1950	1350	1050	1050	1020
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	88.8	73.2	78	54	42	42	40.8
	Temp. Acres (7)	88.8	73.2	78	54	42	42	40.8
	DF Waste (8)	315,980	260,470	277,550	192,150	149,450	149,450	145,180
Facility Installations								
	Compression				2000 hp (10)			
	Artificial Lift		1		1			
	Acres (9)		1		3			
Production	**Oil MB/Yr**	29,673.26	29,647.19	28,327.41	26,156.32	25,216.76	22,279.72	19,854.35
	Gas BCF/Yr	143.70	146.63	145.10	152.75	171.05	148.67	134.02
	WaterMB/Yr	42,191.80	45,877.60	49,314.40	48,951.20	50,851.10	50,994.90	51,158.80
	NGL MGal/Yr	209,919.90	212,017.90	200,744.50	212,825.30	226,620.50	205,484.80	189,356.20
NGL to Gas Ratio	**(gal/mmcf)**	1,460.84	1,445.94	1,383.48	1,393.26	1,324.89	1,382.14	1,412.86
Injection	**GasBCF/Yr**	94.6	98.5	103.1	103.9	30.3	13.8	13.8
	WaterMB/Yr	49,435.6	49,961.6	51,215.0	39,400.3	37,574.6	34,378.3	30,086.6

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-1
Production Quantities for Reference Case (continued)

		2004	2005	2006	2007	2008	2009	2010
Remedial	**Reservoir**	138	144	143	142	125	110	100
	Artificial Lift	2	2	2	2	2	1	1
	Wells	96	96	96	95	24	24	20
	Rig Days (1)	1652	1694	1687	1673	1057	945	847
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	236	242	241	239	151	135	121
	DF Waste (4)	155,760	159,720	159,060	157,740	99,660	89,100	79,860
Development Drilling		24	24	21	20	3	2	3
	Rig Days (5)	720	720	630	600	90	60	90
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	28.8	28.8	25.2	24	3.6	2.4	3.6
	Temp. Acres (7)	28.8	28.8	25.2	24	3.6	2.4	3.6
	DF Waste (8)	102,480	102,480	89,670	85,400	12,810	8,540	12,810
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	17,574.60	15,348.42	13,523.34	11,814.95	10,170.93	8,876.28	7,843.49
	Gas BCF/Yr	125.61	116.43	106.21	90.81	68.68	51.35	42.93
	WaterMB/Yr	51,319.70	50,189.00	48,271.60	45,014.00	38,578.70	33,718.70	29,511.30
	NGL MGal/Yr	178,198.80	167,290.10	159,107.90	143,156.30	109,613.90	81,997.60	70,536.60
NGL to Gas Ratio	**(gal/mmcf)**	1,418.71	1,436.89	1,498.08	1,576.50	1,595.92	1,596.85	1,643.10
Injection	**GasBCF/Yr**	13.8	13.8	13.8	13.2	6.4	0.88	0.88
	WaterMB/Yr	25,676.3	22,852.7	20,117.3	18,117.5	13,790.8	12,387.7	11,167.9

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-1
Production Quantities for Reference Case (continued)

		2011	2012	2013	2014	2015	2016	2017
Remedial	**Reservoir**	95	85	80	75	75	75	70
	Artificial Lift		1			1		
	Wells	20	20	20	15	15	15	15
	Rig Days (1)	805	742	700	630	637	630	595
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	115	106	100	90	91	90	85
	DF Waste (4)	75,900	69,960	66,000	59,400	60,060	59,400	56,100
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	7,025.52	6,279.83	5,771.38	5,059.27	4,232.54	3,942.00	3,718.26
	Gas BCF/Yr	36.59	33.07	29.40	24.67	17.11	15.16	12.63
	WaterMB/Yr	26,057.70	23,169.80	20,916.00	16,162.90	12,540.70	11,285.10	9,357.10
	NGL MGal/Yr	62,260.60	58,632.90	54,383.90	48,326.00	39,272.90	35,343.30	30,410.70
NGL to Gas Ratio	**(gal/mmcf)**	1,701.71	1,773.15	1,849.98	1,959.29	2,295.45	2,331.04	2,408.58
Injection	**GasBCF/Yr**	0.88	0.88	0.88	0.88	0.55	0.55	0.55
	WaterMB/Yr	10,232.0	7,869.8	6,621.8	5,705.7	4,430.7	1,230.8	894.3

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-1
Production Quantities for Reference Case (continued)

		2018	2019	2020	2021	2022	2023	2024
Remedial	**Reservoir**	70	70	65	60	60	55	55
	Artificial Lift	1			1			1
	Wells	15	10	10	10	10	10	
	Rig Days (1)	602	560	525	497	490	455	392
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	86	80	75	71	70	65	56
	DF Waste (4)	56,760	52,800	49,500	46,860	46,200	42,900	36,960
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	3,520.43	3,381.00	3,283.18	3,187.55	3,090.82	3,024.39	2,959.79
	Gas BCF/Yr	10.56	7.35	4.94	4.57	3.55	3.45	3.19
	WaterMB/Yr	8,783.40	8,428.90	7,678.90	7,394.20	7,208.40	7,196.70	7,189.00
	NGL MGal/Yr	26,167.60	21,641.90	18,451.80	17,487.20	15,197.90	14,837.30	14,131.00
NGL to Gas Ratio	**(gal/mmcf)**	2,477.76	2,943.68	3,733.67	3,830.71	4,283.51	4,299.42	4,436.73
Injection	**GasBCF/Yr**	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	WaterMB/Yr	649.7	471.6	365.0	365.0			

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-1
Production Quantities for Reference Case (continued)

		2025	2026	2027	2028	2029	2030	2031
Remedial	**Reservoir**	40	40	35	35	30	30	25
	Artificial Lift			1			1	
	Wells	5		5			5	
	Rig Days (1)	315	280	287	245	210	252	175
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	45	40	41	35	30	36	25
	DF Waste (4)	29,700	26,400	27,060	23,100	19,800	23,760	16,500
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	2,899.56	2,843.35	2,789.70	2,722.17	2,675.82	2,632.38	2,594.06
	Gas BCF/Yr	2.96	2.75	2.57	1.74	1.69	1.65	1.61
	WaterMB/Yr	7,191.20	7,200.40	7,218.20	7,124.10	7,169.70	7,217.90	7,269.30
	NGL MGal/Yr	13,507.10	12,940.70	12,452.00	10,585.70	10,375.10	10,179.90	9,999.20
NGL to Gas Ratio	**(gal/mmcf)**	4,569.38	4,709.13	4,837.61	6,090.74	6,135.48	6,177.12	6,214.54
Injection	**GasBCF/Yr**	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	WaterMB/Yr							

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-1
Production Quantities for Reference Case (continued)

		2032	2033	2034	Total (1997-2034)	2035-?	Total (1997-?)
Remedial	**Reservoir**	25	20	20	3,237.0		3,237.0
	Artificial Lift				75.0		75.0
	Wells		5		1,441.0		1,441.0
	Rig Days (1)	175	175	140	33,271.0	0	33,271.0
	Hp/Rig (2)	2,888	2,888	2,888	109,744.0	2,888	112,632.0
	Temp. Acres (3)	25	25	20	4,753.0	0	4,753.0
	DF Waste (4)	16,500	16,500	13,200	3,136,980	-	3,136,980
Development Drilling					446.0		446.0
	Rig Days (5)	0	0	0	13,380.0	0	13,380.0
	Hp/Rig (2)	6,000	6,000	6,000	228,000.0	6,000	234,000.0
	Perm. Acres (6)	0	0	0	535.2	0	535.2
	Temp. Acres (7)	0	0	0	535.2	0	535.2
	DF Waste (8)	0	0	0	1,904,420.0	0	1,904,420.0
Facility Installations					-		-
	Compression				-		-
	Artificial Lift				2.0		2.0
	Acres (9)				4.0		4.0
Production	**Oil MB/Yr**	2,553.54	2,514.85	2,610.85	351,619.2	103,722.6	455,341.7
	Gas BCF/Yr	1.57	1.54	0.86	1,869.1	96.0	1,965.1
	WaterMB/Yr	7,322.60	7,378.50	7,270.80	881,674.3	302,984.3	1,184,658.6
	NGL MGal/Yr	9,832.40	9,678.30	5,189.60	2,928,155.3	176,549.4	3,104,704.7
NGL to Gas Ratio	**(gal/mmcf)**	6,246.76	6,280.53	6,062.62	1,566.62	1,838.83	1,579.92
Injection	**GasBCF/Yr**	0.55	0.55	0.55	535.3		535.3
	WaterMB/Yr				454,998.6		454,998.6

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir

*From Total Development Case in FY 1995 Long Range Plan For 1997-2034

Table B.6-2
Production Quantities for Upper Bound of Government Development Case

		1997	1998	1999	2000	2001	2002	2003
Remedial	**Reservoir**	152	144	138	141	177	156	145
	Artificial Lift	14	11	15	15	10	10	10
	Wells	124	120	120	117	108	98	98
	Rig Days (1)	2030	1925	1911	1911	2065	1848	1771
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	290	275	273	273	295	264	253
	DF Waste (4)	191,400	181,500	180,180	180,180	194,700	174,240	166,980
Development Drilling		74	62	69	48	38	38	35
	Rig Days (5)	2220	1860	2070	1440	1140	1140	1050
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	88.8	74.4	82.8	57.6	45.6	45.6	42
	Temp. Acres (7)	88.8	74.4	82.8	57.6	45.6	45.6	42
	DF Waste (8)	315,980	264,740	294,630	204,960	162,260	162,260	149,450
Facility Installations								
	Compression			EOR (CO_2) (11)	2000 hp (10)	Gas Stg. (12)		
	Artificial Lift							
	Acres (9)			8		4		
Production	**Oil MB/Yr**	29,673.26	29,647.19	28,327.41	26,156.32	25,216.76	25,467.20	25,855.90
	Gas BCF/Yr	143.70	146.63	145.10	152.75	171.05	152.10	142.60
	WaterMB/Yr	42,191.80	45,877.60	49,314.40	48,951.20	50,851.10	52,651.11	58,740.91
	NGL MGal/Yr	209,919.90	212,017.90	200,744.50	212,825.30	226,620.50	210,226.97	201,474.81
NGL to Gas Ratio	**(gal/mmcf)**	1,460.84	1,445.94	1,383.48	1,393.26	1,324.89	1,382.14	1,412.86
Injection	**GasBCF/Yr**							
	WaterMB/Yr	49,435.6	49,961.6	51,215.0	39,400.3	37,574.6	52,651.1	58,740.9

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-2
Production Quantities for Upper Bound of Government Development Case (continued)

		2004	2005	2006	2007	2008	2009	2010
Remedial	**Reservoir**	140	144	143	142	130	115	110
	Artificial Lift	10	5	5	5	4	1	1
	Wells	96	96	96	95	24	24	20
	Rig Days (1)	1722	1715	1708	1694	1106	980	917
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	246	245	244	242	158	140	131
	DF Waste (4)	162,360	161,700	161,040	159,720	104,280	92,400	86,460
Development Drilling		29	29	21	20	3	2	3
	Rig Days (5)	870	870	630	600	90	60	90
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	34.8	34.8	25.2	24	3.6	2.4	3.6
	Temp. Acres (7)	34.8	34.8	25.2	24	3.6	2.4	3.6
	DF Waste (8)	123,830	123,830	89,670	85,400	12,810	8,540	12,810
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	26,450.00	25,510.90	24,010.24	22,979.46	21,236.50	19,089.50	16,868.36
	Gas BCF/Yr	135.16	126.21	115.68	100.17	83.87	70.74	59.14
	WaterMB/Yr	67,076.27	71,674.29	72,989.71	73,108.48	65,902.49	59,422.64	52,007.91
	NGL MGal/Yr	191,752.57	181,355.55	173,296.79	157,911.95	133,853.39	112,961.93	97,172.97
NGL to Gas Ratio	**(gal/mmcf)**	1,418.71	1,436.89	1,498.08	1,576.50	1,595.92	1,596.85	1,643.10
Injection	**GasBCF/Yr**							
	WaterMB/Yr	67,076.3	68,090.6	65,690.7	62,142.2	52,722.0	44,567.0	36,405.5

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-2
Production Quantities for Upper Bound of Government Development Case (continued)

		2011	2012	2013	2014	2015	2016	2017
Remedial	**Reservoir**	95	90	85	80	80	80	75
	Artificial Lift	1	1	1	1	1	1	1
	Wells	20	20	20	20	20	20	20
	Rig Days (1)	812	777	742	707	707	707	672
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	116	111	106	101	101	101	96
	DF Waste (4)	76,560	73,260	69,960	66,660	66,660	66,660	63,360
Development Drilling			3		3		2	
	Rig Days (5)	0	90	0	90	0	60	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	3.6	0	3.6	0	2.4	0
	Temp. Acres (7)	0	3.6	0	3.6	0	2.4	0
	DF Waste (8)	0	12,810	0	12,810	0	8,540	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	15,109.23	13,505.52	12,412.05	10,880.56	9,102.59	8,477.75	7,996.56
	Gas BCF/Yr	50.40	45.55	40.50	33.98	23.57	20.89	17.39
	WaterMB/Yr	46,721.00	45,921.62	36,860.37	28,483.96	22,100.54	19,887.79	16,490.07
	NGL MGal/Yr	85,771.75	80,774.14	74,920.61	66,575.10	54,103.32	48,689.81	41,894.53
NGL to Gas Ratio	**(gal/mmcf)**	1,701.71	1,773.15	1,849.98	1,959.29	2,295.45	2,331.04	2,408.58
Injection	**GasBCF/Yr**							
	WaterMB/Yr	30,368.6	27,553.0	20,273.2	14,242.0	9,945.2	7,955.1	5,771.5

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-2
Production Quantities for Upper Bound of Government Development Case (continued)

		2018	2019	2020	2021	2022	2023	2024
Remedial	Reservoir	75	75	70	65	65	60	55
	Artificial Lift	1	1	1	1	1	1	1
	Wells	15	15	15	10	10	10	
	Rig Days (1)	637	637	602	532	532	497	392
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	91	91	86	76	76	71	56
	DF Waste (4)	60,060	60,060	56,760	50,160	50,160	46,860	36,960
Development Drilling		2		2		2		1
	Rig Days (5)	60	0	60	0	60	0	30
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	2.4	0	2.4	0	2.4	0	1.2
	Temp. Acres (7)	2.4	0	2.4	0	2.4	0	1.2
	DF Waste (8)	8,540	0	8,540	0	8,540	0	4,270
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	Oil MB/Yr	7,571.10	7,271.24	7,060.86	6,855.20	6,647.18	6,504.32	6,365.37
	Gas BCF/Yr	14.55	10.13	6.81	6.29	4.89	4.75	4.39
	WaterMB/Yr	15,479.03	14,854.29	13,532.56	13,030.84	12,703.40	12,682.78	12,669.21
	NGL MGal/Yr	36,049.13	29,814.42	25,419.66	24,090.80	20,937.00	20,440.23	19,467.22
NGL to Gas Ratio	(gal/mmcf)	2,477.76	2,943.68	3,733.67	3,830.71	4,283.51	4,299.42	4,436.73
Injection	GasBCF/Yr							
	WaterMB/Yr	4,643.7	3,713.6	2,706.5	1,954.6			

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-2
Production Quantities for Upper Bound of Government Development Case (continued)

		2025	2026	2027	2028	2029	2030	2031
Remedial	**Reservoir**	40	40	35	35	35	30	25
	Artificial Lift	1	1	1	1	1	1	1
	Wells	5		5			5	
	Rig Days (1)	322	287	287	252	252	252	182
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	46	41	41	36	36	36	26
	DF Waste (4)	30,360	27,060	27,060	23,760	23,760	23,760	17,160
Development Drilling			1		1		1	
	Rig Days (5)	0	30	0	30	0	30	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	1.2	0	1.2	0	1.2	0
	Temp. Acres (7)	0	1.2	0	1.2	0	1.2	0
	DF Waste (8)	0	4,270	0	4,270	0	4,270	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	6,235.85	6,114.97	5,999.58	5,854.35	5,754.66	5,661.25	5,578.83
	Gas BCF/Yr	4.07	3.79	3.55	2.39	2.33	2.27	2.22
	WaterMB/Yr	12,673.09	12,689.30	12,720.67	12,554.84	12,635.20	12,720.14	12,810.72
	NGL MGal/Yr	18,607.72	17,827.43	17,154.18	14,583.12	14,292.99	14,024.08	13,775.15
NGL to Gas Ratio	**(gal/mmcf)**	4,569.38	4,709.13	4,837.61	6,090.74	6,135.48	6,177.12	6,214.54
Injection	**GasBCF/Yr**							
	WaterMB/Yr							

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-2
Production Quantities for Upper Bound of Government Development Case (continued)

		2032	2033	2034	Total (1997-2034)	2035-?	Total (1997-?)
Remedial	**Reservoir**	25	20	20	3,332.0		3,332.0
	Artificial Lift				137.0		137.0
	Wells		5		1,471.0		1,471.0
	Rig Days (1)	175	175	140	34,580.0	0	34,580.0
	Hp/Rig (2)	2,888	2,888	2,888	109,744.0	2,888	112,632.0
	Temp. Acres (3)	25	25	20	4,940.0	0	4,940.0
	DF Waste (4)	16,500	16,500	13,200	3,260,400	-	3,260,400
Development Drilling		1			490.0		490.0
	Rig Days (5)	30	0	0	14,700.0	0	14,700.0
	Hp/Rig (2)	6,000	6,000	6,000	228,000.0	6,000	234,000.0
	Perm. Acres (6)	1.2	0	0	588.0	0	588.0
	Temp. Acres (7)	1.2	0	0	588.0	0	588.0
	DF Waste (8)	4,270	0	0	2,092,300.0	0	2,092,300.0
Facility Installations					-		-
	Compression				-		-
	Artificial Lift				-		-
	Acres (9)				12.0		12.0
Production	**Oil MB/Yr**	5,491.70	5,408.49	5,614.94	529,963.1	119,292.0	649,255.1
	Gas BCF/Yr	2.17	2.12	1.18	2,055.1	94.3	2,149.3
	WaterMB/Yr	12,904.66	13,003.17	12,813.37	1,249,702.5	281,301.7	1,531,004.2
	NGL MGal/Yr	13,545.36	13,333.07	7,149.32	3,295,375.1	151,159.6	3,446,534.7
NGL to Gas Ratio	**(gal/mmcf)**	6,246.76	6,280.53	6,062.62	1,603.53	1,603.53	3,207.05
Injection	**GasBCF/Yr**				-		-
	WaterMB/Yr				864,800.5		864,800.5

(1) Assigned 7 days/remedial workover
(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.
(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells
(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well
(5) 30 days/drilling project
(6) Permanent disturbance: 1.2 acres for well pads and access
(7) Temporary disturbance: 1.2 acres around well pads and pipelines
(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well
(9) Artificial lift installation = 1 acre
(10) Compressor installation 2 acres, DGZ reservoir
(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)
(12) Gas storage installation, NWS A1-A2 Reservoir (Compression, P/L's and processing equipment = 4 acres)

Table B.6-3
Production Quantities for Lower Bound of Government Development Case

		1997	1998	1999	2000	2001	2002	2003
Remedial	**Reservoir**	114	102	97	70	131	113	103
	Artificial Lift	14	11	10	9	4	4	2
	Wells	86	78	80	50	62	50	50
	Rig Days (1)	1498	1337	1309	903	1379	1169	1085
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	214	191	187	129	197	167	155
	DF Waste (4)	141,240	126,060	123,420	85,140	130,020	110,220	102,300
Development Drilling		74	20	20	20	20	20	20
	Rig Days (5)	2220	600	600	600	600	600	600
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	88.8	24	24	24	24	24	24
	Temp. Acres (7)	88.8	24	24	24	24	24	24
	DF Waste (8)	315,980	85,400	85,400	85,400	85,400	85,400	85,400
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	24,332.07	24,310.70	23,228.48	21,448.18	20,677.74	18,269.37	16,280.56
	Gas BCF/Yr	117.83	120.24	118.98	125.26	140.26	121.91	109.90
	WaterMB/Yr	34,597.28	37,619.63	40,437.81	40,139.98	41,697.90	41,815.82	41,950.22
	NGL MGal/Yr	172,134.32	173,854.68	164,610.49	174,516.75	185,828.81	168,497.54	155,272.08
NGL to Gas Ratio	**(gal/mmcf)**	1,460.84	1,445.94	1,383.48	1,393.26	1,324.89	1,382.14	1,412.86
Injection	**GasBCF/Yr**							
	WaterMB/Yr	40,537.19	40,968.51	41,996.30	32,308.25	30,811.17	28,190.21	24,671.01

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-3
Production Quantities for Lower Bound of Government Development Case (continued)

		2004	2005	2006	2007	2008	2009	2010
Remedial	Reservoir	100	114	114	114	49	36	20
	Artificial Lift	2	2	2	2	2	1	1
	Wells	50	50	50	50	24	24	15
	Rig Days (1)	1064	1162	1162	1162	525	427	252
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	152	166	166	166	75	61	36
	DF Waste (4)	100,320	109,560	109,560	109,560	49,500	40,260	23,760
Development Drilling		15	15	10	10	3	2	3
	Rig Days (5)	450	450	300	300	90	60	90
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	18	18	12	12	3.6	2.4	3.6
	Temp. Acres (7)	18	18	12	12	3.6	2.4	3.6
	DF Waste (8)	64,050	64,050	42,700	42,700	12,810	8,540	12,810
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	Oil MB/Yr	14,411.17	12,585.70	11,089.13	9,688.26	8,340.16	7,278.55	6,431.66
	Gas BCF/Yr	103.00	95.47	87.09	74.46	56.32	42.11	35.20
	WaterMB/Yr	42,082.15	41,154.98	39,582.71	36,911.48	31,634.53	27,649.33	24,199.27
	NGL MGal/Yr	146,123.02	137,177.88	130,468.48	117,388.17	89,883.40	67,238.03	57,840.01
NGL to Gas Ratio	(gal/mmcf)	1,418.71	1,436.89	1,498.08	1,576.50	1,595.92	1,596.85	1,643.10
Injection	GasBCF/Yr							
	WaterMB/Yr	21,054.57	18,739.21	16,496.19	14,856.35	11,308.46	10,157.91	9,157.68

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-3
Production Quantities for Lower Bound of Government Development Case (continued)

		2011	2012	2013	2014	2015	2016	2017
Remedial	**Reservoir**	20	20	20	15	15	15	15
	Artificial Lift							
	Wells	15	15	15	10	10	10	10
	Rig Days (1)	245	245	245	175	175	175	175
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	35	35	35	25	25	25	25
	DF Waste (4)	23,100	23,100	23,100	16,500	16,500	16,500	16,500
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	5,760.93	5,149.46	4,617.10	3,946.23	3,216.73	2,917.08	2,677.14
	Gas BCF/Yr	30.00	27.11	23.52	19.24	13.00	11.22	9.09
	WaterMB/Yr	21,367.31	18,999.24	16,732.80	12,607.06	9,530.93	8,350.97	6,737.11
	NGL MGal/Yr	51,053.69	48,078.98	43,507.12	37,694.28	29,847.40	26,154.04	21,895.70
NGL to Gas Ratio	**(gal/mmcf)**	1,701.71	1,773.15	1,849.98	1,959.29	2,295.45	2,331.04	2,408.58
Injection	**GasBCF/Yr**							
	WaterMB/Yr	8,390.24	6,453.24	5,297.44	4,450.45	3,367.33	910.79	643.90

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-3
Production Quantities for Lower Bound of Government Development Case (continued)

		2018	2019	2020	2021	2022	2023	2024
Remedial	**Reservoir**	15	10	10	10	10	10	10
	Artificial Lift							
	Wells	10	5	5	5	5	5	
	Rig Days (1)	175	105	105	105	105	105	70
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	25	15	15	15	15	15	10
	DF Waste (4)	16,500	9,900	9,900	9,900	9,900	9,900	6,600
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	2,464.30	2,299.08	2,166.90	2,040.03	1,916.31	1,814.63	1,716.68
	Gas BCF/Yr	7.39	5.00	3.26	2.92	2.20	2.07	1.85
	WaterMB/Yr	6,148.38	5,731.65	5,068.07	4,732.29	4,469.21	4,318.02	4,169.62
	NGL MGal/Yr	18,317.32	14,716.49	12,178.19	11,191.81	9,422.70	8,902.38	8,195.98
NGL to Gas Ratio	**(gal/mmcf)**	2,477.76	2,943.68	3,733.67	3,830.71	4,283.51	4,299.42	4,436.73
Injection	**GasBCF/Yr**							
	WaterMB/Yr	454.79	320.69	240.90	233.60	-	-	-

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-3
Production Quantities for Lower Bound of Government Development Case (continued)

		2025	2026	2027	2028	2029	2030	2031
Remedial	**Reservoir**	5	5	5	5	5	5	4
	Artificial Lift							
	Wells	5		5			5	
	Rig Days (1)	70	35	70	35	35	70	28
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	10	5	10	5	5	10	4
	DF Waste (4)	6,600	3,300	6,600	3,300	3,300	6,600	2,640
Development Drilling								
	Rig Days (5)	0	0	0	0	0	0	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	0	0	0	0	0	0
	Temp. Acres (7)	0	0	0	0	0	0	0
	DF Waste (8)	0	0	0	0	0	0	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	1,623.75	1,535.41	1,450.64	1,361.09	1,284.39	1,210.89	1,141.38
	Gas BCF/Yr	1.66	1.48	1.34	0.87	0.81	0.76	0.71
	WaterMB/Yr	4,027.07	3,888.22	3,753.46	3,562.05	3,441.46	3,320.23	3,198.49
	NGL MGal/Yr	7,563.98	6,987.98	6,475.04	5,292.85	4,980.05	4,682.75	4,399.65
NGL to Gas Ratio	**(gal/mmcf)**	4,569.38	4,709.13	4,837.61	6,090.74	6,135.48	6,177.12	6,214.54
Injection	**GasBCF/Yr**							
	WaterMB/Yr	-	-	-	-	-	-	-

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-3
Production Quantities for Lower Bound of Government Development Case (continued)

		2032	2033	2034	Total (1997-2034)	2035-?	Total (1997-?)
Remedial	**Reservoir**	2	1		1,509.0		1,509.0
	Artificial Lift				66.0		66.0
	Wells		5		859.0		859.0
	Rig Days (1)	14	42	0	17,038.0	0	17,038.0
	Hp/Rig (2)	2,888	2,888	2,888	109,744.0	2,888	112,632.0
	Temp. Acres (3)	2	6	0	2,434.0	0	2,434.0
	DF Waste (4)	1,320	3,960	-	1,606,440	-	1,606,440
Development Drilling					252.0		252.0
	Rig Days (5)	0	0	0	7,560.0	0	7,560.0
	Hp/Rig (2)	6,000	6,000	6,000	228,000.0	6,000	234,000.0
	Perm. Acres (6)	0	0	0	302.4	0	302.4
	Temp. Acres (7)	0	0	0	302.4	0	302.4
	DF Waste (8)	0	0	0	1,076,040.0	0	1,076,040.0
Facility Installations					-		-
	Compression				-		-
	Artificial Lift				-		-
	Acres (9)				-		-
Production	**Oil MB/Yr**	1,072.49	1,005.94	992.12	273,752.4		273,752.4
	Gas BCF/Yr	0.66	0.62	0.33	1,515.1		1,515.1
	WaterMB/Yr	3,075.49	2,951.40	2,762.90	684,416.5		684,416.5
	NGL MGal/Yr	4,129.61	3,871.32	1,972.05	2,332,345.0		2,332,345.0
NGL to Gas Ratio	**(gal/mmcf)**	6,246.76	6,280.53	6,062.62	1,539.37		1,539.37
Injection	**GasBCF/Yr**				-		-
	WaterMB/Yr	-	-	-	372,016.4	-	372,016.4

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case

		1997	1998	1999	2000	2001	2002	2003
Remedial	**Reservoir**	152	144	150	153	189	168	148
	Artificial Lift	14	11	19	24	22	20	18
	Wells	124	120	125	130	123	110	103
	Rig Days (1)	2030	1925	2058	2149	2338	2086	1883
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	290	275	294	307	334	298	269
	DF Waste (4)	191,400	181,500	194,040	202,620	220,440	196,680	177,540
Development Drilling		74	64	85	64	53	51	46
	Rig Days (5)	2220	1920	2550	1920	1590	1530	1380
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	88.8	76.8	102	76.8	63.6	61.2	55.2
	Temp. Acres (7)	88.8	76.8	102	76.8	63.6	61.2	55.2
	DF Waste (8)	315,980	273,280	362,950	273,280	226,310	217,770	196,420
Facility Installations								
	Compression			EOR (CO2) (11)	2000 hp (10)	Gas Stg. (12)		
	Artificial Lift							
	Acres (9)			8		4		
Production	**Oil MB/Yr**	29,673.26	29,647.19	35,000.00	38,000.00	40,750.00	40,250.00	39,086.89
	Gas BCF/Yr	143.70	146.63	153.60	167.60	190.00	162.78	152.92
	WaterMB/Yr	42,191.80	45,877.60	60,930.53	71,116.49	82,174.82	92,126.15	100,715.40
	NGL MGal/Yr	209,919.42	212,017.90	217,977.17	241,575.65	264,033.04	259,680.45	245,327.29
NGL to Gas Ratio	**(gal/mmcf)**	1,460.84	1,445.94	1,419.11	1,441.36	1,389.66	1,595.25	1,604.31
Injection	**GasBCF/Yr**							
	WaterMB/Yr	42,191.8	45,877.6	60,930.5	71,116.5	82,174.8	87,519.8	90,643.9

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case (continued)

		2004	2005	2006	2007	2008	2009	2010
Remedial	**Reservoir**	143	144	143	142	135	120	110
	Artificial Lift	18	9	6	6	6	1	1
	Wells	96	96	96	95	24	24	20
	Rig Days (1)	1799	1743	1715	1701	1155	1015	917
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	257	249	245	243	165	145	131
	DF Waste (4)	169,620	164,340	161,700	160,380	108,900	95,700	86,460
Development Drilling		45	44	27	25	9	5	4
	Rig Days (5)	1350	1320	810	750	270	150	120
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	54	52.8	32.4	30	10.8	6	4.8
	Temp. Acres (7)	54	52.8	32.4	30	10.8	6	4.8
	DF Waste (8)	192,150	187,880	115,290	106,750	38,430	21,350	17,080
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	37,710.62	35,352.51	32,390.97	31,508.69	30,559.38	29,000.00	25,625.73
	Gas BCF/Yr	146.03	137.49	126.45	111.21	95.83	85.96	71.86
	WaterMB/Yr	110,119.02	115,601.94	115,619.70	120,045.55	115,912.82	110,163.59	96,417.44
	NGL MGal/Yr	237,890.11	228,517.83	214,393.16	199,054.97	184,669.83	160,891.01	138,402.89
NGL to Gas Ratio	**(gal/mmcf)**	1,629.06	1,662.05	1,695.45	1,789.94	1,927.11	1,871.73	1,925.94
Injection	**GasBCF/Yr**							
	WaterMB/Yr	93,601.2	92,481.6	86,714.8	84,031.9	75,343.3	66,098.2	53,029.6

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case (continued)

		2011	2012	2013	2014	2015	2016	2017
Remedial	**Reservoir**	100	95	85	80	80	80	75
	Artificial Lift	1	1	1	1	1	1	1
	Wells	20	20	20	20	20	20	15
	Rig Days (1)	847	812	742	707	707	707	637
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	121	116	106	101	101	101	91
	DF Waste (4)	79,860	76,560	69,960	66,660	66,660	66,660	60,060
Development Drilling			4		4		4	
	Rig Days (5)	0	120	0	120	0	120	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	4.8	0	4.8	0	4.8	0
	Temp. Acres (7)	0	4.8	0	4.8	0	4.8	0
	DF Waste (8)	0	17,080	0	17,080	0	17,080	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	22,953.33	20,517.04	18,855.88	16,529.31	13,828.28	12,879.05	12,148.05
	Gas BCF/Yr	61.25	55.35	49.21	41.29	28.64	25.38	21.14
	WaterMB/Yr	85,134.06	75,698.89	68,335.42	52,806.40	40,972.18	36,869.96	30,570.92
	NGL MGal/Yr	122,164.19	115,046.13	106,708.98	94,822.52	77,059.04	69,348.61	59,670.14
NGL to Gas Ratio	**(gal/mmcf)**	1,994.64	2,078.38	2,168.43	2,296.56	2,690.59	2,732.31	2,823.18
Injection	**GasBCF/Yr**							
	WaterMB/Yr	42,567.0	34,064.5	27,334.2	18,482.2	12,291.7	9,217.5	6,114.2

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case (continued)

		2018	2019	2020	2021	2022	2023	2024
Remedial	**Reservoir**	75	75	70	65	65	60	55
	Artificial Lift	1	1	1	1	1	1	1
	Wells	15	15	15	10	10	10	
	Rig Days (1)	637	637	602	532	532	497	392
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	91	91	86	76	76	71	56
	DF Waste (4)	60,060	60,060	56,760	50,160	50,160	46,860	36,960
Development Drilling		4		3		3		3
	Rig Days (5)	120	0	90	0	90	0	90
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	4.8	0	3.6	0	3.6	0	3.6
	Temp. Acres (7)	4.8	0	3.6	0	3.6	0	3.6
	DF Waste (8)	17,080	0	12,810	0	12,810	0	12,810
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	11,501.71	11,046.17	10,726.58	10,414.14	10,098.13	9,881.09	9,670.02
	Gas BCF/Yr	17.68	12.31	8.27	7.64	5.94	5.78	5.33
	WaterMB/Yr	28,696.56	27,538.36	25,088.01	24,157.86	23,550.83	23,512.60	23,487.44
	NGL MGal/Yr	51,344.57	42,464.50	36,205.07	34,312.39	29,820.45	29,112.90	27,727.04
NGL to Gas Ratio	**(gal/mmcf)**	2,904.27	3,450.39	4,376.38	4,490.12	5,020.87	5,039.51	5,200.46
Injection	**GasBCF/Yr**							
	WaterMB/Yr	4,304.5	2,753.8	1,254.4	1,207.9			

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case (continued)

		2025	2026	2027	2028	2029	2030	2031
Remedial	**Reservoir**	40	40	35	35	30	30	25
	Artificial Lift	1	1	1	1	1	1	1
	Wells	5		5			5	
	Rig Days (1)	322	287	287	252	217	252	182
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	46	41	41	36	31	36	26
	DF Waste (4)	30,360	27,060	27,060	23,760	20,460	23,760	17,160
Development Drilling			2		2		1	
	Rig Days (5)	0	60	0	60	0	30	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	2.4	0	2.4	0	1.2	0
	Temp. Acres (7)	0	2.4	0	2.4	0	1.2	0
	DF Waste (8)	0	8,540	0	8,540	0	4,270	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	9,473.26	9,289.61	9,114.31	8,893.70	8,742.25	8,600.34	8,475.13
	Gas BCF/Yr	4.95	4.60	4.31	2.91	2.83	2.76	2.69
	WaterMB/Yr	23,494.63	23,524.69	23,582.84	23,275.41	23,424.39	23,581.86	23,749.79
	NGL MGal/Yr	26,502.86	25,391.50	24,432.60	20,770.66	20,357.43	19,974.42	19,619.86
NGL to Gas Ratio	**(gal/mmcf)**	5,355.95	5,519.75	5,670.34	7,139.18	7,191.63	7,240.44	7,284.30
Injection	**GasBCF/Yr**							
	WaterMB/Yr							

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Upper Bound of Commercial Development Case (continued)

		2032	2033	2034	Total (1997-2034)	2035-?	Total (1997-?)
Remedial	Reservoir	25	20	20	3,401.0		3,401.0
	Artificial Lift				196.0		196.0
	Wells		5		1,516.0		1,516.0
	Rig Days (1)	175	175	140	35,791.0	0	35,791.0
	Hp/Rig (2)	2,888	2,888	2,888	109,744.0	2,888	112,632.0
	Temp. Acres (3)	25	25	20	5,113.0	0	5,113.0
	DF Waste (4)	16,500	16,500	13,200	3,374,580	-	3,374,580
Development Drilling		1		1	628.0		628.0
	Rig Days (5)	30	0	30	18,840.0	0	18,840.0
	Hp/Rig (2)	6,000	6,000	6,000	228,000.0	6,000	234,000.0
	Perm. Acres (6)	1.2	0	1.2	753.6	0	753.6
	Temp. Acres (7)	1.2	0	1.2	753.6	0	753.6
	DF Waste (8)	4,270	0	4,270	2,681,560.0	0	2,681,560.0
Facility Installations					-		-
	Compression				-		-
	Artificial Lift				-		-
	Acres (9)				12.0		12.0
Production	Oil MB/Yr	8,342.76	8,216.36	8,529.99	753,281.8	178,938.0	932,219.8
	Gas BCF/Yr	2.63	2.58	1.43	2,269.0	141.4	2,410.4
	WaterMB/Yr	23,923.93	24,106.56	23,754.69	2,081,851.1	715,752.0	2,797,603.1
	NGL MGal/Yr	19,292.57	18,990.21	10,182.74	4,115,672.1	256,540.1	4,372,212.2
NGL to Gas Ratio	(gal/mmcf)	7,322.06	7,361.65	7,106.22	1,813.90	1,813.90	1,813.90
Injection	GasBCF/Yr				-		-
	WaterMB/Yr				1,191,347.3		1,191,347.3

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case

		1997	1998	1999	2000	2001	2002	2003
Remedial	**Reservoir**	152	144	137	140	176	153	143
	Artificial Lift	14	11	10	9	6	4	2
	Wells	124	120	120	117	108	98	98
	Rig Days (1)	2030	1925	1869	1862	2030	1785	1701
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	290	275	267	266	290	255	243
	DF Waste (4)	191,400	181,500	176,220	175,560	191,400	168,300	160,380
Development Drilling		74	61	45	45	35	35	34
	Rig Days (5)	2220	1830	1350	1350	1050	1050	1020
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	88.8	73.2	54	54	42	42	40.8
	Temp. Acres (7)	88.8	73.2	54	54	42	42	40.8
	DF Waste (8)	315,980	260,470	192,150	192,150	149,450	149,450	145,180
Facility Installations								
	Compression			EOR (CO_2) (11)	2000 hp (10)	Gas Stg. (12)		
	Artificial Lift							
	Acres (9)			8		4		
Production	**Oil MB/Yr**	29,673.26	29,647.19	28,500.00	26,250.00	26,450.00	26,250.00	24,819.52
	Gas BCF/Yr	143.70	146.63	145.50	152.75	171.05	152.80	138.47
	WaterMB/Yr	42,191.80	45,877.60	49,614.86	49,126.52	53,338.01	60,082.27	63,952.59
	NGL MGal/Yr	209,919.90	212,017.90	201,296.09	212,820.98	226,622.35	211,195.82	195,635.24
NGL to Gas Ratio	**(gal/mmcf)**	1,460.84	1,445.94	1,383.48	1,393.26	1,324.89	1,382.14	1,412.86
Injection	**GasBCF/Yr**							
	WaterMB/Yr	49,435.6	49,961.6	51,215.0	49,126.5	53,338.0	60,082.3	63,952.6

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case (continued)

		2004	2005	2006	2007	2008	2009	2010
Remedial	**Reservoir**	140	144	143	142	125	110	105
	Artificial Lift	2	2	2	2	2	1	1
	Wells	96	96	96	95	24	24	20
	Rig Days (1)	1666	1694	1687	1673	1057	945	882
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	238	242	241	239	151	135	126
	DF Waste (4)	157,080	159,720	159,060	157,740	99,660	89,100	83,160
Development Drilling		24	24	21	20	5	3	3
	Rig Days (5)	720	720	630	600	150	90	90
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	28.8	28.8	25.2	24	6	3.6	3.6
	Temp. Acres (7)	28.8	28.8	25.2	24	6	3.6	3.6
	DF Waste (8)	102,480	102,480	89,670	85,400	21,350	12,810	12,810
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	23,313.51	21,127.90	18,592.32	16,882.63	15,122.03	14,000.00	12,371.04
	Gas BCF/Yr	130.58	121.62	110.91	95.55	75.16	61.29	51.24
	WaterMB/Yr	68,077.93	69,087.77	66,365.36	64,321.45	57,358.40	53,182.42	46,546.35
	NGL MGal/Yr	185,254.73	174,752.74	166,145.78	150,642.20	119,954.01	97,866.53	84,187.49
NGL to Gas Ratio	**(gal/mmcf)**	1,418.71	1,436.89	1,498.08	1,576.50	1,595.92	1,596.85	1,643.10
Injection	**GasBCF/Yr**							
	WaterMB/Yr	64,674.0	62,179.0	56,410.6	51,457.2	40,150.9	31,909.5	25,600.5

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case (continued)

		2011	2012	2013	2014	2015	2016	2017
Remedial	**Reservoir**	95	90	80	80	75	75	70
	Artificial Lift		1		1		1	
	Wells	20	20	20	20	20	20	20
	Rig Days (1)	805	777	700	707	665	672	630
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	115	111	100	101	95	96	90
	DF Waste (4)	75,900	73,260	66,000	66,660	62,700	63,360	59,400
Development Drilling		3	3	2	2	2	2	1
	Rig Days (5)	90	90	60	60	60	60	30
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	3.6	3.6	2.4	2.4	2.4	2.4	1.2
	Temp. Acres (7)	3.6	3.6	2.4	2.4	2.4	2.4	1.2
	DF Waste (8)	12,810	12,810	8,540	8,540	8,540	8,540	4,270
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	11,080.92	9,904.78	9,102.84	7,979.67	6,675.72	6,217.47	5,864.57
	Gas BCF/Yr	43.67	39.47	35.09	29.44	20.42	18.10	15.07
	WaterMB/Yr	41,814.64	41,099.20	32,989.51	25,492.74	19,779.67	17,799.29	14,758.38
	NGL MGal/Yr	74,309.84	69,980.08	64,908.77	57,678.49	46,873.35	42,183.26	36,296.06
NGL to Gas Ratio	**(gal/mmcf)**	1,701.71	1,773.15	1,849.98	1,959.29	2,295.45	2,331.04	2,408.58
Injection	**GasBCF/Yr**							
	WaterMB/Yr	20,907.3	18,494.6	13,195.8	8,922.5	5,933.9	4,449.8	2,951.7

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case (continued)

		2018	2019	2020	2021	2022	2023	2024
Remedial	**Reservoir**	70	70	65	60	60	55	55
	Artificial Lift	1	1	1	1	1	1	1
	Wells	15	15	15	10	10	10	
	Rig Days (1)	602	602	567	497	497	462	392
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	86	86	81	71	71	66	56
	DF Waste (4)	56,760	56,760	53,460	46,860	46,860	43,560	36,960
Development Drilling		1		1		1		1
	Rig Days (5)	30	0	30	0	30	0	30
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	1.2	0	1.2	0	1.2	0	1.2
	Temp. Acres (7)	1.2	0	1.2	0	1.2	0	1.2
	DF Waste (8)	4,270	0	4,270	0	4,270	0	4,270
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	**Oil MB/Yr**	5,552.55	5,332.63	5,178.35	5,027.52	4,874.96	4,770.18	4,668.29
	Gas BCF/Yr	12.60	8.77	5.90	5.45	4.23	4.12	3.80
	WaterMB/Yr	13,853.51	13,294.38	12,111.45	11,662.41	11,369.36	11,350.91	11,338.77
	NGL MGal/Yr	31,231.79	25,830.24	22,022.76	20,871.48	18,139.14	17,708.75	16,865.76
NGL to Gas Ratio	**(gal/mmcf)**	2,477.76	2,943.68	3,733.67	3,830.71	4,283.51	4,299.42	4,436.73
Injection	**GasBCF/Yr**							
	WaterMB/Yr	2,078.0	1,329.4	605.6	583.1			

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case (continued)

		2025	2026	2027	2028	2029	2030	2031
Remedial	Reservoir	40	40	35	35	30	30	25
	Artificial Lift	1	1	1	1	1	1	1
	Wells	5		5			5	
	Rig Days (1)	322	287	287	252	217	252	182
	Hp/Rig (2)	2,888	2,888	2,888	2,888	2,888	2,888	2,888
	Temp. Acres (3)	46	41	41	36	31	36	26
	DF Waste (4)	30,360	27,060	27,060	23,760	20,460	23,760	17,160
Development Drilling			1		1		1	
	Rig Days (5)	0	30	0	30	0	30	0
	Hp/Rig (2)	6,000	6,000	6,000	6,000	6,000	6,000	6,000
	Perm. Acres (6)	0	1.2	0	1.2	0	1.2	0
	Temp. Acres (7)	0	1.2	0	1.2	0	1.2	0
	DF Waste (8)	0	4,270	0	4,270	0	4,270	0
Facility Installations								
	Compression							
	Artificial Lift							
	Acres (9)							
Production	Oil MB/Yr	4,573.30	4,484.64	4,400.01	4,293.51	4,220.40	4,151.89	4,091.44
	Gas BCF/Yr	3.53	3.28	3.07	2.07	2.02	1.97	1.92
	WaterMB/Yr	11,342.24	11,356.75	11,384.82	11,236.40	11,308.32	11,384.35	11,465.42
	NGL MGal/Yr	16,121.12	15,445.10	14,861.82	12,634.34	12,382.98	12,150.01	11,934.34
NGL to Gas Ratio	(gal/mmcf)	4,569.38	4,709.13	4,837.61	6,090.74	6,135.48	6,177.12	6,214.54
Injection	GasBCF/Yr							
	WaterMB/Yr							

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

Table B.6-4
Production Quantities for Lower Bound of Commercial Development Case (continued)

		2032	2033	2034	Total (1997-2034)	2035-?	Total (1997-?)
Remedial	**Reservoir**	25	20	20	3,254.0		3,254.0
	Artificial Lift				85.0		85.0
	Wells		5		1,471.0		1,471.0
	Rig Days (1)	175	175	140	33,670.0	0	33,670.0
	Hp/Rig (2)	2,888	2,888	2,888	109,744.0	2,888	112,632.0
	Temp. Acres (3)	25	25	20	4,810.0	0	4,810.0
	DF Waste (4)	16,500	16,500	13,200	3,174,600	-	3,174,600
Development Drilling		1			452.0		452.0
	Rig Days (5)	30	0	0	13,560.0	0	13,560.0
	Hp/Rig (2)	6,000	6,000	6,000	228,000.0	6,000	234,000.0
	Perm. Acres (6)	1.2	0	0	542.4	0	542.4
	Temp. Acres (7)	1.2	0	0	542.4	0	542.4
	DF Waste (8)	4,270	0	0	1,930,040.0	0	1,930,040.0
Facility Installations					-		-
	Compression				-		-
	Artificial Lift				-		-
	Acres (9)				12.0		12.0
Production	**Oil MB/Yr**	4,027.54	3,966.52	4,117.92	447,557.0	59,646.0	507,203.0
	Gas BCF/Yr	1.88	1.84	1.02	1,966.0	47.1	2,013.1
	WaterMB/Yr	11,549.48	11,637.65	11,467.78	1,181,970.8	157,521.4	1,339,492.2
	NGL MGal/Yr	11,735.26	11,551.33	6,193.94	3,118,221.8	74,757.6	3,192,979.3
NGL to Gas Ratio	**(gal/mmcf)**	6,246.76	6,280.53	6,062.62	1,586.10	1,586.10	3,172.20
Injection	**GasBCF/Yr**				-		-
	WaterMB/Yr				788,944.9		788,944.9

(1) Assigned 7 days/remedial workover

(2) From 1993 Supplemental to 1979 EIS, average Hp of equipment in use.

(3) From 1993 Supplemental to 1979 EIS, average land disturbance/site = 1 acre temporary disturbance for remedial well activities and 2.2 acres for drilling new wells

(4) Drilling Fluid waste, volume of average 7,000ft well with7in. casing = 330Bbls * 2 for reserve = 660 Bbls for disposal/well

(5) 30 days/drilling project

(6) Permanent disturbance: 1.2 acres for well pads and access

(7) Temporary disturbance: 1.2 acres around well pads and pipelines

(8) 1995 API Production Waste Survey avg. drilling waste volume for disposal for Class 2 wells = 0.61Bbl/Ft * 7,000Ft. well = 4,270Bbls/well

(9) Artificial lift installation = 1 acre

(10) Compressor installation 2 acres, DGZ reservoir

(11) Two installations: 29R/24Z, 31S C/D, and 31S N/A Reservoirs (4 acres each)

B.7. DRILLING ACTIVITY

B.7.1. Reference Case

Based primarily on Reservoir Development Plans (see Section B.5) and Well Remedial Actions (see Section B.8), additional wells would be required to continue producing at the reference case. Before FY 1997, about 2500 wells had been drilled at the NPR-1. Development and exploratory drilling and testing through FY 2034 includes an additional 446 new wells, redrills and deepenings. Wells are redrilled when mechanical problems or reservoir conditions necessitate abandonment of the original well bore. Typically, the redrilled well is completed in the same geologic formation as was targeted for the original well. The deepening of a well is normally intended to achieve production from a deeper reservoir. Table B.7-1 shows well drilling activity projected through 2034 by year for each case. The estimated total land disturbance for the projected 446 new wells would be 981 acres of land. This is based on the assumption that 2.0 acres is required for each new well pad (1 acre "permanent" disturbance and 1 acre well drilling related temporary disturbance) plus .2 acres for well pad access and gathering lines.

B.7.2. Government Case

Based primarily on Reservoir Development Plans and Well Remedial Actions, additional wells would be required to produce at the upper bound of this development case. Development and exploratory drilling and testing through FY 2034 includes an additional 490 new wells, redrills and deepenings for the upper bound and 252 for the lower bound. Table B.7-1 shows well activity projected through 2034 by year for each case. Total land disturbance for new wells is estimated to be 1078 and 554 acres of land for the upper and lower bound respectively.

Table B.7-1
NPR-1 New Well Drilling for All Development Cases

CASE	1997	1998	1999	2000	2001	2002	2003	2004
Reference	74	61	65	45	35	35	34	24
Government - Lower Bound	74	20	20	20	20	20	20	15
Commercial - Lower Bound	74	61	45	45	35	35	34	24
Government - Upper Bound	74	62	69	48	38	38	35	29
Commercial - Upper Bound	74	64	85	64	53	51	46	45

CASE	2005	2006	2007	2008	2009	2010-34	Total
Reference	24	21	20	3	2	3	446
Government - Lower Bound	15	10	10	3	2	3	252
Commercial - Lower Bound	24	21	20	5	3	26	452
Government - Upper Bound	29	21	20	3	2	22	490
Commercial - Upper Bound	44	27	25	9	5	36	628

B.7.3. Commercial Case

Based primarily on Reservoir Development Plans and Well Remedial Actions, additional wells would be required to produce at the upper and lower bound of the Commercial level. Development and exploratory drilling and testing through FY 2034 includes an additional 628 new wells, redrills and deepenings for the upper bound and 452 for the lower bound. Table B.7-1 summarizes well activity projected through 2034 by year for the upper and lower bound. The estimated total land disturbance for the projected new wells to be drilled covers 1382 acres of land and 994 acres of land for the upper and lower bound respectively.

B.8. WELL REMEDIAL ACTIVITY

To maintain the reference case production, a number of remedial activities would be necessary at wells where production has fallen off (including shut-in wells) or other circumstances requiring a change in operation. Major remedial activities include: (1) Well stimulations—physical or chemical treatment of a well at production zones to revitalize decreasing production; (2) recompletions—physical reconstruction of well bores to increase lower-than-expected production rates; and (3) conversion—physically retrofitting a production well to convert it to an injection well when production has become uneconomic to maintain or remediate.

Other remedial activities involve maintaining oil production via well-bore delivery systems. When free flow decreases or ceases, flow enhancement/recovery techniques must be applied. These techniques consist of various forms of artificial-lift, including rod pumping, electrical submersible pumps and gas lift. Repressuring the reservoir by gas, water and steam injection (flooding) would also cause wells to flow again.

B.8.1. Reference Case

Table B.8-1 lists the number of remedial activities planned for each major action for each case. Total projects planned through the year 2034 would be approximately 4,753, (3,130 and 1,623 for the periods FY 1995-2010 and FY 2010-2034, respectively).

Table B.8-1
NPR-1 Well Remedial Activities for All Development Cases

	Reference	Government - Lower Bound	Commercial - Lower Bound	Government - Upper Bound	Commercial - Upper Bound
Stimulations:					
1997 - 2009	1,847	1,257	1,849	1,867	1,931
2010 - 2034	1,390	252	1,405	1,465	1,470
Total	3,237	1,509	3,254	3,332	3,401
Recompletions and Conversions:					
1997 - 2009	1,216	704	1,216	1,216	1,266
2010 - 2034	225	155	255	255	250
Total	1,441	859	1,471	1,471	1,516
Artificial Lift Installations:					
1997 - 2009	67	65	67	115	174
2010 - 2034	8	1	18	22	22
Total	75	66	85	137	196
Total Remedial Activities:					
1997 - 2009	3,130	2,026	3,132	3,198	3,321
2010 - 2034	1,623	408	1,678	1,742	1,742
Total	4,753	2,434	4,810	4,940	5,113

B.8.2. Government Case

Total projects planned through the year 2034 for the upper bound of the Commercial case would be 4,940, (3,198 and 1,742 for the periods FY 1997-2010 and FY 2010-2034, respectively). For the lower bound the total planned projects would be 2,434 (2,026 and 408 for the same periods).

B.8.3. Commercial Case

Total projects planned through the year 2034 for the upper bound of the Commercial case would be 5,113, (3,371 and 1,742 for the periods FY 1997-2010 and FY 2010-2034, respectively). For the lower bound the total planned projects would be 4,810, (3,132 and 1,678 for the same periods).

Table B.8-2 summarizes estimated equipment use (including duration and numbers of units required) for new well drilling, well completion and remedial work.

Table B.8-2
Summary of Estimated Equipment Use During New Well Drilling, Remedial Work, and New Well Completion Activities at NPR-1

Type of Activity	Zone	Depth (ft)	Drilling (a)			Moving		
			Machine	No.	Days	Machine	No.	Hours
New well drilling/ deepening (b)	Deep Stevens/Carneros	8,500	Engine, diesel (912 hp)	1	30	Crane, diesel (65-85 tons)	2	10-12 (70%)
			Engine, diesel (610 hp)	1	30	Truck, diesel (400 hp)	6-8	10-12 (100%)
	Shallow Stevens	7,000	Engine, diesel (380 hp)	7 (c)	20	Truck, diesel (400 hp)	6-8	10-12 (100%)
	Sallow Oil	3,500 -4,000	Engine, diesel (380 hp)	3	10	Crane, diesel (65 tons)	1	6-8
			Engine, diesel (285 hp)	1	10	Engine, diesel (380 hp)	1	2
						Engine, diesel (285 hp)	1	2-4
Remedial work/new well completion	Various	Various	Engine, diesel (380 hp)	2	1-25	Engine, diesel (380 hp)	1	1.5-2
			Engine, diesel (175 hp)	1	1-25	Truck, heavy duty (highway-type)	1	2-2.5

(a) Typically ata any one time throughout the NPR-1, there are 3 drilling rigs in operation at the deep Steven/Carneros Zones (24 hr/day, 100% utilization), 1 drilling rig at the SOZ (24 hr/day, 100% utilization), and 5 remedial work rigs (24 hr/day, 90% utilization).
(b) Well deepening requires the same equipment as new drilling, but takes less time by about 8-10 days.
(c) 5 of 7 engines are in operation at any one time.

B.9. OTHER PRODUCTION ACTIVITIES

B.9.1. Waterflood Activities

The Stevens sand reservoirs have been successfully produced with peripheral waterfloods, but field production and evaluation data indicate oil is not being swept from the lower quality sands by the existing water injection alignment. Best industry practices and recommendations from an industry panel study of Elk Hills indicate that the Stevens ultimate recovery may be significantly increased by reconfiguring the existing waterfloods to a pattern waterflood. Economic runs for the FY 1995 LRP conclude that an MBB pattern waterflood would conservatively develop 2.8 million barrels of oil and generate a net present value of $17.3 million on an investment of $2.8 million.

B.9.2. Gas Injection Activities

Historically, produced gas has been reinjected into the oil reservoirs to maintain pressure and increase the ultimate oil recovery. Preliminary studies in the major gas injection pools (26R Sand, NWS A1-A2 and 24Z) indicate the reservoirs are nearing a stage in their depletion where incremental oil recovery will not be sufficient to justify the expense of gas injection and the deferral of gas sales. Simulation exercises indicate that properly timing the termination of gas injection will increase the net present value of Elk Hills by more than $200 million. Also, large profit potential might exist in gas storage projects.

Residue gas from the gas plants is injected into the Stevens Zone structures to maintain pressure. There are approximately 17 miles of steel pipe in the gas injection distribution system to the Stevens gas injection wells. The operating pressure of the system ranges between 2,800 psig and 3,200 psig depending on location and gas volumes. The pipelines range in size from three-inches to eight-inches in diameter. The pipelines are installed above ground on wooden and steel pipe supports.

B.9.3. Oil Recovery With CO_2 Injection

Industry utilizes several methods to ensure that the maximum volume of oil is extracted from the reservoir in an effort to maximize recovery of oil and thus return on investment. Following the primary and secondary methods to produce oil, a third (or tertiary) technique has been developed using chemicals to "wash" the oil from the reservoir. The chemicals used are miscible (or will chemically combine) with the oil and carries the oil out of the reservoir. The procedure is much the same as waterflood or gas injection projects. The chemical is injected into the shale where it combines with the oil and is carried out through the production wells in a chemical compound. Carbon dioxide (CO_2), as a liquid or gas, is a favorable oil recovery chemical because it is miscible, with nearly all of the carbon compounds in oil and, at standard conditions (60°F and 14.73 psi) it is a gas and the oil is easily extracted.

Chemical flooding is employed where the oil is immobile and does not respond to conventional production methods. Oil, in shale intervals, in sandstone reservoirs is an example of immobile oil. The possibility of producing oil from the thick shale beds within the sand reservoirs at the NPR-1 using chemical (CO_2) flooding has been recognized and studied by the DOE staff, the contract operators and the DOE partner at the reserve, Chevron USA (CUSA). Estimates of the recoverable oil from the shales is more than 300 MMB. The availability of CO_2 in the NPR -1 area is the main difficulty with the project. Because it could be (marginally) profitable now and the possibility exists that it would be more profitable in the future, the CO_2 projects have been included in the Government Development and Commercial Development upper bound projections of future activities at the NPR -1

APPENDIX C
NPR-2 OPERATIONS, FACILITIES AND PRODUCTION

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C. NPR-2 OPERATIONS, FACILITIES AND PRODUCTION

C.1. INTRODUCTION

At the 30,181 acre NPR-2, where the field is nearing the end of its useful life and the level of production is only a fraction of NPR-1 production, the Federal government owns approximately 35 percent of the acreage in a checkerboard arrangement. The oil and gas rights associated with 9,224 of these acres have been leased to seven oil companies under 15 active leases. The Federal government receives a royalty interest equal to approximately 4 to 14 percent of production depending on the lease and the type of production, but has no active role in the day-to-day operations. Historical production since 1977 is shown in Table C.1-1.

This appendix provides additional information about the ongoing private company oil and gas exploration and production activities, operations and facilities on the government's share of NPR-2 that form part of the reference case against which the impacts of the proposed action and alternative are compared. As the production life of the field is nearly over, it is expected that these oil and gas field operations and facilities will remain essentially the same for the proposed action or any alternative.

Table C.1-1
NPR-2 Production History

Year	Total Oil (Bbls)	Gov. Lease Oil (Bbls)	Gov. Lease Gas (Mcf)	Gov. Lease NGL (Gal)	Gov. Lease Total (BOE)
1977	2,284,257	1,189,820	3,289,796	11,667,027	1,968,971
1978	2,812,882	1,923,362	2,868,451	10,604,321	2,609,828
1979	1,123,078	978,061	2,767,854	9,530,754	1,628,899
1980	2,154,919	858,507	2,241,888	8,720,394	1,402,147
1981	2,140,171	777,476	1,875,459	7,912,794	1,242,431
1982	2,014,331	771,353	1,994,452	8,037,625	1,259,597
1983	1,889,812	745,611	1,820,356	7,292,265	1,190,515
1984	1,883,666	746,042	1,883,836	7,648,429	1,208,139
1985	1,836,082	712,297	1,924,649	6,600,065	1,164,414
1986	1,202,400	658,578	1,885,141	6,106,455	1,095,518
1987	1,366,540	552,031	1,643,877	5,871,849	942,056
1988	1,319,149	537,582	1,613,405	5,445,112	915,142
1989	1,381,571	500,720	1,770,320	5,291,562	903,753
1990	1,366,299	542,593	1,957,040	3,933,081	956,576
1991	1,359,838	559,800	2,015,096	4,061,597	986,259
1992	1,288,302	543,844	1,990,302	3,686,590	959,704
1993	1,404,045	777,973	1,961,381	3,729,822	1,189,384
1994	1,236,107	681,231	2,009,136	3,319,705	1,094,411
1995	1,076,433	595,308	1,967,432	2,025,800	979,741
1996	948,366	437,067	1,949,308	1,513,871	865,836

C.2. CURRENT OPERATIONS

C.2.1. Petroleum Related Operations

C.2.1.1. General

Currently there are approximately 200 active wells, 225 abandoned or idle wells, 34 tank settings and six oil/water sumps on DOE lands within NPR-2. Continued production and development of known reserves at NPR-2 would require drilling and completing new production wells, commonly known as infill wells. Development drilling consists of the drilling, redrilling, deepening, completion, recompletion and testing of wells to enhance producing reservoirs. The additional production or infill wells would require pipelines, pumps, storage tanks, and other permanent equipment. Drill rigs would be temporary structures at the well site. Under the continued production, approximately 75 new wells would be drilled.

Production in NPR-2 is organized in eight pools or units located at various zones beneath the surface. Approximately 71 percent of all NPR-2 production is from the Shallow Pool. Production techniques on NPR-2, including well completions, workovers and abandonments, are the same as found on NPR-1 (see Appendices A & B).

Support facilities for hydrocarbon development at NPR-2 include facilities at the well site, such as oil and gas meters; gauging facilities; utility lines; tank settings, pipelines, pumps and sumps; roads; buildings; transport pipelines; storage and equipment yards; oil/water/gas dehydration/lease automatic custody transfer (LACT) units; compressors and tanks. Dehydration/LACT facilities include a production tank, a settling tank, a shipping tank, monitoring and metering equipment and a pump.

For NPR-2, individual lessees have developed and implemented SPCC plans in accordance with the Federal Clean Water Act (40 CFR §112). In addition, DOE monitors the environment and facilities at NPR-2. As part of these activities, the following measures are implemented at NPR-2, reducing the risk of a spill:

- Routine inspections are conducted to prevent equipment failures and to detect spills before they become an environmental or physical hazard.
- Workers are trained in emergency response procedures to protect human health and the environment.
- Secondary containment is provided to contain potential spills from oil storage tanks. In addition, secondary containment has been provided for some equipment with higher leak potential, such as valves.

Most of the pipelines at NPR-2 are aboveground, allowing for routine inspection, ease of maintenance and reduced external corrosion. Where pipelines must pass below ground, such as at road crossings, corrosion protection is provided to prevent spills caused by external corrosion.

DOE currently administers unleased lands in Sections 8B, 12C and 18H (See Figure 1.4-1); there are no active oil production wells on these lands. There is one shut-in well on Section 18H and one abandoned well in Section 12C. The drill site on Section 12C was reclaimed within the past two years. DOE has no plans to reactivate the 18H well or to conduct any additional exploration or production activities on these lands.

DOE conducts bimonthly inspections of the drill sites in Section 12C. These inspections will result, if warranted, in performing routine maintenance of existing fences around drill sites; removing unwanted vegetation growth and illegal dumping; monitoring and responding to maintenance requests from third parties that hold various rights-of-way through the drill sites for alleyways, local utilities, etc.; and filling in any subsidence depressions located on the drill sites that could create a hazard for local residents.

C.2.1.2. Lessee Activities

The private companies that conduct petroleum-related activities on DOE-owned NPR-2 lands include Chevron USA, Inc. Fred S. Holmes; Aera Energy; Oakland Petroleum Operating Company; Phillips Petroleum Company; Texaco, USA; UNOCAL Corporation; Vintage Petroleum Company; and numerous petroleum pipeline companies (see Figure 1.4-1).

Chevron USA, Inc. Chevron leases a total of 1,490 acres (600 ha) of DOE land in Sections 22B, 26B, 28B, 34B, 12C, 2D and 18D. Chevron has 31 active oil and gas wells on these sections, producing about 200 barrels of oil per day (BD) and 225,000 cubic feet of gas per day (CFD). Chevron has ten tank settings, one each on Sections 28B and 12C, two on Section 22B and three on Sections 26B and 2D. Nine of the ten tank settings are currently operating. One tank setting in Section 22B is inactive. Chevron's lease of Section 18D is currently inactive. Two sumps, one located on Section 22B and one on Section 2D, are closed. Chevron plans to remove these sumps and reclaim the areas. Chevron generates approximately 146,000 barrels per year of produced water, which is disposed of by injection.

Fred S. Holmes Oil. Fred S. Holmes operates 80 acres (32 ha) of land in Section 32G through a DOE approved farm-out agreement with Phillips Petroleum Company. Fred S. Holmes has four active oil wells and one tank setting in this section. The tank setting consists of one 750-barrel wash tank, four 500-barrel oil storage tanks and one 200-barrel water tank. Holmes' wells are presently producing 210 barrels/d and 30 barrels of water per day. Approximately 11,000 barrels of water per year are produced and disposed of through a Chevron disposal pipeline.

Aera Energy/Oakland Petroleum Operating Company. Aera has three leases totaling 280 acres (110 ha) in Section 32G. Aera has reassigned one of these leases totaling 80 acres (32 ha) to the Oakland Petroleum Operating Company and has not conducted operations on lands under the other two leases for over 30 years. Aera is considering reassigning the remaining two leases as well. Oakland is currently operating one tank setting and two stripper wells. The stripper wells produce eight barrels/d. The tank setting consists of one 500-barrel shipping tank, one 100-barrel produced water tank, one 500-barrel oil/water separator, and one covered oil/water sump. Oakland generates approximately 9,000 barrels of produced water per year, which is disposed of by injection off-site.

Phillips Petroleum Company. Phillips leases 2,280 (925 ha) of DOE land in Sections 18B, 28B, 2D, 12D, 30G and 32G. The major portion of Phillips' oil exploration and production activity occurs on Section 32G. Three oil wells, one gas well and one tank setting with two 2,000-barrel oil tanks and one 800-barrel wash tank operate in Section 32G. Phillips' wells in Section 32G produce approximately 90 BD and 25 MCFD. Phillips extracts approximately 26 BD and 80 MCF from four wells on Section 28B. Three tank settings are located on this section; however, only two are in operation. Phillips lease on Section 18B has been inactive for more than 30 years. Phillips generates approximately 130,000 barrels of produced water per year. Produced water generated on Section 28B is transported to Valley Waste for disposal off-site and water generated from Section 32G activities is transported off-site via pipeline for disposal by injection. The Section 30G lease to Phillips in currently inactive and has undergone a formal clean-up action for ultimate relinquishment back to DOE.

Pipeline Companies. Several pipeline companies have third-party agreements for easements or rights-of-way. Companies include Chevron USA, Inc.; Cuyama Pipeline Company; Four Corners Pipeline Company; Mobil Pipeline Corporation; Mojave Pipeline Company; Koch Gathering Systems, Inc.; Southern California Gas (SoCal); Texaco Transportation Company; and UNOCAL. These companies maintain and replace existing pipelines and associated equipment as required. Approximately 250 miles (402 km) of pipeline currently exist at NPR-2.

Texaco USA. Texaco leases 4,520 acres (1,830 ha) of DOE land in 11 sections. The majority of Texaco's operating facilities are on Sections 6D, 8D and 14D. Texaco operates approximately 124 oil and gas wells and produces approximately 447 barrels/d of oil, 6,857 MCF/d of gas, and 6,300 gallons/d of natural gas liquids. Petroleum gathering, shipping and separating stations are located on Sections 20B, 22B, 26B, 34B, 6D, 8D and 14D. Texaco's leases in Sections 22B, 28B, 34B, 2D, 4D and 12D have no production. Texaco generates approximately 1.8 million barrels of produced water per year. This water is disposed on-site by injection.

Texaco had a gas plant located on Section 8D with one fractionation and one compression system. Decommissioning and removal of some equipment at the gas plant and closure of the facility is currently underway.

UNOCAL Corporation. UNOCAL leases 360 acres (225 ha) of DOE land on Sections 34B and 32G; however, UNOCAL is not currently operating any equipment or facilities on these sections. About 15 acres (6 ha) are currently disturbed. UNOCAL will conduct closure and clean-up activities as needed on Section 34B to ensure environmental compliance.

Vintage Petroleum Company. Vintage leases 400 acres (160 ha) of DOE land in Sections 20B and 28B. The lease on Section 28B is inactive. Vintage operates approximately 26 producing wells, two tank farms, a compressor station and a maintenance yard on Section 20B. Vintage's wells produce approximately 1,000 barrels/d and 3,000 MCF. Approximately 450 MCF are used in existing field operations. The remaining 2,550 MCF are delivered to an ARCO dehydration plant through a supply line. Produced water generated by Vintage operations is either transported by pipeline to injection wells in Sections 19B and 20B or directed to sumps and removed by vacuum truck.

C.2.1.3. Future Lessee Activities

Reassignment and relinquishment of leases, farm-out agreements and third-party-operator agreements might occur with the concurrence of DOE. Reassignment occurs when the leaseholder sells the lease to another party. Relinquishment is the process in which the leaseholder returns the lease to DOE. Farm-out agreements occur when the leaseholder allows a third-party-operator to enter into legal agreements with a lessee. The third-party-operator generally develops and potentially produces part of the lease with an agreement to pay royalty fees to the lessee (the lessee is still responsible for paying the government (lessor) any contractual royalties). It is anticipated that some of the reassignments, relinquishments and agreements would help to preserve existing production and promote future development and production of new reserves in order to maintain profitability for government at NPR-2.

C.2.2. Non-Petroleum Related Activities

The Federal government issues and administers revocable permits to various public and private parties for surface rights to conduct a variety of activities on NPR-2. These activities occur throughout NPR-2 on leased and unleased lands and include agricultural and produced water disposal activities; maintaining oil, gas and water pipelines; operating the California Aqueduct and a pumping plant; and maintaining television cables, telephone lines and power lines.

The private companies and government agencies conducting non-petroleum-related activities on DOE-administered NPR-2 lands include BPOI, BLM, California Department of Food and Agriculture (CDFA), California Department of Transportation (CALTRANS), California Department of Water Resources (DWR), the incorporated city of Taft and adjacent unincorporated Ford City, Continental Telephone Company (CONTEL), EASI, Kern County (Kern County Waste Management and Road Maintenance Department, Pacific Gas and Electric Company (PG&E), Warner-Amex and West Kern Water District. Livestock grazing, firearms target practice, hunting and off-road vehicle use are prohibited on NPR-2. DOE routinely contacts local ranches in the area to warn them of its no grazing policies. Due to the fragmented nature of NPR-2, it is very difficult to administer these restrictions to prevent trespass. New agreements may be established between DOE and other companies and agencies. A description of the current operations conducted by each of the current groups is presented below.

Bechtel Petroleum Operations, Inc. (BPOI). BPOI has no permanent facilities on NPR-2 and performs activities onsite in support of DOE. BPOI routinely witnesses gas meter calibrations, tank gauges (tank strappings for oil sales), oil/water cuts and gravities, proving for LACT meters and LACT ticket changes. BPOI reports to DOE any operations by lessees on Federal leases that may be in violation of state or Federal environmental, safety and health rules or regulations. BPOI also manages DOE's interest in non-leased lands on Sections 8B, 12C and 18H.

Bureau of Land Management. Under a Memorandum of Understanding between BLM and DOE, BLM has the authority to grant and renew a right-of-way through Federal lands (including NPR-2) for a 30-inch (76-cm) pipeline being constructed, operated and maintained by the Mojave-Kern Pipeline Company. This pipeline right-of-way encompasses about 555 acres (225 ha) on NPR-2. The action was evaluated in a 1989 *Federal Energy Regulatory Commission Environmental Impact Statement.*

California Department of Food and Agriculture (CDFA). CDFA conducts a state-wide pesticide spraying program for controlling the sugar beet leafhopper, which is a vector for the curly top virus. This program encompasses NPR-2 lands and is implemented on an as-needed basis in areas with high populations of the sugar beet leafhopper. These areas are spot-treated, as needed, usually once a year by aerial spraying of the pesticide malathion. This action was evaluated under a separate NEPA document (CDFA 1991).

California Department of Transportation (CALTRANS). State Highway 119, known as the Taft-Bakersfield Highway, overlies DOE land north of Ford City. CALTRANS maintains this road, which includes hole repair, weed control, sign maintenance and trash pickup.

California Department of Water Resources (CDWR). CDWR operates the large, concrete-lined California Aqueduct canal and pumping station. The surface rights on approximately 120 acres (49 ha) are leased by CDWR. The aqueduct conveys water from the Sacramento delta region to the Los Angeles metropolitan area. CDWR has an easement in Section 12D for this aqueduct and its operations, which includes the Buena Vista Pumping Plant (BPOI 1991a).

City of Taft and Ford City. The Taft Heights Sanitation District, operated by the cities of Taft and Ford, leases acreage in Section 18D. This lease will expire on June 16, 1997. Since 1985, the 167 acres (68 ha) have been subleased for farming. An informal consultation was concluded with the FWS (FWS 1984) for the continued irrigation of the alfalfa crops on Section 18D. Treated sewage effluent from a nearby sewage treatment plant has been used to irrigate alfalfa crops on 120 acres (49 ha) of the area (BPOI 1991a).

Within Ford City (Section 12C), DOE has eight vacant one-half-block lots that were formerly U.S. Navy drill sites and has retained the subsurface mineral rights for all sites under Ford City except

those leased to Chevron (BPOI 1991a). Use of the surface for development of these mineral resources is not included in the proposed action or any of the alternative actions.

Continental Telephone Company (CONTEL). CONTEL maintains a permit for easements for communication lines across NPR-2. These easements are approximately 10-feet (3-m) wide and, where feasible, parallel existing roads. The total length of the CONTEL easements on NPR-2 is 19,873 feet (6,057 m). The majority of CONTEL's communication lines are overhead with the remaining portion underground. CONTEL activities along these easements include surveillance and maintenance of existing lines. These activities require small crews in light equipment trucks or hoist trucks.

Environmental Adisory Services, Inc. (EASI). EASI conducts biological and historical archaeological surveys and studies to assist DOE in complying with the Endangered Species Act and National Historic Preservation Act, respectively. In addition, EASI manages some revegetation activities on NPR-2. Biological and resource specialists conduct activities year round. Activities include monitoring animals; inventorying vegetation; and monitoring reseeding work. No permanent structures or facilities are operated by EASI on NPR-2.

Kern County. The Kern County Road Maintenance Department maintains a number of county roads on NPR-2. Kern County Waste Management Department operates the Class III Taft Sanitary Landfill adjacent to DOE lands. An easement through DOE land in Section 30G was granted in 1972 for a 45-foot-wide access road to the landfill from Elk Hills Road.

Pacific Gas and Electricity (PG&E). PG&E has a number of rights-of-way for the electrical and gas distribution lines that cross NPR-2 lands. PG&E activities along these rights-of-way include surveillance and maintenance of existing utility lines. These activities require small crews in light equipment trucks or hoist trucks.

Warner-Amex. A fenced communications facility with three large dish-satellite antennas and two small sheds for storage of equipment is located on DOE land in Section 18D. This facility is operated by the Warner-Amex cable television service (BPOI 1991a).

West Kern Water District. The West Kern Waster District operates a municipal booster pumping station and pipelines in Section 32G. This pumping station is used to add line pressure needed to convey potable water to the Maricopa, Taft and Fellows areas (BPOI 1991a).

Other. No public recreation occurs within the boundaries of DOE-administered lands on NPR-2. Much of the area surrounding DOE-administered land in NPR-2 consist of agricultural land and open space, with oil extraction occurring as a compatible use. Sheep and cattle are grazed to the south and west; this type of land use is not permitted on DOE-administered lands. Livestock grazing has been prohibited on the NPR-2 since the mid-1960s. This restriction was imposed because of excessive environmental damage to topsoil, vegetative productivity, sedimentation in drainages and adverse changes in the composition of the vegetative cover. Further, NPR-2 is habitat for Federally-listed and protected species; therefore, public livestock grazing remains restricted on NPR-2 under existing operating policies.

C.3. FUTURE ACTIVITIES UNDER THE RECOMMENDED ACTION AND ALTERNATIVES

C.3.1. General Types of Activities

The following general types of activities would occur under the proposed action and any of the alternatives:

- Petroleum-related activities, including actions directly or indirectly related to petroleum development and exploration.
- Non-petroleum-related activities, such as utility easements and agricultural use.

Proposed petroleum-related activities on NPR-2 would be conducted under DOE leases, farm-out agreements, third-party operator agreements and revocable permits. Oil production and exploration operations would continue through existing agreements that are consistent with energy production requirements, royalty maximization for the U.S. government and Federal, state and local regulations. However, oil and gas development is expected to be minimal since reserves are highly depleted (BPOI 1991a). All oil would be retained by the lessee or competitively sold on the open market. Other petroleum-related activities would include produced water disposal, oil and gas pipeline maintenance and construction activities.

Non-petroleum-related activities would be conducted under leases, cooperative agreements, third-party operator agreements, revocable permits, memoranda of understanding and contractual arrangements. These would include continuation of various surface uses and site management. Non-petroleum-related surface uses would consist of produced water injection, agriculture, utility easements and right-of-ways, roadways and city uses.

Under the recommended action and the no-action alternative, the government would administer NPR-2 in compliance with applicable laws and regulations, including managing unleased lands (e.g., Sections 12C, 18H, 8B and future relinquished lands), conducting oil exploration and development activities, administering leases, ensuring correct royalty payments and performing environmental surveillance. The government would continue to coordinate, monitor and approve activities of private and public organizations that conduct activities on the 10,446 acres of government lands within NPR-2.

Under the recommended action, petroleum-related activities on the government-owned portions of NPR-2 would include the following:

- Drilling and installing new infill, offset development and exploratory wells;
- Withdrawing oil, gas and water from production wells;
- Shutting-in, abandoning and re-abandoning wells;
- Conducting well workovers and well maintenance;
- Constructing, operating, maintaining and replacing support facilities;
- Abandoning, storing, disassembling and salvaging equipment and facilities;
- Conducting seismic surveys, engineering evaluations and field observations of production activities;
- Conducting regulatory compliance activities, including reclamation of habitat and surveys for archaeological and natural resources;

- Reassigning and relinquishing leases, farm-out agreements and third-party operator agreements; and
- Transporting, injecting and temporarily sumping produced water.
- Proposed non-petroleum-related activities on NPR-2 would include the following:
- Constructing, operating, maintaining and replacing equipment and facilities, including new pipelines, utility distribution lines and roads;
- Abandoning, storing, disassembling and salvaging equipment and facilities;
- Conducting regulatory compliance activities, including reclamation of habitat, archaeological and natural resource surveys, facility closure and site cleanup;
- Performing agricultural activities and pesticide spraying; and
- Conducting engineering evaluations.

C.3.2. Petroleum Related Activities

The following estimates of the quantity and magnitude of potential petroleum (as well as non-petroleum related) activities to be conducted under the proposed action serve as an upper bound. These estimates are based on best available information from recent past use and projections provided by current users of NPR-2. The activities and their levels described below may not occur because of oil market conditions or policy decisions within the Federal government (Table C.3-1).

Under the recommended action new facilities maintenance operations would disturb a maximum of 943.5 acres (381 ha) of which approximately two-thirds would be previously disturbed land. The total area disturbed would increase to a maximum of 2,309.5 acres (935 ha) (22.1 percent of DOE-operated NPR-2 lands) since 2,022 acres (818 ha) are currently disturbed.

Continued production and development of known reserves at NPR-2 would require drilling and installing new reservoir wells commonly known as infill and offset wells. Development drilling consists of the drilling, redrilling, deepening, completion, recompletion and testing of wells to enhance the producing reservoirs. Infill wells, when converted to production wells, would require pipelines, pumps, tanks and other permanent equipment. Drill rigs would be temporary structures at the well site. Under the proposed action, approximately 75 new wells would be drilled.

Hydrocarbons, water and gas are typically produced by artificial lift with pumping units from the pressure depleted reservoirs. Remedial well workovers are generally performed to restore and/or increase oil production in older wells. Workovers consist primarily of bailing sand from wells, squeezing cement, perforating intervals and stimulations with chemicals such as solvents, acids and surfactants to remove paraffins, asphaltenes, sand clays and other debris away from the wellbore. To maintain production at NPR-2, wells may be recompleted or redrilled and/or enhanced recovery techniques such as waterflooding or injection of chemicals may be implemented when hydrocarbon production from wells is approaching economic limits.

Projected future production to the end of the field's life is shown in Table C.3-2. Like the Government Development Case and Commercial Development Case a range of future production has been provided. A range is being used because NPR-2 has experienced a dramatic change in the rate of production decline over the last five years. The lower bound of the NPR-2 case assumes the continuation of the current trend, the upper bound assumes a resumption of the previous trend.

Table C.3-1
Projected NPR-2 Activities Under the Proposed Action (1997 to 2017) and Activities Conducted in 1992[a] (provided for comparison)

Type of Activity	Estimated Activities in 1992	Proposed Activities 1993 to 2017
Petroleum-Related Activities		
Maximum Daily Oil Production (barrels)	1430	1281 _ 800
Active Wells (approximate)	208	208 _ 108
New Wells/Acres	5/11	75/165
Abandon, Idle, Shut-in Wells/Acres	5/5	175/175
Re-abandon Wells/Acres	5/7.5	125/187.5
Operate Existing Sumps/Acres	6/3	0/0
Abandoned Sumps/Acres	0	6/3
Tank Settings/Acres	34 existing/26 active 34 acres	34/34 _ 16/16
New Tank Settings/Acres	1/1	5/5
Abandon Tank Settings/Acres	0/0	23/23
Existing Major Facilities (operational)	1) 1 gas plant	1) Shut down and abandon gas plant
Non-petroleum-Related Activities		
New, Abandoned Facilities (Acres Disturbed)	5	75
Existing Major Facilities (Operational)	1) WKWD Pumping Station 2) DWR California Aqueduct 3) DWR Buena Vista Pumping Plant	1) WKWD Pumping Station 2) DWR California Aqueduct 3) DWR Buena Vista Pumping Plant
Activities Common to Petroleum and Non-petroleum Actions		
New Roads (Miles/Acres)	0.2/0.5	2.25/7.5
Road Abandonment (Miles/Acres)	0.2/0.5	5.25/17.5
New Pipelines (Miles/Acres)	1.5/4	22.5/75
Pipeline Abandonment (Miles/Acres)	1.5/4	52.5/175
Seismic Surveys (Acres Disturbed)	5	125
Amount of Area Disturbed		
Total Acres Disturbed (new developments plus abandonments)	37.5	943.5
Acres Disturbed from New Developments	15.5	287.5
Acres Disturbed from Abandonments	22	656
Total Disturbed Habitat by end of time period (Acres)[c]	2,022	2,309.5[d]
Percent of Total Area Disturbed by end of time period	19.4%	22.1%[e]

Sources of Information: *Environmental Plan for Naval Petroleum Reserves No. 2, January 1991; Naval Petroleum and Oil Shale Reserves Annual Reports* 1986 to 1991; and *NPRC FY 1991-1997 LRP, Naval Petroleum Reserves in California.*

[a] Based on best available information from recently completed activities and projections provided by current users.

[b] Previously disturbed acres available for habitat reclamation.

[c] An unquantified amount of habitat will be reclaimed.

[d] This is a cumulative total of 2,022 acres disturbed prior to the proposed action plus 287.5 acres that would be newly disturbed under the proposed action.

[e] This percentage is a cumulative percentage calculated by dividing 2,309.5 acres by 10,446 acres (DOE-owned NPR-2 total acres).

Table C.3-2
Projected Government Lease Oil, Gas & NGL Production at NPR-2

	Accelerated Production Decline			Historical Production Decline		
Years	Oil Mbbls	Gas MMcf	NGL MGals	Oil Mbbls	Gas MMcf	NGL MGals
1997	431	1,939	1,502	453	2,038	1,579
1998	377	1,885	1,461	417	2,085	1,616
1999	330	1,650	1,279	383	1,915	1,484
2000	288	1,440	1,116	353	1,765	1,368
2001	252	1,260	977	324	1,620	1,256
2002	220	1,100	853	298	1,490	1,155
2003	192	960	744	275	1,375	1,066
2004	168	790	612	253	1,265	980
2005	147	735	570	233	1,165	903
2006	129	645	500	214	1,070	829
2007	113	565	438	197	985	763
2008	99	495	384	181	905	701
2009	86	430	333	167	835	647
2010	75	375	290	153	765	593
2011	66	330	255	141	705	546
2012	58	290	224	130	650	504
2013	50	250	232	119	595	461
2014	-	-	-	110	550	426
2015	-	-	-	101	505	391
2016	-	-	-	93	465	360
2017	-	-	-	86	430	333
2018	-	-	-	78	390	302
2019	-	-	-	72	360	279
2020	-	-	-	66	330	256
2021	-	-	-	61	305	236
2022	-	-	-	56	280	217
2023	-	-	-	52	260	202
2024	-	-	-	48	240	186
Total	3,081	15,139	11,770	5,114	24,983	19,639

BOE 1997 - 2013 = 5,921,301 Accelerated Production Decline
1997 - 2024 = 9,959,677 Historical Production Decline

Tank settings are used to separate oil from produced water and gas. Most produced water would be transported for reinjection either onsite or off-site into the Tulare Formation. The remaining produced water would be temporarily stored in tanks and/or sumps and then ultimately transported off-site for reinjection. The resulting pipeline-quality oil is sent off-site for processing. Dehydration/LACT facilities include a production tank, a settling tank, a shipping tank, monitoring and metering equipment and a pump. Maintenance and repair of petroleum support facilities would be required to maintain operation of tank settings and dehydration/LACT facilities.

Wells that are no longer economically productive would be shut-in or abandoned. Shut-in status occurs when a production well is physically or mechanically incapable of producing economic oil or gas but may have value as a service completion for enhanced recovery or water disposal. Under the proposed action re-abandonments may be required to upgrade the closure of wells which were abandoned prior to current abandonment requirements (43 CFR §3160). About 175 wells would be abandoned or shut-in, and 125 wells may be reabandoned.

Facilities and equipment that become unnecessary, such as compressors, pumps and gas plants, may be secured for later reactivation (stored or mothballed), abandoned, disassembled and/or salvaged. Under the proposed action, the six existing oil/water sumps, covering a total of three acres (1.2 ha), would be reclaimed and closed. In addition, all or portions of the gas plant owned and operated by Texaco would be shut down, abandoned, reclaimed and closed. Approximately 5.25 miles (3.3 km) of roads would be closed and reclaimed, revegetating 17.5 acres (7.1 ha) of land. Approximately 37.5 miles (60.0 km) of existing pipeline and 18 tank settings would be abandoned, salvaged, or disposed and 118 acres (47.75 ha) would be revegetated. In addition, 175 wells and well pads would be abandoned and approximately 175 acres (70.8 ha) would be reclaimed and revegetated.

C.3.3. Non-Petroleum Related Activities

About 2.25 miles (1.4 km) of new roads would be constructed, disturbing an additional 7.5 acres (3.0 ha), and over 200 miles (320 km) of existing roads would be maintained by grading. Between 1997 and 2017, approximately 22.5 miles (36 km) of new pipeline would be constructed, disturbing about 75 acres (30.3 ha). Over 300 miles (483 km) of existing pipelines would be inspected and repaired as needed at least annually.

The California Aqueduct and pumping station would be maintained. This would include inspecting and repairing roads and fences, inspecting the aqueduct and patching portions of the concrete apron, as needed. The pump station's building, pumps and support systems would continue to be operated and maintained. Pump station maintenance would include changing, recycling and disposing of lubricants used for the equipment (500 to 600 gal/year). Antenna transmission facilities, communication cables and power transmission lines would be inspected and maintained. Permanent and temporary power and water connections would be installed and connected to existing nearby sources.

During conduct of the proposed action, it may be necessary to conduct geophysical (seismic) surveys to identify geologic structures at depth. In addition, engineering evaluations and siting studies, along with field observations of ongoing production-related activities, would be conducted. Surveys are expected to disturb an additional 125 acres (50.6 ha) during the 25-year period under the proposed action.

Regulatory compliance activities would include environmental monitoring; spill response actions; inactive waste site investigation, characterization, remediation and closure; and reclamation of habitat. Environmental monitoring would consist of semi-monthly site inspections, government site surveillance and regulatory agency inspections. Regulatory agency inspections would be conducted by state agencies, such as the Regional Water Quality Control Board and the California Division of Oil, Gas and Geothermal Resources and local agencies, such as the fire department and other city and county agencies. Spill response actions would include containment, cleanup and reporting as required by Federal, state and local regulations.

Additionally, endangered-species surveys, archaeological surveys and natural-resource surveys would be conducted by the government, government contractors, or lessees/permittees. It is assumed that about 120 endangered-species and archaeological surveys would be conducted each year. Preactivity surveys would be conducted for all potential and planned construction, maintenance and operations sites.

The government, lessees and/or third parties would utilize qualified biologists to conduct surveys to ensure that endangered species and their habitat are avoided to the maximum extent possible.

APPENDIX D
AIR RESOURCES

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D. AIR RESOURCES

This appendix discusses existing conditions and air quality conditions of the Reference Case, No Action and Proposed Action at the Naval Petroleum reserve-1 and 2 (NPR-1 and NPR-2) facilities. This appendix provides more detailed and background information for the data presented in Sections 3.3 and 4.3 and is divided into five sections:

- Section D.1 discusses the climatology and meteorology of the geographical area (This information is necessary for understanding the air quality conditions and is used in the modeling efforts.);
- Section D.2 presents information on air quality standards and regional air quality regulations;
- Section D.3 discusses the release of atmospheric pollutants associated with stationary and mobile equipment used in oil production activities at NPR-1;
- Section D.4 discusses atmospheric emissions produced at the NPR-2 facility; and
- Section D.5 presents the methodology and results of dispersion modeling used to determine the air quality impacts of the proposed actions.

D.1. CLIMATOLOGY AND METEOROLOGY

This section discusses the climatology and meteorology of the San Joaquin Valley and the area around NPR-1 and NPR-2. Specifically, the normal wind direction, speed and persistence are presented along with the trends over the last several years. In addition, the mixing height of the air typical for this area is discussed. This information is necessary for the air quality dispersion modeling efforts.

D.1.1. Climate of the San Joaquin Valley

The NPR-1 facility is located in the southwestern corner of Kern County, the southernmost county of the San Joaquin Valley. The San Joaquin Valley Unified Air Pollution Control District (Figure D.1-1) covers the central section of California, running north/south from directly east of the San Francisco Bay area to northeast of Santa Barbara. The airflow patterns in the San Joaquin Valley air basin are generally characterized by one of the four directional patterns shown in Figure D.1-2, and show strong seasonal variation. Table D.1-1 presents the percentage occurrence of each of the four airflow types by season. The northwesterly upvalley flow is predominant in the summer, while calm conditions predominate in winter. Although frequent inversions occur in the central valley, the occurrence of severe air pollution episodes is relatively small in the winter due to increased cloud cover and lower temperatures.

Strong daily diurnal wind patterns also affect pollutant build up in the San Joaquin Valley. Daytime upslope winds from the west predominant in contrast to the nighttime gravity winds. The daytime upslope winds, which develop as the floor of the valley heats up, are primarily from the north and flow from the valley floor up the mountain ranges on either side of the valley, as shown in Figure D.1-2. The nighttime drainage flows, occurring as the temperatures in the valley drop, are primarily from the southwest.

Table D.1-1
San Joaquin Valley Air Basin Surface Airflow Types

Season	Upvalley	Downvalley Drainage	Southerly	Northerly (No Marine Air)	Calm
Winter	13 %	18 %	24 %	14 %	31 %
Spring	41 %	13 %	9 %	26 %	11 %
Summer	69 %	5 %	2 %	21 %	3 %
Fall	38 %	13 %	10 %	17 %	22 %
Annual	40 %	13 %	11 %	19 %	17 %

The nearest National Weather Service (NWS) station is approximately 40 miles northeast of the NPR sites in Bakersfield. Bakersfield, located on the southeastern side of the San Joaquin Valley, is surrounded by the Sierra Nevada mountains to the northeast and the Tehachapi mountains to the southeast. The climate in Bakersfield is similar to that of the rest of the San Joaquin Valley, with hot, dry summers and mild and semi-arid winters. Bakersfield normally receives 5.72 inches of rain per year, with 6.02 inches as the average from 1989 to 1994. Average daily temperatures typically vary from 48.2°F in January to 84.5°F in June Daily minimum and maximum extremes can vary from 64.3 to 92.2°F in June and from 38.7 to 57.6°F in December.

Figure D.1-3 shows wind patterns for Bakersfield and other local meteorological stations. Although wind patterns vary with the location of the station in relation to the nearby mountains, winds at all stations show the bimodal distribution of winds with daytime upflow from the north and nighttime southeast drainage flows. The windrose for the Maricopa station, however, indicates that this area, which is located very close to the eastern slope of the Temblor Range, is more strongly influenced by nighttime drainage winds originating from the higher terrain. In contrast, winds in Bakersfield are more strongly influenced by the daytime, northerly winds.

D.1.2. Local Meteorological Patterns

Wind Direction, Speed and Stability. As indicated in the 1993 Supplement to the 1979 Environmental Impact Statement (DOE 1993) completed for the NPR-1 site, wind flow data for an entire year have not been collected within the facility. Hourly measurements, however, were collected for an 8-day period during the summer of 1987. Since the measurement period is too short to determine consistent wind patterns in the area, the 1993 SEIS wind data measured at sites operated by the West San Joaquin Area Monitoring Group of the Kern County Westside Operators were examined in the 1993 SEIS to determine the site most representative of conditions at the NPR. Evaluation of the wind roses suggests that wind patterns at the Fellows monitoring station best represent these conditions.

Figure D.1-4 shows the frequency distributions of wind direction, wind speed and stability class for the Fellows meteorological site. Winds near the NPR sites are predominately from the west-southwest. Wind speeds between 1 to 3 m/s are most common, and speeds over 11 m/s are rare. Stability class values, determined using ceiling height and cloud cover data measured at the NWS station at Meadows Field, show that neutral conditions (stability class D) occur approximately 26 percent of the time. The combination of stable conditions (classes E, F & G), which typically occur at night, develop 43 percent of the time, and unstable conditions (classes A, B, & C) occur 31 percent of the time.

Figure D.1-1
San Joaquin Valley

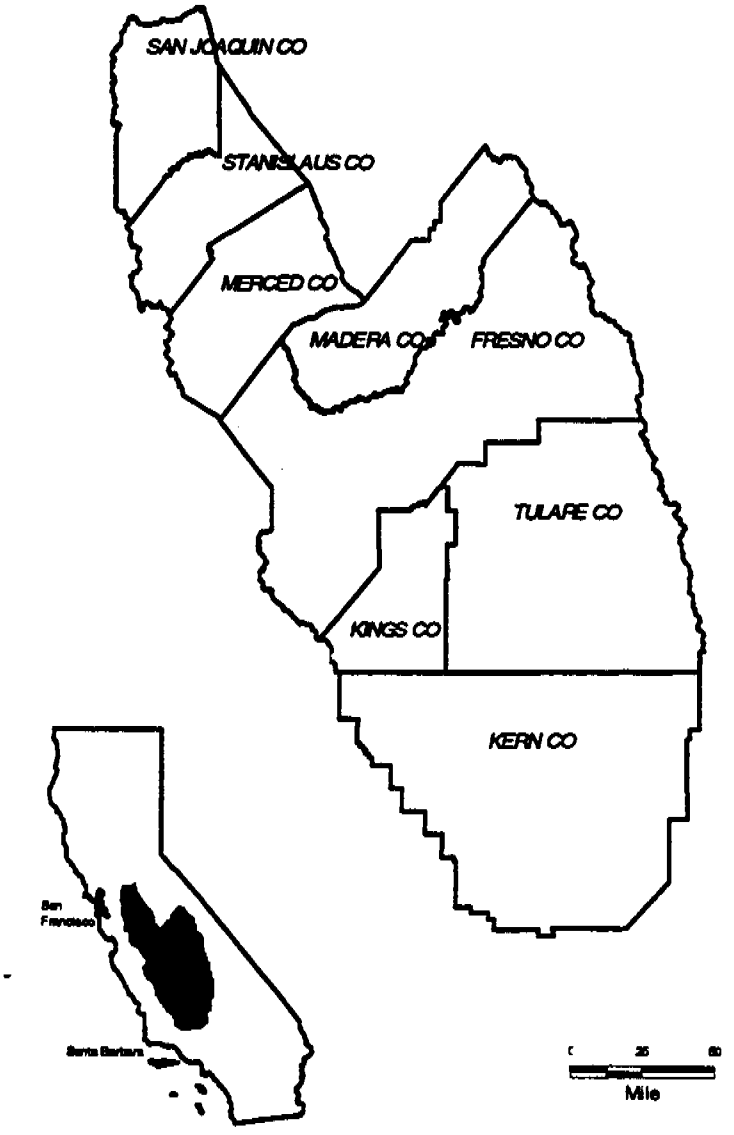
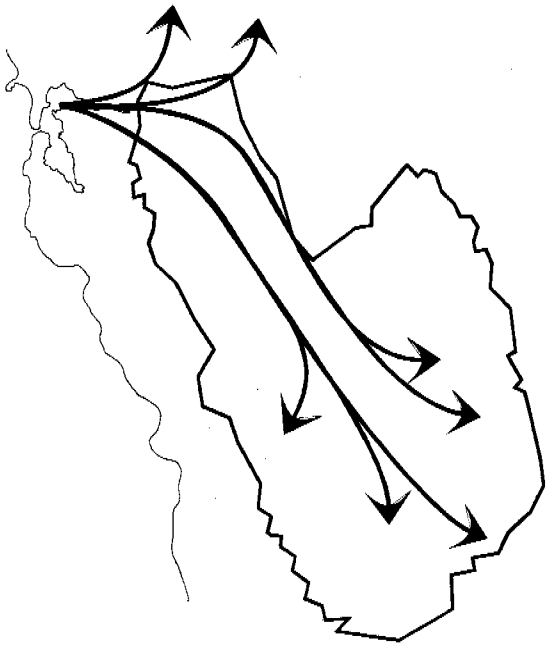
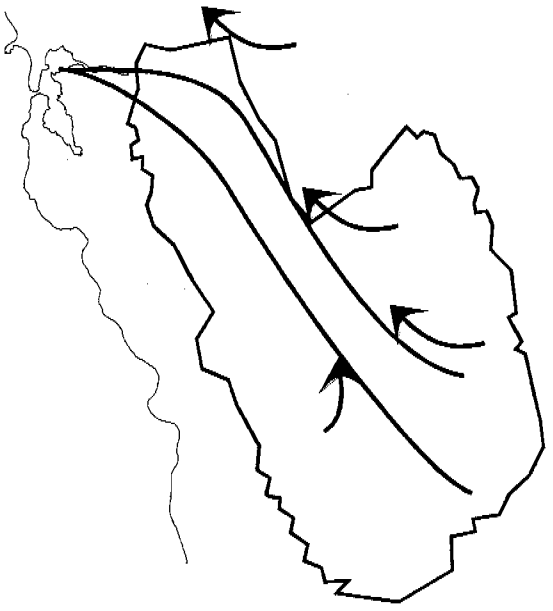


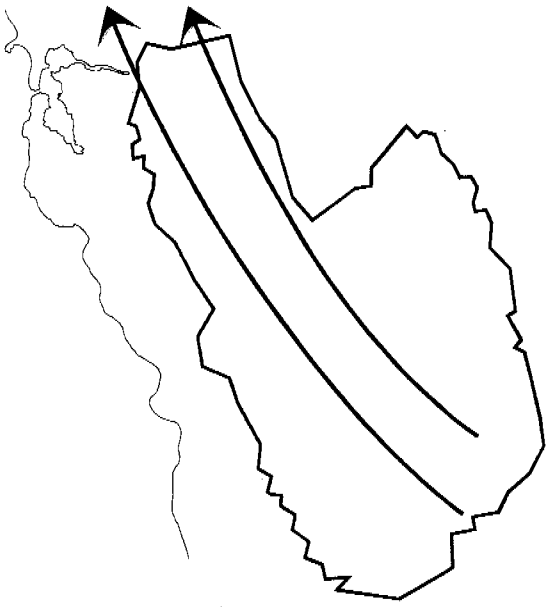
Figure D.1-2
Wind Patterns in the San Joaquin Valley



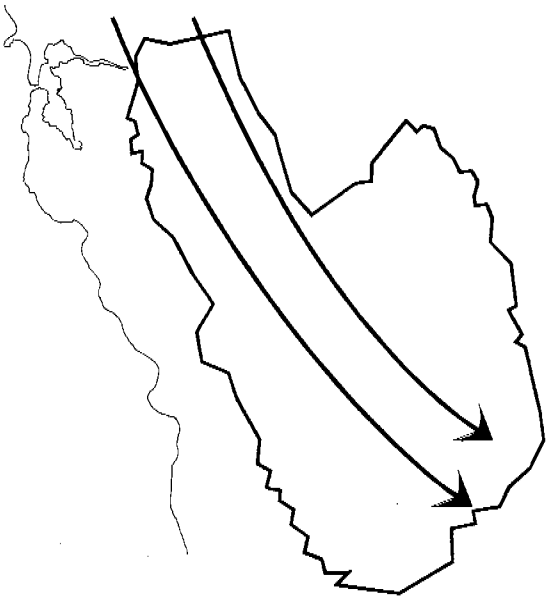
I. Upvalley



II. Downvalley/Drainage



III. Southerly



IV. Northerly
(no Marine Air)

cdr\96\sjv05

Figure D.1-3
Wind Roses for Meteorological Sites Around NPR

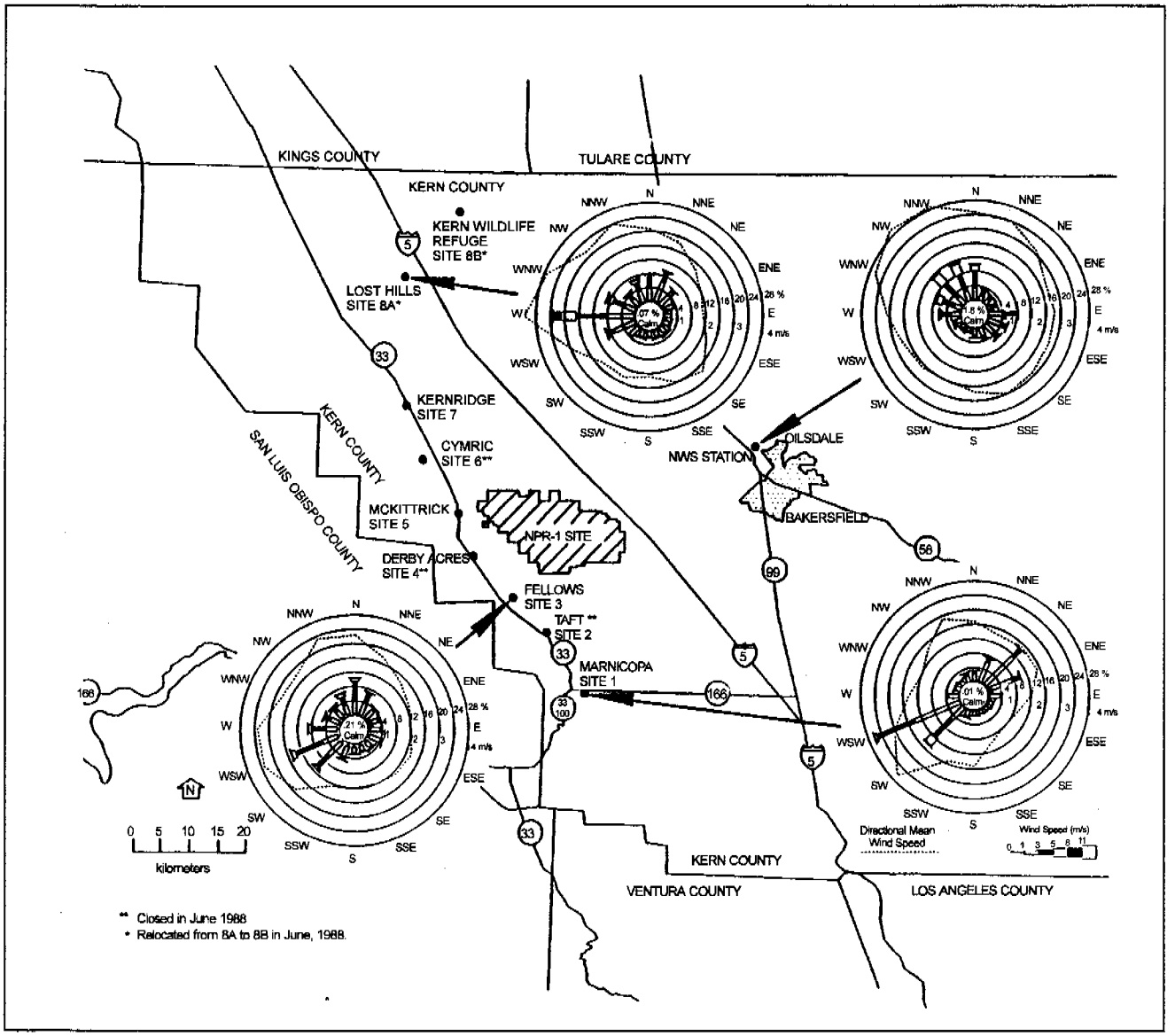


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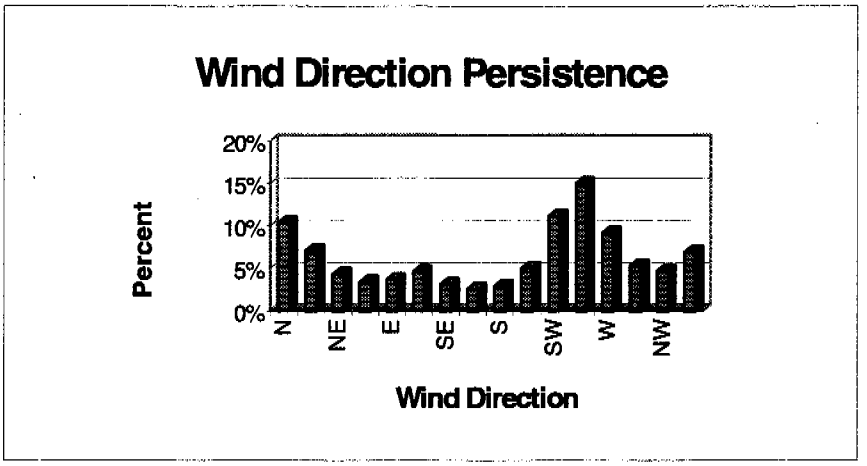
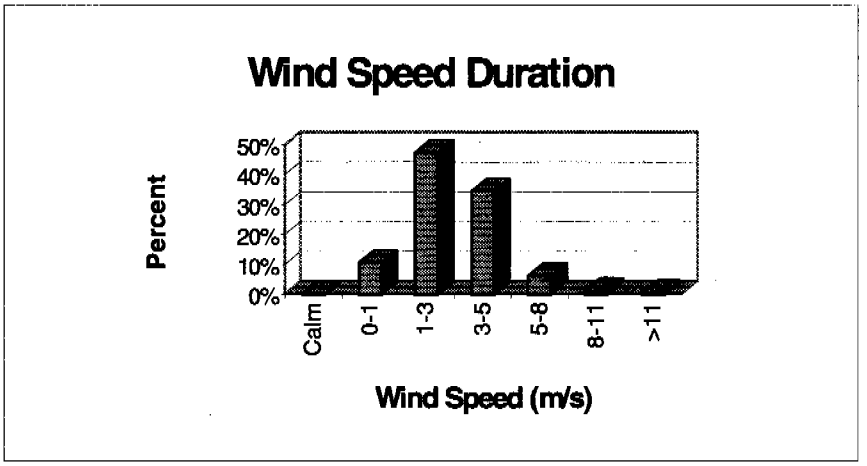
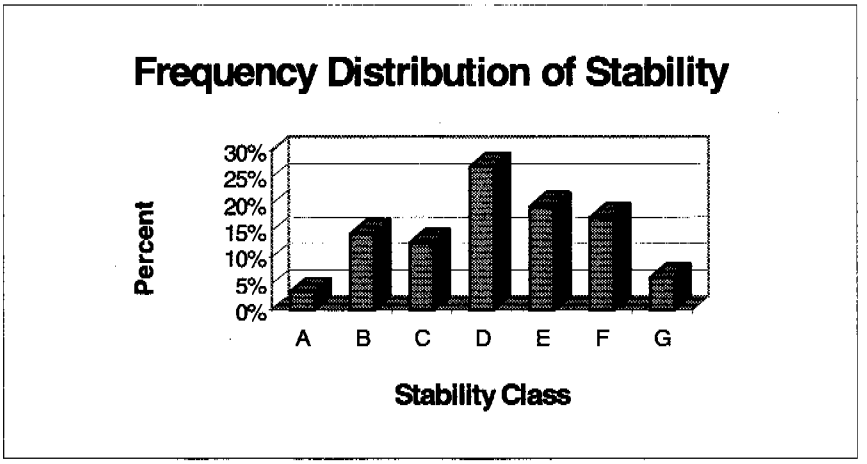
Figure D.1-4
Frequency Distribution of Wind Direction, Wind Speed and Stability Class







Wind persistence. Figure D.1-5 shows the frequency distributions of wind direction persistence at the Fellows meteorological station. The four graphs at the top of the page indicate the persistence of the winds in both the most common wind directions (north and west-southwest) and in two of the less common wind directions (east-southeast and south-southwest). The wind direction persistence for all wind directions is illustrated in the graph at the bottom of this figure, which indicates that the predominant west-southwest winds also persist (up to 4 hours for 5 percent of the time) for longer periods than any other wind direction. Winds from the north, which predominate during the daytime, last two hours for approximately seven percent of the time.

Figure D.1-6 illustrates frequency distributions of wind speed persistence at the Fellows meteorological station. The small graphs at the top of the page indicate the persistence of wind speeds from 0 to 8 m/s. The graphs indicate that wind speeds of 1 to 3 m/s are the most common and persist for the longest periods (up to 13 hours for 5 percent of the time). In contrast, winds from 0 to 1 m/s occur more rarely, but can last over 20 hours.

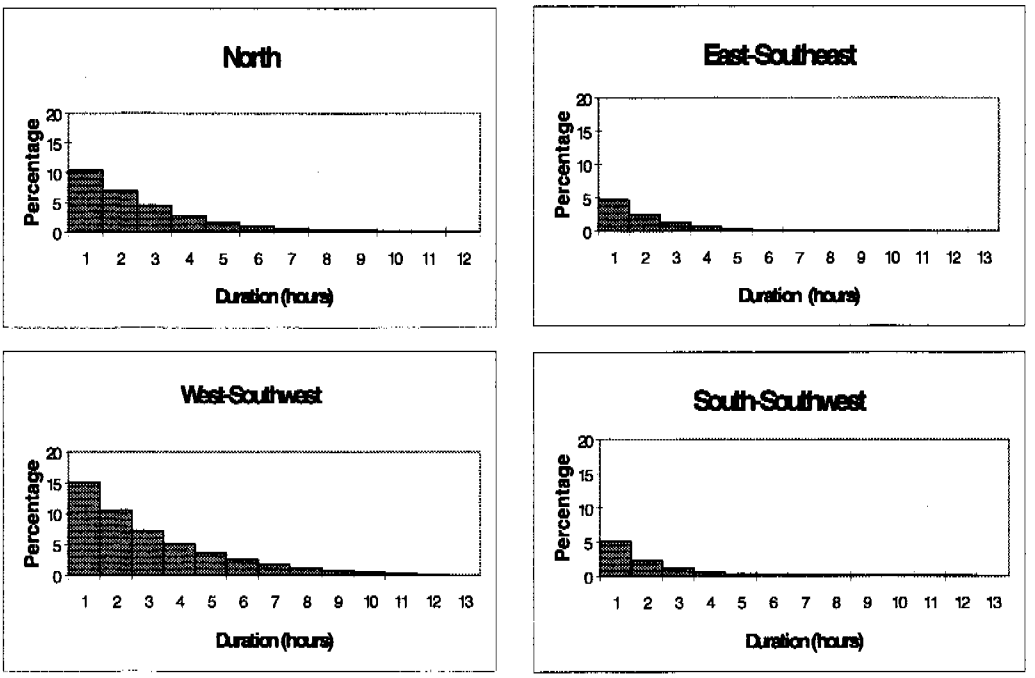
Joint Frequency Distribution. One statistical measure of atmospheric trends at the meteorological measurement site is a joint frequency distribution. A three-way joint frequency distribution shows the relationships between wind direction, wind speed and stability class at a site. This information can be presented graphically via windroses for each stability class. Figure D.1-7 shows the results of the joint frequency distribution for the Fellows Site. Nighttime conditions (winds from the west-southwest) occur with low wind speeds (0 to 1 m/s) and stable conditions (Stability Class E, F and G). Daytime conditions (winds from the north) are common with higher wind speeds (1 to 3 m/s and 3 to 5 m/s) and unstable conditions (Stability Class A, B and C).

D.1.3. Mixing Height

One measure of the dispersion potential of an area is the size of the mixing depth or height. When the atmosphere is unstable, pollutants in the air can mix vertically. However, during inversion conditions, vertical mixing is limited from the ground surface to the base of the inversion. The layer of air where relatively vigorous vertical mixing occurs is defined as the mixing depth. The inversion prevents mixing and prevents pollutants from dispersing into the air above the inversion or mixing height. Consequently, the inversion acts like a lid, resulting in higher ground level emission concentrations. On sunny days, as the ground warms, the height of the mixing layer typically increases as the inversion is slowly eroded away by rising thermals. At night, as winds die down and temperatures decrease, the atmosphere becomes more stable and the height of the mixing layer decreases.

Figure D.1-8 shows the seasonal variation in mixing height values as measured at the Meadows Field site near Bakersfield. Meadows Field is the closest meteorological station where upper air temperature soundings are measured and is considered representative of mixing height values in the southern San Joaquin Valley. These values are thus appropriate for use in air quality modeling for the NPR facility.

Figure D.1-5
Frequency Distribution of Wind Direction Persistence at Fellows Site



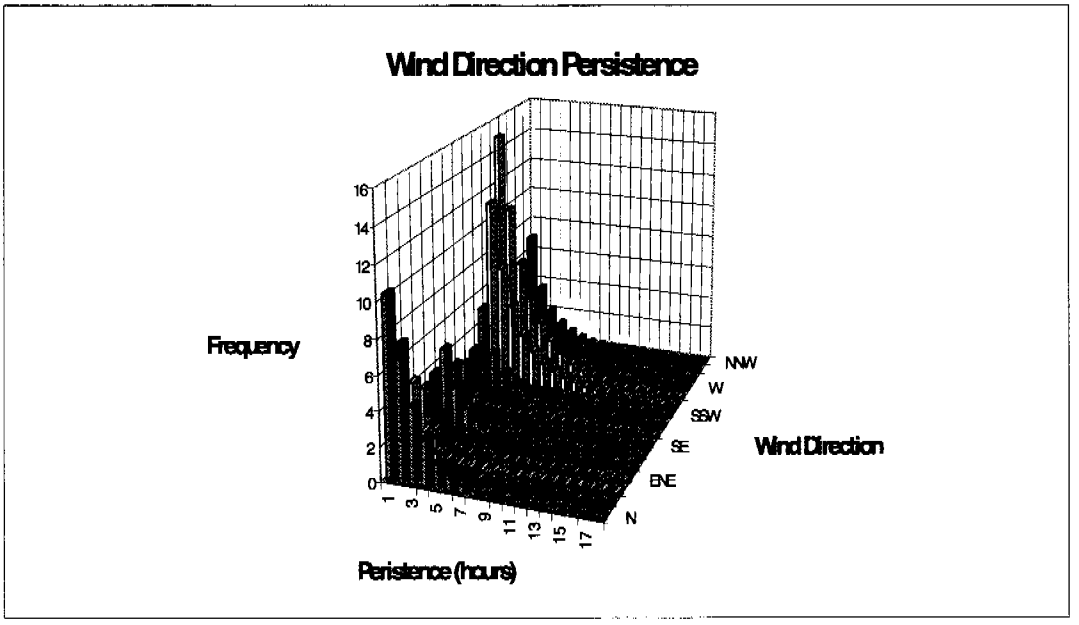


Figure D.1-6
Frequency Distribution of Wind Speed Persistence at Fellows Site

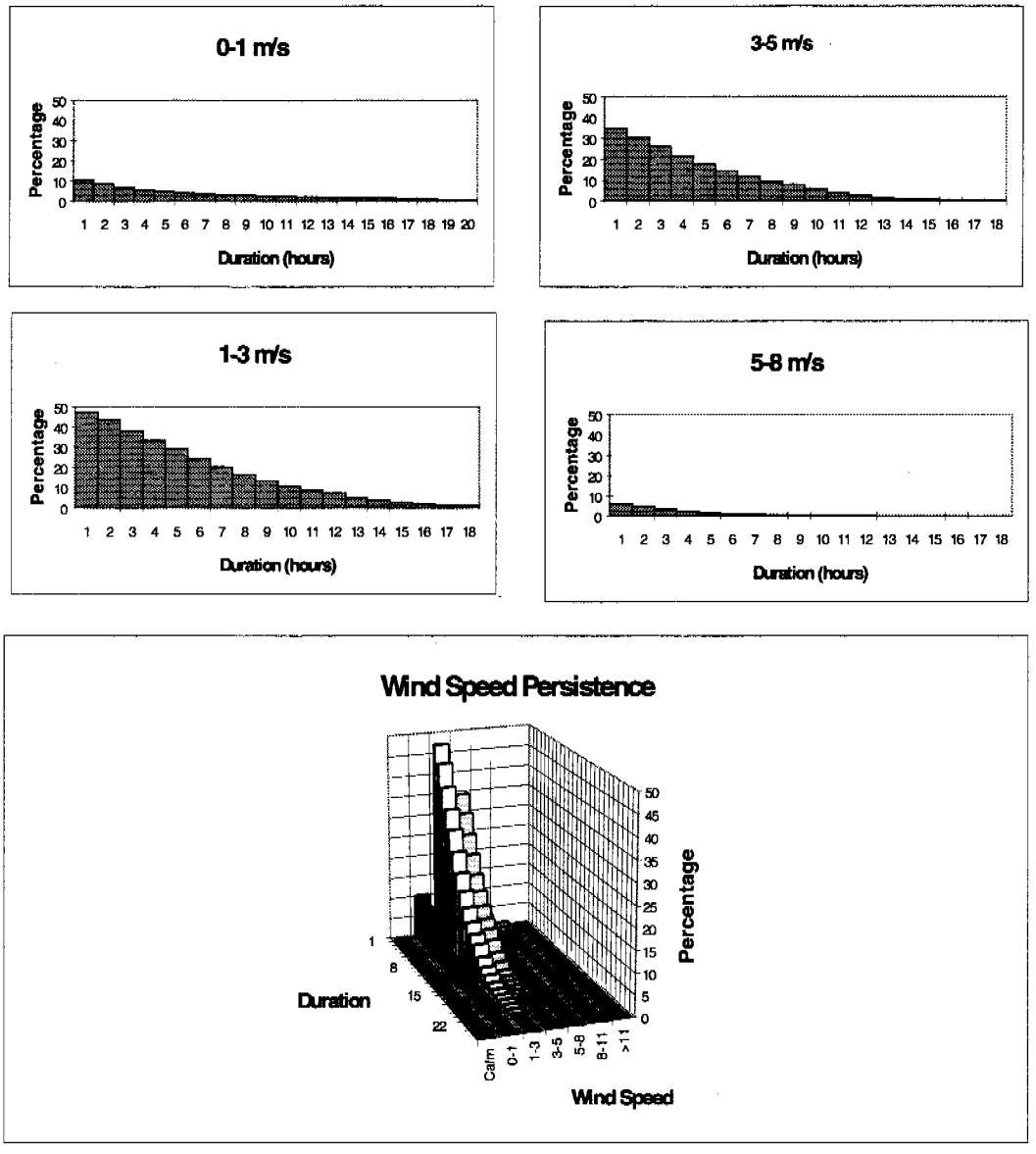


Figure D.1-7
Wind Roses for the Fellows Site

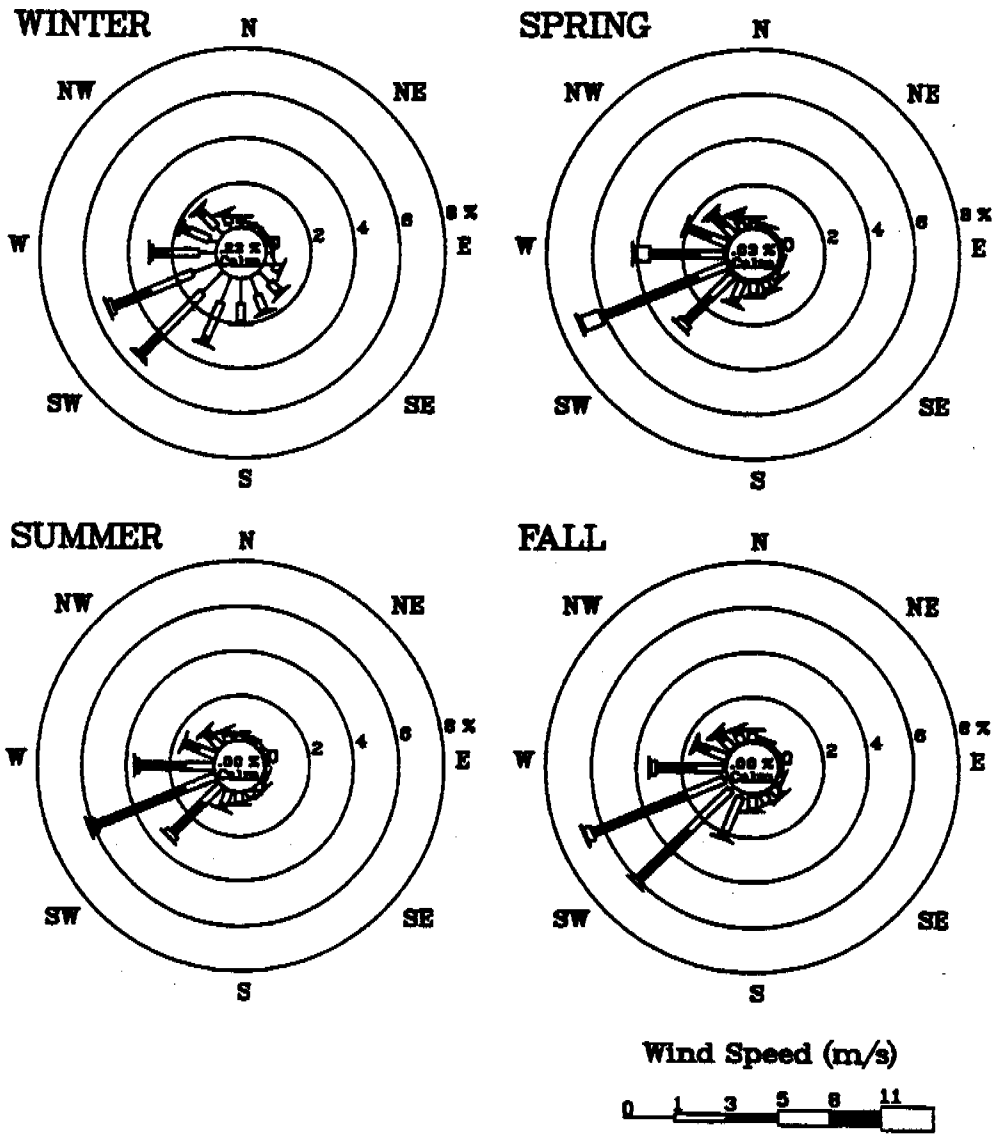
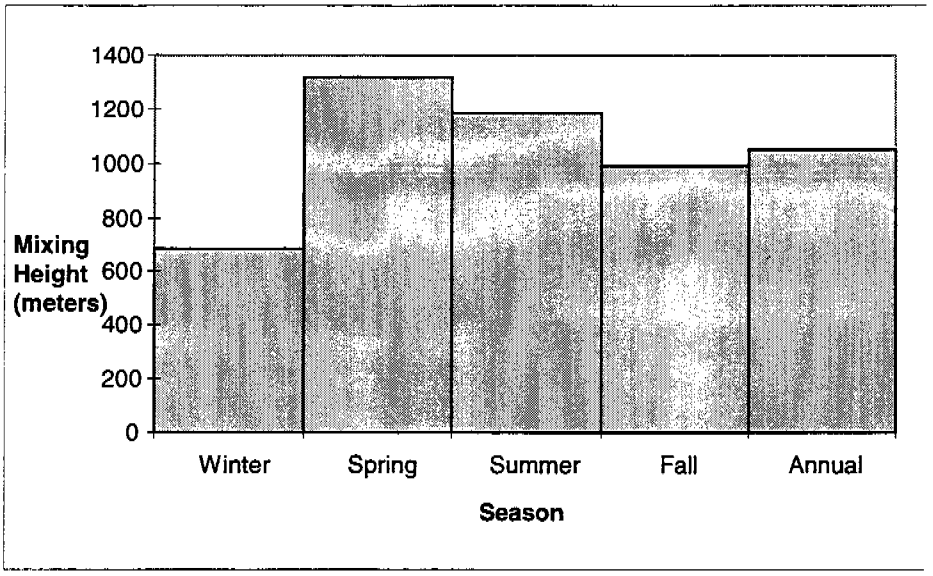


Figure D.1-8
Variation in Seasonal Mixing Height Values



D.2. AIR QUALITY STANDARDS AND REGIONAL AIR QUALITY REGULATIONS

This section discusses the Federal, state and local air quality regulations that affect these facilities. The state and Federal ambient air quality standards presented provide a basis for determining the impacts of the emissions from these facilities on the surrounding air quality. Data showing the trends in the air quality of the area are also described for various air pollutants. This section also discusses the air quality regulations that are applicable to these facilities such as permitting requirements and specific emission limiting conditions.

D.2.1. Air Quality Standards

The EPA and the California Air Resource Board (CARB) have set national and state ambient air quality standards (AAQS) for pollutants determined to be injurious to public health or welfare. Ambient air quality standards were first set in California with the implementation of the Mulford-Carrel Act in 1969. Shortly thereafter, Federal AAQS were established with the passage of the 1970 Clean Air Act. Both primary and secondary national ambient air standards exist. The primary standards were established to protect the public health with an adequate margin of safety, while the secondary standards were intended to protect the public welfare from any known or anticipated adverse effect of a pollutant. Years of research on the health effects of various concentrations of pollutants on biological organisms have helped determine these threshold levels.

State and Federal standards have been established for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter 10 microns or less in diameter and lead. California's standards are more stringent than the Federal standards. In addition, California has standards for four other pollutants: sulfates, hydrogen sulfide, vinyl chloride and visibility-reducing particles. The state and Federal AAQS for these pollutants are shown in Table D.2-1. The impacts of these air pollutants on humans are well documented in the literature and are discussed briefly here.

Ozone (O_3). Unlike most regulated pollutants, O_3 is not directly emitted into the atmosphere but is formed by the reaction of oxides of nitrogen and reactive organic gases in the presence of sunlight. Several studies have shown that ozone damages the individual air sacs in the lungs. Bronchitis, asthma and other respiratory ailments as well as cardiovascular disease are aggravated by exposure to ozone. Individuals with less developed or damaged respiratory systems, such as infants or the elderly, are particularly vulnerable to the adverse effects of ozone. Research has shown that ozone also damages vegetation.

Oxides of nitrogen (NOx and NO_2). NO_x has damaging effects alone or in combination with other compounds. By itself, NO_2 has been linked to irritation of the respiratory tract and impaired breathing ability. NO_x may also lower the body's resistance to such diseases as pneumonia and influenza. In combination with other compounds, NO_x is know to contribute to the formation of ozone and acid rain.

Sulfur Dioxide (SO_2). SO_2 is a colorless, irritating gas formed primarily by the combustion of sulfur-containing fossil fuels. SO_2 causes harm to both the upper respiratory system and the lungs. Prolonged exposure to SO_2 may result in sore throat, coughing and respiratory tract infections. SO_2 has also been show to cause adverse effects on plant growth.

Carbon Monoxide (CO). CO, a byproduct of incomplete combustion of fossil fuels, is a colorless and odorless toxic gas. CO deprives vital organs of oxygen by entering the bloodstream and attaching to hemoglobin. Other effects of CO range from fatigue and nausea to impairment of the central nervous

system and changes in heart function. The severity of the health disorder caused by CO exposure depends largely on the concentrations and length of exposure experienced.

Particulate Matter (PM_{10}). PM_{10}, suspended particulate matter 10 microns in diameter or less, is primarily composed of dusts, aerosols, fumes and mists. Because of its ability to bypass the human body's natural filtering mechanisms, PM_{10} has the potential to cause irritation and damage to the respiratory tracts of humans. In particular, these particles can damage the alveoli, the tiny air sacs responsible for gas exchange in the lungs. Other effects include irritation of the eyes, throat and nose. (Note: USEPA proposed a standard for $PM_{2.5}$ in 1996 that is expected to be finalized in June 1997. Because $PM_{2.5}$ is not currently a regulated pollutant, it was not analyzed in detail for this analysis.)

Toxics. Toxic air pollutants, also referred to as hazardous air pollutants (HAPs), are highly injurious to health, even in small quantities. These substances are know to cause cancer, birth defects and other adverse health effects. Both Federal and state legislation have provided for the designation of hazardous air pollutants with accompanying emissions limits. Table D.2-2 lists the toxic air contaminants identified by CARB. EPA has designated 188 HAPs.

D.2.2. Attainment Plans

The 1970 Federal Clean Air Act (CAA) established a joint state and Federal program to control air pollution. The main enforceable measure of the program was the requirement that states with measured pollutant concentrations above the ambient air quality standards must submit State Implementation Plans (SIPs) which include strategies that would lead to attainment of the national AAQS (NAAQS). As shown in Table D.2-3, Kern County is attainment for all pollutants except ozone and PM_{10}. The only exception is the city of Bakersfield, which is classified as a "transitional nonattainment" area at the state level and "not classified" at the Federal level for CO.

When originally drafted, the Federal Clean Air Act required the attainment of the NAAQS no later than July 1, 1977. Because most areas of the nation failed to come into attainment within this period, the CAA Amendments of 1977 were passed, setting rigorous additional requirements for the nonattainment areas to ensure timely attainment of the NAAQS. These included a new attainment deadline of 1982, with a possible extension to the end of 1987 for O_3 and CO. To meet these requirements, the Kern County Air Pollution Control District (KCAPCD) adopted an attainment plan in 1979 and a more stringent, revised plan in 1982. Implementation of these plans resulted in reduction of air pollutant concentrations, with the exception of O_3 and PM_{10}. To attain the NAAQS for O_3 and CO, the KCAPCD plan was revised again in 1986, and later updated in 1987. However, the plan was not approved by EPA, and the O_3 standard was not met.

The CAA Amendments of 1990 completely revised the nonattainment provisions for areas which had not attained the NAAQS for ozone. Under the new provisions, ozone nonattainment areas are classified according to the severity of the nonattainment problem. Since Kern County is designated as a serious nonattainment area according to the Federal standard, the area must meet the ozone standards by 1999. The Amendments also required that ozone nonattainment areas submit a plan to show reasonable further progress toward attainment by November 15, 1994. As a result, on November 14, 1994, the Board of the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) adopted the Ozone Attainment Demonstration Plan for the San Joaquin Valley. On November 15, 1994, CARB modified the plan and adopted it as the local element of the 1994 California Ozone SIP, which CARB then submitted to EPA to comply with the Reasonable Further Progress (RFP) and attainment demonstration requirements of the Act.

Table D.2-1
Federal and State Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	Federal Standards	
			Primary	Secondary
Ozone	1 hour	0.09 ppm (180μg/m^3)	0.12 ppm (235μg/m^3)	0.12 ppm (235μg/m^3)
Carbon Monoxide	1 hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	--
	8 hours	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	--
Nitrogen Dioxide	1 hour	0.25 ppm (470 μg/m^3)	--	--
	Annual	--	0.053 ppm (100μg/m^3)	0.053 ppm (100μg/m^3)
Sulfur Dioxide	1 hour	0.25 ppm		
	3 hours	--	--	0.5 ppm (1300μg/m^3)
	24 hours	0.04 ppm (105 μg/m^3)	0.14 ppm (365μg/m^3)	--
	Annual	--	0.03 ppm (80μg/m^3)	--
Particulate Matter (PM_{10})	24 hours	50 μg/m^3	150μg/m^3	150μg/m^3
	Annual	30 μg/m^3	50μg/m^3	50μg/m^3
Lead	30 days	1.5 μg/m^3	--	--
	Calendar quarter	--	1.5μg/m^3	1.5μg/m^3
Sulfates	24 hours	25μg/m^3	--	--
Hydrogen Sulfide	1 hour	0.03 ppm (42μg/m^3)	--	--
Vinyl Chloride (Chloroethene)	24 hours	0.010 ppm (26μg/m^3)	--	--
Visibility-reducing Particles	8 hours	In sufficient amount to produce extinction of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent	--	--

Table D.2-2
Toxic Air Contaminants Identified by CARB

Asbestos	Chromium (VI)
Benzene	Ethylene bromide
Cadmium	Ethylene dichloride
Chlorinated dioxins and dibenzofurans (15 species)	Carbon tetrachloride
	Ethylene oxide

Table D.2-3
Kern County Attainment Status

Pollutant	Attainment Status	
	State Standard	Federal Standard
Ozone	Severe Nonattainment	Serious Nonattainment
Carbon Monoxide	Attainment	Attainment (except Bakersfield)
Sulfur Dioxide	Attainment	Attainment
Nitrogen Dioxide	Attainment	Attainment
Particulate Matter PM_{10}	Nonattainment	Serious Nonattainment
Lead	Attainment	Attainment
Sulfates	Unclassified	--
Hydrogen Sulfide	Unclassified	--
Vinyl Chloride	Unclassified	--

The SJVUAPCD has recently put together an air quality plan for reaching attainment of PM_{10} air quality standards in the air basin (SJVUAPCD 1997). This plan indicates that the Federal annual standard would be attained in the air basin in the years 2001 and 2006. Decreases in particulate emissions at NPR-1 should help meet the annual standard. The plan does not show attainment of the 24-hour standard by December 31, 2001. Thus the SJVUAPCD has committed to pursue and implement additional control strategies.

When a state submits a SIP to EPA, the Clean Air Act requires the Agency to review the plan to determine if it meets the Act's requirements and environmental goals. California's 1994 Ozone SIP included (for both the State and local agencies) a combination of fully adopted regulations and control measures for which regulations must be written. Since submittal, EPA has approved all but one of the State's fully adopted regulations and most of the State's commitments to adopt regulations in the future. The State submitted its enhanced motor vehicle inspection and maintenance (I/M) regulations on January 22, 1996. EPA is proposing approval of the I/M regulations, which should help to assure the maximum benefits from the California motor vehicle emissions standards.

The 1987 revision to the Kern County SIP contained an important provision that is directly relevant to operation of NPR-1. That provision required a more effective NO_x control strategy for western Kern County (Kern County west of Highway 5) if existing precursor control measures were not sufficient to prevent more than three violations of the Federal O_3 standard during the 3-year period from 1988 to 1990. The provision, referred to as KCAPCD Rule 427, mandated more NO_x controls for

existing internal combustion engines with rating greater than 50 hp. The Federal standards were exceeded in October 1988. The subsequent application of Rule 427 to western Kern County and the requirement of additional NO_X emission reduction from existing internal combustion engines became effective in April 1989 (DOE 1993).

D.2.3. Trends in Ambient Air Quality

This section discusses air quality trends in the San Joaquin Valley Air Basin and provides a historical perspective of ozone violations in Kern County. Many factors influence the air quality in an area like Kern County, including the amount of pollutants emitted into the air, the regional topography, meteorological factors (wind patterns, temperature, rainfall) and the amount of pollutant dispersion from other areas. Consequently, for a given year it may be difficult to determine whether a reduction in area-wide pollution levels is due to implemented control measures or favorable meteorological conditions. Examining historical data for a pollutant, however, can help factor out unrepresentative years and allow general trends to be identified.

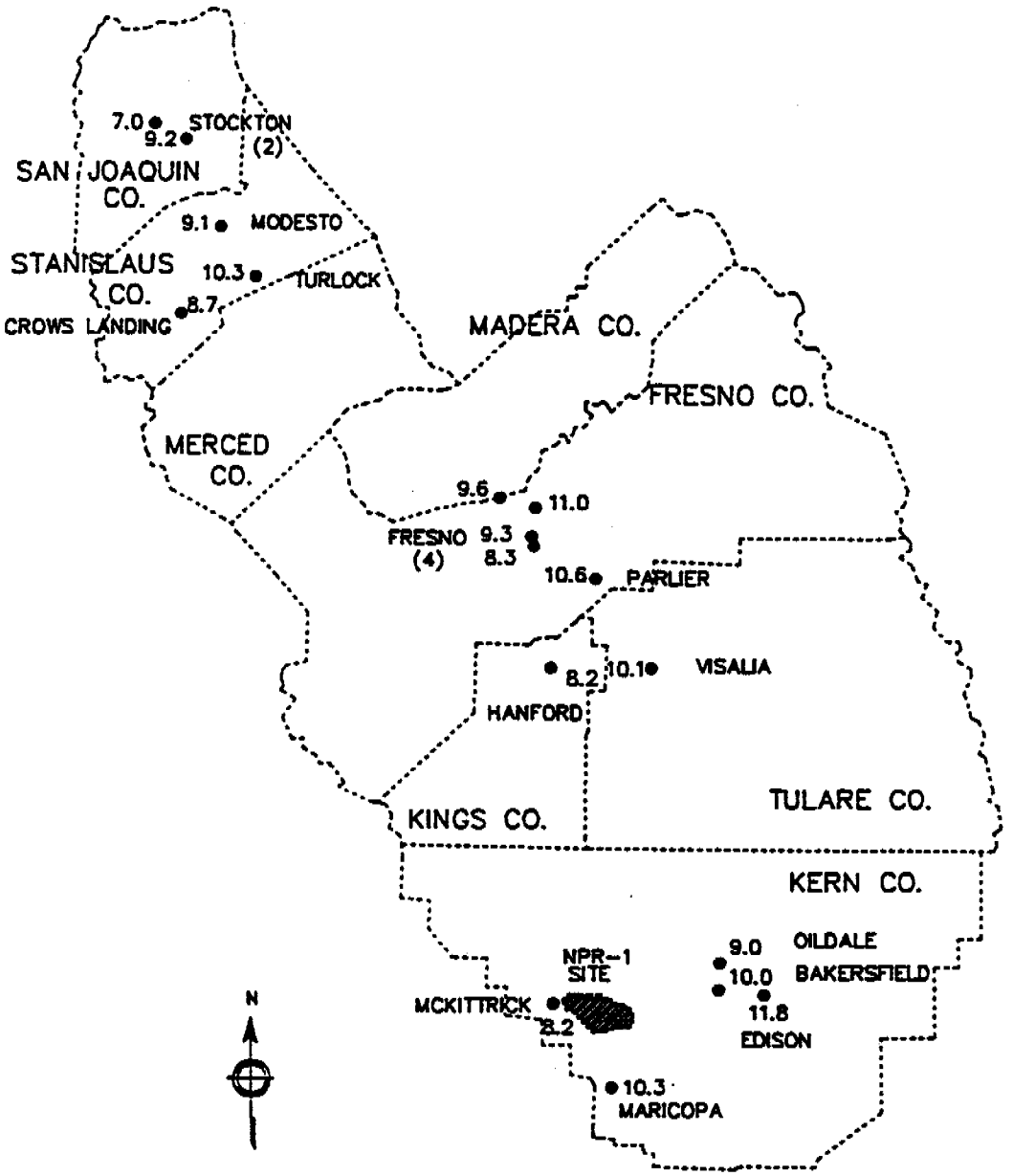
The air quality dynamics of the entire San Joaquin Valley Air Basin (SJVAB) must be examined to gain an understanding of air quality within Kern County. Geographically, the San Joaquin Valley is relatively flat and is bounded by mountain ranges on the east and west. As discussed earlier, the wind predominantly blows from north to south, carrying emissions to the southern region of the basin. Kern County is the southernmost county within the basin. Consequently, emissions from some of the larger cities in the basin, including Stockton and Fresno, are dispersed into Kern County. Because of this transport, ozone exposures in the SJVAB increase from north to south (CARB 1992).

Ambient air quality in Kern County is measured by a network of air monitoring stations operated by the CARB, local air pollution control districts, the U.S. Park Service and private firms. Prior to 1989, ambient air quality data were monitored at three stations: Bakersfield (Chester), Edison (Johnson Ranch) and Oildale. Since then, one site in monitoring network has closed (Bakersfield - Chester) and six others have been added (Arvin, Bakersfield - Golden Gate Hwy, Bakersfield - California Ave, Maricopa, Shafter and Taft). Locations of the monitoring stations are shown in Figure D.2-1. Air quality parameters measured at these monitoring stations are listed in Table D.2-4. The data presented here are from the CARB's annual "California Air Quality Data" reports from the last 15 years (1981 to 1995).

Table D.2-4
Air Quality Parameters Measured at Monitoring Stations in Kern County (1995)

	Air Pollutants Monitored													
Station	**O_3**	**CO**	**NO_2**	**SO_2**	**H_2S**	**THC**	**CH_4**	**TSP**	**Pb**	**SO_4**	**NO_3**	**PM_{10}**	**COH**	**Neph**
Arvin	x		x											
Bakersfield - Golden State Hwy	x	x	x			x	x					x		
Bakersfield - California Ave	x	x	x	x		x	x			x		x	x	x
Edison - Johnson Ranch	x		x											
Maricopa	x													
Oildale	x		x	x		x	x			x		x	x	x
Shafter	x		x											x
Taft College										x		x		

Figure D.2-1
Location of Monitoring Stations



D.2.3.1. Ozone

Ozone concentrations in the SJVAB have fluctuated over the last 15 years, but have not significantly improved since the early 1980's (CARB 1992). Table D.2-5 lists the number of state and Federal ozone violations in Kern County since 1981 at monitoring stations for which data were available. An analysis of the data shows that the annual ozone violations within Kern County have also fluctuated over the 15 year period. Figure D.2-2 shows the number of annual violations of the state standard since 1981 for the three monitoring stations for which data are available (Bakersfield, Edison and Oildale). A general increase in the number of violations occurred from the mid 1980s until 1988, when the number of violations peaked at most of the monitoring stations. The number of violations began decreasing in 1990/1991 and since then has remained at around the 15-year average. A comparison of the readings from the different monitoring stations shows how ozone concentrations vary across the county.

Table D.2-6 presents 1995 ozone violations. The ozone season within Kern County lasts from April through October with most violations of the state and Federal standards occurring from June through September. This pattern reflects both the increase in temperatures during the middle of the summer and the increase in emissions (especially from mobile sources) during the summer travel season. The highest number of violations were monitored at the Edison and Arvin monitoring sites, with 103 and 87 violations of the state standard, respectively. Table D.2-7 presents the highest 1-hour and annual mean concentrations measured at each of the monitoring stations. The highest 1-hour concentrations of 0.17 and 0.15 ppm were recorded at the Edison and Arvin monitoring stations, respectively. These values are almost double the California standard for ozone. The highest annual daily maximum hour concentrations of 0.074 and 0.069 ppm were also recorded at the Edison and Arvin monitoring stations.

Figure D.2-2
Violations of the State Ozone Standard in Kern County Since 1980

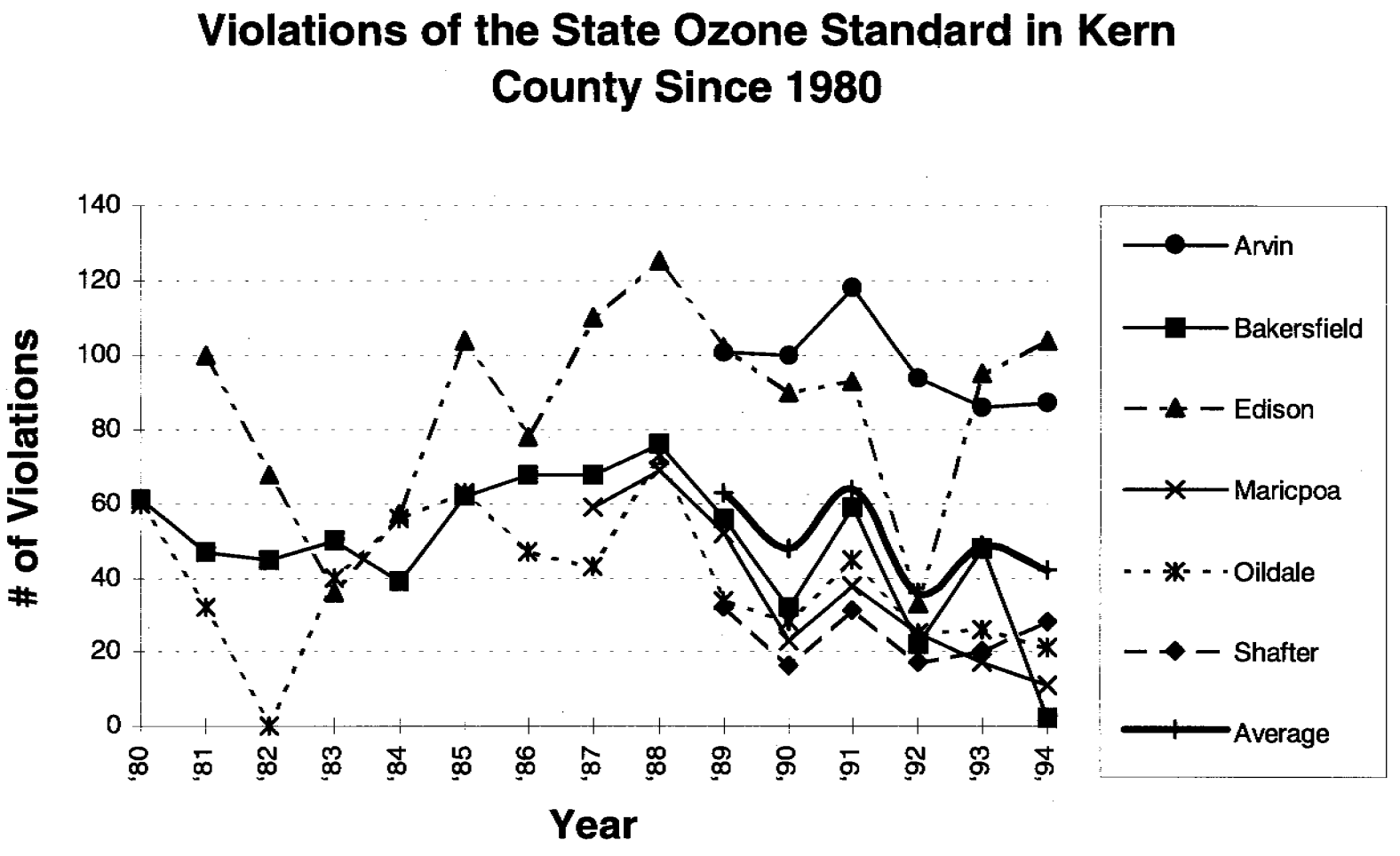


Table D.2-5
Annual Number of Ozone Violations in Kern County Since 1981

	Number of Days with 1-hour Concentrations Higher than Ambient Standards For Years 1981 to 1995														
Monitoring Station	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**
California Standard (0.09 ppm)															
Arvin	-	-	-	-	-	-	-	-	101	100	118	94	86	87	87
Bakersfield - Chester	47	45	50	39	62	68	68	76	56	32	59	22	48	-	-
Edison - Johnson Ranch	100	68	36	57	104	78	110	125	102	90	93	33	95	104	103
Maricopa	-	-	-	-	-	-	59	69	52	23	38	25	17	11	57
Oildale	32	-	40	56	63	47	43	73	34	28	45	25	26	21	33
Shafter	-	-	-	-	-	-	-	-	32	16	31	17	20	28	24
Federal Standard (0.12 ppm)															
Arvin	-	-	-	-	-	-	-	-	25	23	28	9	13	17	19
Bakersfield - Chester	7	7	7	2	5	7	10	5	4	-	3	1	7	-	-
Edison - Johnson Ranch	50	19	17	23	24	28	43	54	27	22	22	3	28	31	34
Maricopa	-	-	-	-	-	-	9	6	3	-	-	-	-	-	1
Oildale	-	-	3	4	3	3	1	5	1	1	1	-	-	-	1
Shafter	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table D.2-6
Violations of the State and Federal Ozone Standards by Month for 1995

	Number of Days with 1-hour Concentrations Higher than Ambient Standards (1995)												
Monitoring Station	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Year**
Arvin	0	0	0	0	5	13	17	25	15	11	1	0	87
Bakersfield - Golden State	0	0	0	0	0	1	5	12	8	1	0	0	27
Bakersfield - California Ave	0	0	0	0	1	7	9	20	12	10	0	0	59
Edison - Johnson Ranch	0	0	0	2	6	14	22	27	18	14	0	0	103
Maricopa	0	0	0	0	0	7	10	15	12	12	1	0	57
Oildale	0	0	0	0	0	3	7	9	8	6	0	0	33
Shafter	0	0	0	0	0	5	7	3	6	3	0	0	24
Federal Standard (0.12 ppm)													
Arvin	0	0	0	0	0	4	5	7	3	0	0	0	19
Bakersfield - Golden State	0	0	0	0	0	0	0	1	0	0	0	0	1
Bakersfield - California Ave	0	0	0	0	0	0	1	0	0	0	0	0	2
Edison - Johnson Ranch	0	0	0	0	0	1	8	16	9	0	0	0	34
Maricopa	0	0	0	0	0	0	0	0	1	0	0	0	1
Oildale	0	0	0	0	0	0	0	0	1	0	0	0	1
Shafter	-	-	-	-	-	-	-	-	-	-	-	-	-

Table D.2-7
1995 Annual Ozone Data in Kern County

Monitoring Station	Ozone Concentration (ppm)				# Days with concs. exceeding Calif. 1-hour standard (> .09 ppm)	Total Number of Observations
	1-hour Mean		Annual Mean			
	1st Highest	2nd Highest	All Hours	Dly Max Hr.		
Arvin	.15	.14	.043	.069	87	8190
Bakersfield - Golden State Hwy	.13	.12	.025	.057	27	8146
Bakersfield - California Ave	.13	.13	.029	.064	59	8220
Edison - Johnson Ranch	.17	.17	.044	.074	103	8234
Maricopa	.13	.12	.049	.066	57	7916
Oildale	.13	.12	.033	.058	33	8238
Shafter	.11	.11	.027	.058	24	8203

D.2.3.2. Particulate Matter (PM_{10})

For PM_{10}, Kern County is designated nonattainment. PM_{10} emissions result from fuel combustion, through the abrasion of materials such as tires and brake linings, and through wind erosion of the soil and unpaved roads. Small particles are also formed in the atmosphere through chemical reactions. Table D.2-8 shows the annual summary statistics for 24-hour PM_{10} concentrations measured in Kern County in 1995. The table includes the levels of 24-hour concentrations (the highest, second highest and the lowest), annual mean concentrations (geometric and arithmetic) and the number of 24-hour samples that exceeded the California and national standards.

Of the four monitoring stations in Kern County where samplers were in operation throughout the year, only the Bakersfield Golden State Highway site measured an exceedance of the annual NAAQS for PM_{10} (60 $\mu g/m^3$ as an arithmetic mean) in 1995. All four stations with PM_{10} monitoring, however, exceeded the California standard (50 $\mu g/m^3$) while the Federal 24-hour standard (150 $\mu g/m^3$) was exceeded at only one station (Oildale). These data show that PM_{10} emissions continue to be a major air pollution problem in the county (DOE 1993).

Table D.2-8
1995 Annual PM_{10} Data in Kern County

Monitoring Station	24-hour PM_{10} Concentration ($\mu g/m^3$)					Number of 24-hour Samples		
	First Highest	Second Highest	Lowest	Annual Mean				
				Geometric	Arithmetic	> 50 $\mu g/m^3$	> 150 $\mu g/m^3$	Total
Arvin	-	-	-	-	-	-	-	-
Bakersfield - Golden State Hwy	132	131	8	48.9	58.0	31	0	61
Bakersfield - California Ave	130	126	10	41.8	49.7	36	0	88
Edison - Johnson Ranch	-	-	-	-	-	-	-	-
Maricopa	-	-	-	-	-	-	-	-
Oildale	195	111	8	37.8	46.6	22	1	68
Shafter	-	-	-	-	-			-
Taft College	93	84	4	31.7	38.5	15	0	61

D.2.3.3. Carbon Monoxide

Table D.2-9 shows the highest and the second highest values of 1-hour concentrations and 8-hour moving average concentrations of carbon monoxide measured in Kern County in 1995. No violations of either the California standard (9.0 ppm) or the more lenient Federal standard (9.5 ppm) were measured. The highest 1-hour and 8-hour concentrations, 8 ppm and 6.4 ppm respectively, were recorded at Bakersfield (California Avenue Station). With the exception of the City of Bakersfield, the rest of Kern County has maintained its status as an attainment area for CO for more than 10 years (DOE 1993). The 1995 data show a continuation of this trend.

Table D.2-9
1995 Annual CO Data in Kern County

Monitoring Station	CO Concentration (ppm)				# Days with concs. exceeding Calif. 8-hour standard (> 9.1 ppm)	Total Number of Observations
	1-Hour Mean		8-Hour Mean			
	1st Highest	2nd Highest	1st Highest	2nd Highest		
Arvin	-	-	-	-	-	-
Bakersfield - Golden State Hwy	7	7	4.6	3.8	0	8641
Bakersfield - California Ave	8	7	6.4	4.9	0	8479
Edison - Johnson Ranch	-	-	-	-	-	-
Maricopa	-	-	-	-	-	-
Oildale	-	-	-	-	-	-
Shafter	-	-	-	-	-	-

D.2.3.4. Nitrogen Dioxide

Table D.2-10 lists the highest and second highest ambient 1-hour and annual mean NO_2 concentrations measured in 1995 in Kern County. No violations of California (0.25 ppm 1-hour) or Federal (0.05 ppm annual) NO_2 ambient air quality standards were measured. The maximum annual (mean) NO_2 concentration observed in 1995 was 0.052 ppm, measured at the Bakersfield Golden State Highway monitoring site. The highest 1-hour mean value was 0.11 ppm, measured at both the Bakersfield Golden State Highway and California Avenue monitoring stations. Kern County has maintained its status as an attainment area for NO_x for more than 15 years (DOE 1993). The 1995 data show a continuation of this trend.

Table D.2-10
1995 Annual NO_2 Data in Kern County

Monitoring Station	NO_2 Concentration (ppm)				# Days with concs. exceeding Calif. 1-hour standard (> 0.25 ppm)	Total Number of Observations
	1-Hour Mean		Annual Mean			
	1st Highest	2nd Highest	1st Highest	2nd Highest		
Arvin	.5	.5	.008	.017	0	8254
Bakersfield - Golden State Hwy	.11	.10	.029	.052	0	8253
Bakersfield - California Ave	.11	.11	.022	.046	0	8184
Edison - Johnson Ranch	.06	.06	.012	.029	0	8094
Maricopa	-	-	-	-	-	-
Oildale	.08	.08	.017	.032	0	8272
Shafter	.08	.08	.018	.036	0	8346

D.2.3.5. Sulfur Dioxide

Table D.2-11 presents the highest and second highest 1-hour and 24-hour mean SO_2 concentrations measured in 1995 in Kern County and the number of days with concentrations exceeding the California 24-hour standard (0.05 ppm). No violations of the California standard or the more lenient Federal standard (0.14 ppm 24-hour mean) were measured. The highest 1-hour mean concentration of 0.03 ppm was measured at the Oildale monitoring site. The highest 24-hour mean concentration was 0.017 ppm, measured at the Bakersfield-California site.

Table D.2-11
1995 Annual SO_2 Data in Kern County

Monitoring Station	SO_2 Concentration (ppm)				# Days with concs. exceeding Calif. 24-hour standard (> 0.05 ppm)	Total Number of Observations
	1-Hour Mean		24-Hour Mean			
	1st Highest	2nd Highest	1st Highest	2nd Highest		
Arvin	-	-	-	-	-	-
Bakersfield - Golden State Hwy	-	-	-	-	-	-
Bakersfield - California Ave	.03	.03	.017	.013	0	8077
Edison - Johnson Ranch	-	-	-	-	-	-
Maricopa						
Oildale	.02	.02	.01	.01	0	8013
Shafter	-	-	-	-	-	-

* Data presented are valid but incomplete in that an insufficient number of valid data points were collected to meet EPA and/or ARB criteria for representativeness.

D.2.3.6. Lead

The Federal ambient air quality standard for lead was violated in Kern County until the early 1980's. Lead concentrations since then have steadily decreased to the present low levels. The most recent year for which lead measurements in Kern County are available is 1989. At that time, the Bakersfield (Chester) monitoring station recorded quarterly lead concentrations of 0.06, 0.05, 0.05 and 0.06 $\mu g/m^3$, respectively. These values are well below the Federal standard of 1.5 $\mu g/m^3$. Despite the fact that more recent data are not available, it is suspected that lead values in the basin continue to be an order of magnitude below the ambient standards.

D.2.3.7. Sulfates/Nitrates

No national ambient air quality standards exist for suspended sulfates (SO_4) associated with PM_{10}. California, however, has a 24-hour state standard (25 ug/m^3). The highest sulfate concentration measured in Kern County in 1995, 7.6 $\mu g/m^3$, is well below this standard. The California sulfate standard was exceeded in Kern County until 1985 (DOE 1993). Sulfate concentrations since then, however, have steadily decreased and have remained below the state standard.

Unlike SO_4, ambient air quality standards have not been established for nitrate (NO_3) anions associated with either TSP or PM_{10}. However, NO_3 has been identified as an important secondary PM_{10} constituent. The 1995 annual statistics for ambient PM_{10} nitrate concentrations show that the highest monitored concentration in Kern County was the 43 $\mu g/m^3$ recorded at the Bakersfield California Avenue station. The annual geometric mean at this station, 3.29 $\mu g/m^3$, is about 10 percent of the California AAQS for PM_{10}.

D.2.3.8. Toxic Air Contaminants

Ambient concentrations of toxic air contaminants are not routinely measured at the air monitoring stations operated by state or local agencies. However, ambient concentrations of a number of toxics and other organic compounds were measured at several solid-waste disposal sites on NPR-1 in 1987. These measurements were discussed in the 1987 EIS for NPR-1 (DOE 1993). While detectable

amounts of benzene and carbon tetrachloride were found at all four of the monitoring sites, the concentrations of these toxic were found to be much lower than the time-weighted average threshold values specified for these compounds.

D.2.3.9. Visibility

The 1987 EIS for NPR-1 provides a detailed discussion of visibility in southern San Joaquin Valley, including a discussion of the historical trends in visibility as recorded by the NWS stations in the valley (DOE 1993). Conditions of low visibility are relatively common in the air basin throughout the year. Haze, smog, particulate matter and the accumulation of aerosols combine to obscure views within the valley during the summer. During the winter, dense fog on the valley floor is the main cause of reduced visibility. The NWS station where visibility is routinely measured is at Meadows Field near Bakersfield, about 20 miles east of NPR-1. Monitoring data collected at this station show that visibility is lowest during the winter (where visibility is considered "low" 20 to 30 percent of the time) and highest in the summer (low visibility occurs 1 to 5 percent of the time). Low visibility is defined as conditions where the prevailing visibility is less than 6 miles when the relative humidity is less than 70 percent.

The contributing factors to low visibility in the area (such as high concentrations of particulate and aerosols in the air) remain a serious problem to this day, as discussed above in the Particulate Matter and Sulfite/Nitrate sections. Hence, it is expected that visibility conditions, which have not changed much historically, would remain similar to how they are reported in the 1987 EIS.

D.2.4. Existing Air Permits

Permits to Operate. A total of 504 Permits to Operate (PTO) have been issued to NPR-1 for air pollution emission sources (DOE 1997). These permits were issued to NPR-1 based on SJVUAPCD Rule 2010 (Permits Required). Rule 2010 requires "any person constructing altering, replacing, or operating any source which emits, may emit, or may reduce emissions to obtain an Authority to Construct or a Permit to Operate".

Authorities to Construct. The issuance of Authorities to Construct (ATC) by the SJVUAPCD is also governed by Rule 2010. Although ATCs are valid for two years, NPR-1 does not typically hold ATCs for extended periods of time. Upon installation of equipment covered by the ATC, a start-up inspection is conducted by District inspectors and a PTO is issued. No ATC permits are anticipated to be pending at the time of the sale (DOE 1997).

Prevention of Significant Deterioration Permits. For pollutants for which the area is considered to be in attainment or not classified, the U.S. EPA implements the Prevention of Significant Deterioration program. NPR-1 currently holds one PSD permit (NSR 4-4-8/SJ 77-42) which was originally issued by U.S. EPA on February 22, 1992. This permit covers 34 IC engines and limits NO_x emissions. On April 7, 1989, this permit was modified to address the retrofitting of the original 34 engines with pre-combustion chamber or pre-stratified charge NO_x control technologies.

Emission Reduction Credits. The SJVUAPCD administers the storage or transfer of emission reduction credits (ERC) under Rule 2301 (Emission Reduction Banking). Banked ERCs refer to reduction of actual emissions from emission units recognized by the SJVUAPCD as being available for use a tradeoffs or offsets. To be eligible for certification as ERCs, emission reductions must be real, surplus, permanent, quantifiable and enforceable. NPR-1 currently holds ERC banking certifications for the following pollutants (DOE 1997):

- NO_x - 2,197.8 tons per year;
- CO - 8,534.5 tons per year; and
- ROG - 1,161.4 tons/year.

NPR-1 has been issued nineteen ERC certificates by the SJVUAPCD.

D.2.5. Title V Permit

Under Tittle V of the 1990 Clean Air Act Amendments (CAAA), thousands of industrial sources and governmental facilities are required to apply for a comprehensive operating permit that addressees all the air pollution emission sources at the site and the applicable CAA regulations for each source. Title V does not impose any new requirements or emission limits on sources, but may cause sources to incur some additional compliance demonstration requirements and costs because Title V puts the burden of demonstration of compliance on the source's owners and operators.

Sources are subject to Title V if they are considered to be a major source as defined by the amended Act. In attainment areas, major sources are defined as facilities that have the potential to emit at least 100 tons per year of a criteria pollutant.[1] 10 tons per year of an individual HAP, or 25 tons per year of combined HAPs.[2] For nonattainment areas, the threshold for individual criteria pollutants may be lower depending on the exact nonattainment designation for that pollutant. Since the emissions at NPR-1 are greater than 100 tons per year for NO_x, CO and ROG, NPR-1 is subject to the Title V program. Emission sources at NPR-1 that are subject to Title V include the following:

- Cogeneration units (gas turbines),
- Internal combustion engines,
- Heaters and boilers,
- Oil storage tanks,
- Flares,
- Loading racks,
- Gasoline transferring facilities,
- Cooling towers,
- Gas plant systems,
- Air pollution control devices and
- Miscellaneous utility and facility support systems.

[1] Criteria pollutants include lead, NO_2, SO_2, CO, PM_{10}, and precursors of ozone (NO_x and ROG).

2 Hazardous air pollutants (HAPs) are defined in Section 112 of the Clean Air Act Amendments. There are a total of 188 HAPs.

Although Title V is a Federal program, the program has been delegated by EPA and is being administered at the state and local level. The SJVUAPCD has jurisdiction over the NPR-1 and NPR-2 facilities. The SJVUAPCD Title V program is contained in District Rule 2520 (Federally Mandated Operating Permits). The SJVUAPCD has taken a unique approach in assisting industry with the preparation of their applications, which includes the release of General Permit Templates for a number of source types. These templates list all of the federally applicable requirements to be included in the Title V permit. Essentially, if a template is available for a source, the applicant is only required to sign a *qualification form* for the source, which then is submitted to the District as the application instead of the regular application forms. The availability of these templates makes the permit application preparation process much simpler for most facilities.

Title V applications typically include the following types of information:

- detailed source, process and emissions information;
- a complete listing of all applicable Federal and local air pollution requirements;
- detailed compliance information;
- description of alternative operating scenarios; and
- certification of compliance by a responsible official.

The due date of the application depends on the complexity of the facility, with all of the permit applications being due to the District by May 24, 1997. Additionally, the District has asked facilities to send their applications in partial submittals. The due dates of the partial submittals depend on the source types at the facility. Partial submittals are due 30 days after release of a permit template by the District. Once received, the District would evaluate the completeness of the application within 60 days and grant an application shield if the application is acceptable. The application shield allows the facility to operate under the Title V program until the operating permit has been issued by the District. All Title V operating permits would be issued by the District by May 24, 1999. It should be noted that noncompliance with Title V can lead to citizen suits and fines of up to $25,000 per day.

Two separate Title V applications have been prepared for the NPR-1 facility: 1) 35R Gas Plant Source and 2) Western Light Oil source. Multiple permits are normally used to keep independent operations separated and sheltered from each other's potential compliance issues. The 35R Gas Plant processes natural gas received from crude oil production wells. The natural gas is separated into natural gasoline, liquefied petroleum gas (propane and butane) and dry gas (primarily methane). The Western Light Oil Source consists of oil production equipment wells, oil production storage tanks and other support equipment. The facility processes crude oil and natural gas from oil production wells. The oil is piped to offsite refineries for processing and the natural gas is processed by the 35R Gas Process Plant.

It should be noted that the Title V permit applications that have been submitted to the District to date do not include alternative operating scenarios. These scenarios allow a facility the flexibility to adjust to different operating conditions depending on market demands. With the addition of new equipment or the increase in production rates, such as a dehydrator that may be needed under the upper-bound commercial case, the Title V permit would have to be "opened" to include the additional equipment. This would require public and EPA comment before the permit can be issued.

The facility has provided partial submittals for the cogeneration units (gas turbines), internal combustion engines and heaters and boilers to the District in accordance with the District's Title V program. Completeness determinations are currently underway by the District for these partial submittals. Additionally, further submittals are required for the remainder of the equipment 30 days after

permit templates become available from the District or no latter than May 24, 1997. A Title V permit is anticipated to be issued to NPR-1 by December of 1997 (DOE 1997); the permit term is 5 years once issued.

D.2.6. New Source Review and Prevention of Significant Deterioration

Two Federal air permitting programs have been promulgated to assure that stationary sources would neither prevent nor interfere with the attainment or maintenance of ambient air quality standards. For areas that are in attainment or not classified for a particular pollutant, the Prevention of Significant Deterioration (PSD) program may be applicable. The New Source Review (NSR) program may be applicable for areas classified as nonattainment for a particular pollutant. Future new equipment and operations may become subject to these programs if the changes are considered to be major modifications. For this reason, new future equipment and operations are potentially subject to emission offsets, Best Available Control Technology (BACT),[3] Lowest Achievable Emission Rate (LAER)[4] and air quality impact modeling as part of the permitting process. EPA has delegated the NSR program to the SJVUAPCD, which is include in Rule 2201.

NPR-1 currently holds a PSD permit (NSR 4-4-8/SJ 77-42), originally issued by EPA on February 22, 1982, for NO_x emissions associated with 34 internal combustion engines. Table D.2-12 indicates the type and size of these 34 engines.

This PSD permit was revised on April 7, 1989 to address the retrofitting of the original 34 engines with prig-combustion chamber or prig-stratified charge NO_x control technologies.

Table D.2-12
Engines Operating at NPR-1

Manufacturer	Type	Horsepower	Number of Engines	Total Horsepower
Ingersoll-Rand	616 KVR	5,500	6	33,000
	512 KVR	4,000	3	12,000
	412 KVR	2,000	6	12,000
Waukesha	L7042GSIU	1,000	16	16,000
	L7042GU	650	3	1,950
		Total	34	74,950

D.2.7. Transfer of Permits and Certificates

The new owners are required to submit an application to transfer PTO and ATC ownership, listing current permits and the filing fee at the completion of the sale. The transfer of PTOs is governed by SJVUAPCD Rule 2031 (Transfer of Permits) and Rule 3010 (Permit Fees). A letter notifying the SJVUAPCD of the pending change in ownership is required to be submitted to DOE at least 30 day prior to completion of the sale. The permit application for the transfer of the PTOs to the new owners should be submitted to the SJVUAPCD by the new owners within 30 days of completion of the sale.

[3] Required for under PSD if the source is subject to the program.
[4] Required under NSR if the source is subject to the program.

The ATC application essentially reopens the normal permit processing timeline, including 30 days to deem the application complete and 180 days review period to complete processing. Since the ATC application would reinitiate the permit review process, new or upgraded pollution control technologies may or may not be required.

The new owners are also required to submit an application to transfer ERC certificates at the completion of the sale. The transfer of ERCs is governed by SJVUAPCD Rule 2301 (Emission Reduction Credit Banking) and Rule 3060 (Emission Reduction Credit Banking Fee). A letter notifying the SJVUAPCD of the pending change in ownership is required to be submitted by DOE at least 30 days prior to the completion of the sale. The ERC certificates would be reissued upon completion of application processing.

Issuance of the final Title V permit is anticipated in December of 1997. Should the new owners be identified prior to the issuance of the Title V permit, NPR-1 can identify the new owners as the permitted. Otherwise an application would be required to be submitted by the new owners for the transfer of the permit at the completion of the sale. The requirements for notification and application are the same for Title V permit as for the PTOs.

The PSD permit program is being administered by the EPA. The transfer of the ownership requirements for PSD permit (NSR 4-4-8/SJ 77-42) are detailed in Section VI (Transfer of Ownership) of the 1982 permit. The PSD permit clearly required that DOE notify the new owners of the existence of the PSD permit, including applicable permit conditions. A letter notifying the EPA of the pending change in ownership is required to be submitted by DOE to the EPA, CARB and SJVUAPCD at least 30 days prior to completion of the sale.

D.2.7.1. Applicable Air Regulations for Specific Sources

IC Engines. All of the larger engines at the reserve have been modified to reduce NO_x emissions as part of the Federal Facility Compliance Agreement between EPA and DOE.[5] The agreement contains a plan to assure that the reserve achieves and maintains compliance with applicable provisions of the Clean Air Act and Prevention of Significant Deterioration regulations. The engines were modified by installing prig-stratified charge units on the rich-burn engines and prig-combustion chamber (PCC) units on the lean-burn engines. Non-selective catalytic reduction was also installed on several engines.

All engines rated at greater than 50 horsepower are required to be permitted with the SJVUAPCD. The District has also used this size cut-off to specify which engines are subject to Rule 4701; the rule limits emissions for IC engines. Section 7.0 of Rule 4701 establishes compliance dates for IC engines, which are described below in Table D.2-13. By December 19, 1997 owners of these engines must submit an emission control plan to satisfy the emission limits specified in Section 5.1 of the rule. Because of the Federal Facility Compliance Agreement, the larger engines at NPR appear to be in compliance already with the year 2001 deadline. NPR-1 has electrified the remainder of the engines at the facility to comply with the December 31, 1995 deadline. Note that the Title V application does not address this Rule since it was not federally applicable at the time the application was due. This, however, is likely to change and the facility may be required to open the application to include the requirements of this rule.

Gas Turbines (Cogeneration Units). The cogeneration turbines are subject to SJVUAPCD Rule 4703. This Rule limits the NO_x and CO emissions beginning in August 18, 1998. Full compliance must

[5] The Federal Compliance Agreement was issued by EPA, Region IX. The PSD permit (NSR 4-4-8/SJ 77-42) was originally issued by EPA on February 22, 1982 for NOx emissions associated with 34 internal combustion engines.

be demonstrated by August 18, 2000. The units appear to be in compliance with this regulation already with the use of selective catalytic reduction to control NO_x emissions. However, future compliance with the requirement was not certified in the Title V application. As with the IC engines Rule 4701, the Title V application does not address this Rule since it was not federally applicable at the time the application was dug. This, however, is likely to change and the facility may be required to open the application to include the requirements of this rule. The units are also subject to New Source Performance Standards (40 CFR 60), Subpart GG, which limits NO_x and CO emissions. As part of the Title V application, compliance with Subpart GG was certified by a responsible official at NPR-1. Compliance with District and this standard is achieved through continuous emissions monitoring.

Table D.2-13
Emission Limits and Compliance Dates for Engines at NPR-1

Engine Type	Compliance Date	NO_x Limit	CO Limit	ROG Limit
Rich-Burn	12/31/95	9.5 g/bhp-hr or 640 ppmv	2,000 ppmv	None
	5/31/2001	50 ppmv or 90% reduction	2000 ppmv	250 ppmv
Lean-Burn	12/31/95	10.1 g/bhp-hr or 740 ppmv	2000 ppmv	None
	5/31/2001	75 ppmv or 85% reductions	2,000 ppmv	750 ppmv
Diesel	12/31/95	9.6 g/bph-hr or 700 ppmv	2000 ppmv	None
		80 ppmv or 90% reduction	2000 ppmv	750 ppmv

General Conformity. The Clean Air Act Amendments of 1990 (CAAA) required that Federal actions conform to state air quality plans (State Implementation Plans-SIPs) in order to meet the CAAA's air quality goals. The final General Conformity Rule (EPA 1993), stated that Federal activities must conform with the SIP and not 1) cause or contribute any violation of air quality standards, (2) increase the frequency or severity of existing violations, or 3) delay timely attainment of air quality standards or milestones.

The Proposed Action, the sale of the NPR-1 or NPR-2 facilities to commercial operators is a Federal action, however is exempt from General Conformity. The action is exempt since the Federal agency can not control air quality impacts at the facility once ownership is relinquished. As stated in the Final Rule:

> "The Federal agencies would, in many cases, be unable to reduce emissions from sources that they cannot practicably control. This would result in the Federal action having to be prohibited because a positive conformity determination could not be made. The EPA believes that the Act does not intend to unreasonably restrict Federal actions so that they are generally prohibited in areas with air quality problems. Instead, the Federal agencies are required to control emissions in a reasonable manner and States must develop general air quality plans to achieve the NAAQS."

In contrast, one of the proposed alternatives to the proposed action, transfer of the property to another Federal Agency, such as BLM, for lease to commercial operators is not exempt from General Conformity as a Federal Action. Future activities at this site, which could directly or indirectly cause emission increases above de minimis levels, must be examined for applicability with the General

Conformity rule. As proposed, projected activities under this alternative would cause increases in emissions due to the addition and operation of new equipment. This new equipment is needed to produce oil and gas at the higher commercial production rates. However, under existing SJVUAPCD and EPA permitting rules, (see Section 3.3.2) all of this equipment operated under New Source Review (NSR) and Prevention of Significant Deterioration (PSD) permitting rules. As stated in the General Conformity Rules below, these increased are exempt from General Conformity since emission increases would be regulated by the SJVUAPCD, who has responsibility to develop the SIP.

> "Applicability--Exemptions and Presumptions of Conformity...Sources Subject to NSR or PSD. Actions subject to review under the NSR or PSD programs are exempt under the final rule. As explained in the NPR, such actions undergo procedures and criteria, including air quality analyses, equivalent to those required by the conformity rule. Thus, additional review under conformity is not necessary."

D.3. ATMOSPHERIC EMISSIONS AT NPR-1

The activities at these facilities which generate emissions are described in this section. This section also provides a more detailed discussion of the emissions associated with the various stationary, drilling and construction, fugitive and mobile sources and the methodology used to estimate these emissions. To determine the air quality concentrations associated with the emissions, air dispersion modeling was conducted. This section also discusses the modeling assumptions and results.

D.3.1. General Description of NPR-1 Activities and Pollutant Emission Sources

Production operations at NPR-1 consist of three distinct phases:

1. *Drilling operations,* consisting of boring a hole from the surface to the producing reservoir and lining the hole with casing to form a well.

2. *Production operations,* during which oil, gas and water are brought to the surface through tubing hung concentricity inside of the casing.

3. *Gas plant operations,* during which the liquefied petroleum gases are separated from natural gas (resulting primarily in methane).

Two categories of wells are used in the oil industry: exploratory wells and development wells. Exploratory wells are wells drilled for the purpose of locating oil, condensate, or gas bearing strata. These may or may not be completed as producing wells depending on the well design and if gas or oil is located. Development wells are drilled in known producing areas and are designed for the purpose of removing hydrocarbon from the formation.

Oil, gas and water are brought from the reservoir to the surface through a small diameter pipe. The mixture flows from the wellhead to a treatment plant, which is composed of separators, treaters and stock tanks. After the oil is treated to a sufficiently low water content, it flows to shipping or stock tanks where it is held for short periods of time prior to sale. Sale of the oil is made through a measurement system called Lease Automatic Custody Transfer (LACT). The oil is then transported to a refinery via a pipeline. The gas produced along with the oil is gathered off the separator and oil treaters. The vapors from the stock tanks are gathered in a vapor recovery system. Prior to sale or field use (fuel, gas lift, or injection), the gas is processed through a glycol dehydration unit to reduce the water content of the gas. Oily water separated from the crude oil in the separators is reinjected in the strata.

Natural gas as produced from a well contains a mixture of hydrocarbon species which includes methane, ethane, propane, butane, etc. The heavy fractions, heavier than methane, liquefy upon cooling and/or pressure increase and are removed at the gas plants. The types of equipment which produce air emissions due to these operations are summarized in Table D.3-1. Operations specific to NPR-1 are discussed in Appendix A and C of this document.

D.3.2. Summary of Existing and Future Emissions

The following section presents the estimated 1995 and 2001 emissions of PM_{10}, CO, SO_x, NO_x and ROG for the source types listed in Table D.3-1. There are over 600 emission sources at NPR-1. These sources are regulated by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD or District) through a permit to operate. Emission estimates developed for this analysis include all permitted emission sources, as well other sources not regulated by the SJVUAPCD or EPA permits (e.g., oil-spills).

Table D.3-1
Stationary Emission Source Types at Petroleum Production Facilities.

Source Description	Use in Production	Types of Emissions				
		NO_x	VOC	PM	CO	SO_x
Fuel Combustion						
Internal Combustion Engines	Gas compressors engines, wells pumps, pump water into injection wells, drill rigs	√	√	√	√	√
Boilers	Heat treatment, steamers, glycol reboilers	√	√	√	√	√
Flares	Emergency	√	√	√	√	√
Evaporative/Fugitive						
Well Cellars/Heads	Oil and Gas Wells		√			
Components	Valves, Fittings, Pumps and Compressor Seals		√			
Tanks	Storage, LACT, etc.		√			
Other Miscellaneous Sources	Oil-Spills, Stack Vent Releases, Sumps & Pits		√			

The 1995 emission estimates were developed from actual operating conditions for the year 1995. To start, the total emission estimates provided in this document were based on emission calculations submitted to the SJVUAPCD by NPR-1. This emission inventory was enhanced to include sources that are not usually included in the annual emission inventory submitted to the District, such as tanks.

Total emissions were estimated using emission factors. An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as an amount of pollutant released per unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., pounds of particulate emitted per ton of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average). Using an emission factor, emissions are estimated as follows:

Emissions = Activity Level x Emission Factor x (1-Overall Control Efficiency)
(activity unit/year) (pound/activity unit)

The quality of emission factors used range from good to poor, depending of the type of emission source and source for the emission factor. Significant variations in emissions can be found in test results on otherwise apparently identical sources. In this case, the total estimated emissions from a large number of sources is more accurate than the emissions estimated for an individual source. Also, the activity level for NPR-1 sources was well-known in some cases, but more uncertain in others.

The future year (2001) inventory was developed by considering the maximum potential emissions based on the upper-bound commercial case. Equipment emission estimates for 2001 were based on maximum potential emissions. To account for proposed new facilities/operations associated with the upper-bound commercial case, additional equipment were added to the inventory and the maximum allowable emissions were estimated based on the size of the equipment. The proposed new facilities/ operations for the upper-end commercial case are described in Appendix A. As with the base year inventory, future year emissions were estimated using emission factors in some cases. Most estimates for the future year, however, were developed based on pollutant-specific permitted limits for specific equipment.

Table D.3-2 summarizes the 1995 base and 2001 future year emission inventory for stationary sources at NPR-1. Emissions are reported in three categories: 1) stationary combustion sources, 2) drilling and construction sources; and 3) evaporative sources. Detailed information for each of the these categories is provided below.

D.3.3. Stationary Combustion Sources

Combustion sources at NPR include internal combustion (IC) engines used for a variety of purposes, including gas compression engines, well pumps and drill rigs. The SJVUAPCD requires an air permit for IC engines rated at greater than 50 horsepower (maximum output). In 1995, a total of 237 engines rated at 50 horsepower or greater were operated. About sixty of these engines are used for gas compression and are as large as 5,500 horsepower each; these engines are referred to as the "K units" by the facility and the District. The remaining, smaller engines are used primarily as well pumps, and tend to be about 100 horsepower in size.

Table D.3-3 summarizes the locations, numbers and sizes of the compressor units included in the base and future year inventories. Two electrically-driven compressors at the facility are not included in the inventory since they have no emissions.

When possible, the 1995 baseline emissions were estimated based on actual emission test results. The SJVUAPCD requires annual source tests to verify compliance with permit conditions for most of the compressor engines. In conjunction with the source test data, actual gas-metering data or fuel usage were used when appropriate. When direct measurement of emissions was not available, emission factors tabulated by the EPA (1995) were used.

The maximum emissions were estimated for the year 2001 by calculating either maximum potential emissions or by using the maximum allowable emissions from permit limits. The actual methodology used depended on the permit associated with a piece of equipment. For equipment with permitted pollutant emission limits, the pollutant limits were used to estimate the maximum case emissions. Regulatory restrictions associated with SJVUAPCD Regulations and the NO_x reduction program were taken into account when estimating the future year emissions; these restrictions are discussed below. Note that most of the compressor are controlled with either prig-stratified combustion, prig-combustion chamber, or non-selective catalytic reduction. The source test data and pollutant permit limits used to estimate the baseline and future emissions includes the effect of the control device. In most cases, these limits specify the maximum allowable emissions in units of pounds per hour by pollutant. These limits are usually conservative so that the source is in compliance at all times under normal operating conditions. When pollutant permit limits were not specified for a piece of equipment, the maximum potential emissions were estimated. The maximum potential emissions are based on the maximum capacity of the source to emit under its physical and operational design. The maximum potential emissions are always larger or equal to the maximum allowable emissions and in all cases larger than the actual emissions (under normal operating conditions).

Combustion sources also include boilers and heaters. These units include glycol reboilers and process heaters. The baseline emissions were estimated using EPA emission factors in conjunction with metered fuel usage. Future year emissions were estimated from permitted emission limits for all of the sources except the closed-loop gas heater. EPA emission factors were used to estimate the emissions from this unit since it had no associated permit limits.

Table D.3-2
Summary of Baseline and Future Year Emissions at NPR-1

Source Type	1995 Base Year Emissions (lb/hr)					2001 Future Year Emissions (lb/hr)				
	PM_{10}	CO	SO_X	NO_X	ROG	PM_{10}	CO	SO_X	NO_X	ROG
Stationary Combustion Sources										
Compressors Engines	3.68	384.77	0.35	169.36	45.86	24.73	925.48	42.08	581.03	648.57
Boilers and Heaters	0.68	3.04	0.09	15.22	0.35	5.57	13.88	4.24	55.63	3.91
Cogenerators	0.02	3.46	1.48	5.17	0.92	4.22	45.38	1.51	20.48	4.28
Flares	0.19	0.84	0.03	4.21	0.11	0.32	1.42	0.04	7.08	0.41
Pump Engines	0.15	9.83	0.01	5.55	2.37	3.87	36.31	11.62	252.30	10.40
Diesel Fired Engines	0.04	0.12	0.04	0.55	0.03	0.22	2.05	0.68	14.88	0.59
Subtotal	*4.76*	*402.06*	*1.99*	*200.06*	*49.64*	*38.92*	*1,024.52*	*60.18*	*931.39*	*668.16*
Drilling and Construction Sources										
New Development Drilling	17.90	31.44	3.65	131.02	12.70	31.33	55.03	6.38	229.28	22.23
Remedial Drilling	14.00	29.21	3.33	122.36	12.00	19.60	40.90	4.67	171.31	16.80
Fugitive Dust - New Construction	0	0	0	0	0	16	0	0	0	0
Subtotal	*31.90*	*60.65*	*6.98*	*253.38*	*24.70*	*66.93*	*95.92*	*11.05*	*400.59*	*39.03*
Evaporative Emission Sources										
Tanks	0	0	0	0	117.05	0	0	0	0	196.64
Fugitive Emissions										
Valves, Connectors, etc.	0	0	0	0	92.53	0	0	0	0	92.53
Well Heads and Cellars	0	0	0	0	226.61	0	0	0	0	207.5
Stack Vent Releases	0	0	0	0	63.64	0	0	0	0	106.91
Oil-Spill related Emissions	0	0	0	0	1.53	0	0	0	0	2.57
Percolation Ponds	0	0	0	0	5.52	0	0	0	0	9.27
Subtotal	*0*	*0*	*0*	*0*	*506.87*	*0*	*0*	*0*	*0*	*615.41*
Grand Total	36.66	462.72	8.97	453.44	581.22	105.85	1,120.44	71.23	1,331.98	1,322.60

Table D.3-3
Compressor Engines by Location and Capacity
for the Base and Future Year Inventories

Location	Number of Engines	Total Capacity (Horsepower)
1995 Base Year Compressors		
7R	2	2,000
17R	4	2,950
19R	3	3,000
30R	10	11,000
33S	5	9,000
35R Field	4	1,980
35R Gas Plant	13	17,490
35R LTS 2	5	20,500
35R HPI	3	12,000
35R LTS 1	3	16,500
36R	7	7,000
Subtotal	61	102,050
2001 Future Year Additional Compressors		
26R	1	2,000
30R	1	1,000
35R	1	5,000
36R	1	5,000
Subtotal	4	13,000
Grand Total	65	115,050

Two 24.5 megawatt natural gas fired gas turbine cogeneration systems are present at NPR-1. Each unit includes a 250 MMBtu/hr gas turbine, 103 MMBtu/hr duct burner assembly and a 150,000 lb/hr heat recovery system. The turbine engines are equipped with a selective catalytic reduction system to control NO_x emissions. Emissions for the base and future year were estimated from the source test data and pollutant permit limits, respectively. Note that the units have continuous emission monitoring for NO_x, CO and O_2. NPR-1 produces about 25 percent excess power which is sold to the power grid.

Base year emissions from flares were estimated based on actual flare usage and EPA (EPA 1995) emission factors. For the future year, a ratio of the production rates for the base and future year was used to project the future year emissions.

D.3.4. Drilling, Construction and Maintenance Sources

As discussed above, both remedial and development drilling are normal operations at an petroleum production facility. Appendix A provides further details about the past and present well drillings associated with the facility. Emissions for these operations were estimated based on the number of remedial and development wells drilled annually. For 1995, under typical operating conditions, four development wells and five remedial wells were drilled; in 2001, it was assumed that seven development and seven remedial wells would be drilled. The number of operations on a typical base and future year day was then determined. By assuming that remedial operations take an average of seven days per operation, while developmental drilling takes about 30 days per operation, the total number of operational days for 1995 and the future year were calculated and then divided by 365 to yield the average number of operations for a typical base year and future year day. The emissions for each drilling operation were then determined as shown in Table D.3-4 and multiplied by the number of operations to yield the emission totals presented in Table D.3-2.

Fugitive dust emissions from the construction of new facilities/operations were also estimated for the future year. In Table B.21 of the revised EIS for NPR-1 (DOE 1993), emissions from these operations are estimated to equal 0.4 pounds per hour per acre of disturbed area. The future year inventory includes a conservative estimate of 40 acres of land being disturbed during the future year day.

Table D.3-4
Summary of Emissions for Developmental and Remedial Well Operations

			Emissions (lb/hr)				
Source Category	**Capacity**	**Units**	**ROG**	**NO_x[a]**	**CO**	**SO_2**	**PM_{10}**
New Well Drilling							
Equipment Operation	1200	Horsepower	2.6	26.5	6.3	0.5	2.6
Moving	61.8	Horsepower	0.1	1.4	0.4	0.1	0.1
Site Preparation							
Equipment Operation	158	Horsepower					
	10.4	Miles/day					
Subtotal for Equipment Operation			0.4	4.9	1.1	0.3	0.3
Fugitive Dust	2.0	Acres	0	0	0	0	1.4
Subtotal			3.2	32.8	7.9	0.9	4.5
Remedial Work, New Well Completion and Routine Well Pulling							
Equipment Operation	962	Horsepower	2.1	21.2	5.1	0.4	2.1
Moving	37.9	Horsepower	0.1	0.8	0.3	0.1	0.1
Site Preparation							
Equipment Operation	79	Horsepower					
	5.2	Miles/day					
Subtotal for Equipment Operation			0.2	2.4	0.5	0.2	0.2
Fugitive Dust	2.0	Acres	0	0	0	0	0.4
Subtotal			2.4	24.5	5.8	0.7	2.8

[a] Diesel engines > 50 hp associated with well drilling equipment, service, workover rigs, portable pumps, portable compressors are subject to SJVUAPCD Rule 2280 - Equipment Registration, limiting NO_x emissions to 10 grams/bhp-hr (0.022 lb/bhp-hr). Accordingly, the NOx emissions have been modified from the 1993 Supplemental to 1979 EIS to account for this rule adopted in 1994. Other emission factors updated from EIS Table B.21 to account for changes in emission factors from the 1993 Supplement to the 1979 EIS.

D.3.5. Evaporative Emissions Sources

Evaporative emissions were estimated using a variety of methods. The EPA program TANKS (version 3.0) was utilized to estimate evaporative losses from storage tanks. Two types of emissions result from tanks: storage losses and working losses. Storage loss is the release of vapor from the tank through vapor expansion and contraction, which are the results of changes in temperature and barometric pressure. This loss occurs without any liquid level change in the tank. The combined loss from filling and emptying is called working loss. Evaporation during filling operations is the result of an increase in the liquid level in the tank. As the liquid level increases, the pressure inside the tank exceeds the relief valve pressure and vapors are expelled from the tank. Evaporative loss during emptying occurs when air drawn into the tank during liquid removal becomes saturated with organic vapor and expands, thus exceeding the capacity of the vapor space. It should be noted that most of the tanks at NPR-1 are required to be equipped with a vapor recovery system.[6] Emissions from the system are piped to the gas plant were they are converted to product. The control efficiency of the vapor recovery systems is 99.9

[6] SJVUAPCD Rule 4623 - Storage of Organic Liquids

percent. The emission estimates included in Table D.3-2 represent total emissions for over 300 tanks located throughout NPR-1. The base and future year emissions were adjusted for the production rates of the two cases.

Evaporative fugitive emission are the result of leaking components (e.g., valves, connectors, etc.). These emissions were estimated based on emission factors compiled by the American Petroleum Institute (Eaton et al. 1980). The facility is required to monitor and repair leaking fugitive emissions sources[7] and the component counts generated for this program were used to estimate emissions.[8] The emission estimate for heads and cellars is based on 1,150 active oil and gas wells. Since significant increases in the equipment are not required for future operations, the future year fugitive emissions are estimated to be equal to those of the baseline year as shown in Table D.3-2.

In 1995, NPR-1 released 34.71 million cubic feet of gas from stack vents. Based on this value, the estimated emissions are about 63 pounds per hour of ROG emissions for the baseline year. For the future year, a ratio of the production rates for the base and future year was used to project the future year emissions to 106 pounds per hour.

Another source of evaporative emissions is from oil-spills. In 1995 there were 453 reported oil spills at the facility. Of the 3,102 barrels of oil spilled, about 71 percent was recovered. Accordingly, emissions were estimated based on 910 barrels of spilled oil. For the percolation ponds, the emissions were estimated based on the size of the ponds. The total pond size used to estimate the emissions was 242,125 square feet of surface area, compared to 180,000 square feet in the 1993 EIS. Future year emissions for the oil spills and the percolation ponds were estimated using the same procedure described above for future year emissions of stack vent releases.

D.3.6. Mobile Source Emissions

Mobile source emissions of PM_{10}, CO, NO_x, TOG and ROG at the NPR facility (and in surrounding areas) were estimated for 1995 and 2001 using the tools and assumptions described below.

Emission Factor Development. Emissions are estimated by multiplying a unit of activity (such as vehicle miles traveled, or VMT) by an emission factor, an estimate of the rate at which a pollutant is being emitted. Two computer models were used to develop the emission factors for this study. For particulate rates, the EPA's PART5 model was used. PART5 is a FORTRAN program which calculates particle emission factors in grams per mile (g/mi) for on-road automobiles, trucks and motorcycles; factors for particle sizes from 1 to 10 um can be estimated. Exhaust particulate, exhaust particulate components, brake wear, tire wear and reentrained road dust, which are required for PM_{10} inventories, are all included in the emission rates produced by PART5 (EPA 1995).

For the NPR region, maximum particulate emission rates were modeled for the 1995 and 2001 analysis years. This was done to insure that the most conservative estimates of total PM_{10} emissions from mobile sources would be calculated. Table D.3-5 summarizes the key PART5 assumptions.

In addition to emission rates in g/mi for various vehicle processes (e.g., exhaust, tire wear), PART5 generates estimates of fugitive PM_{10} emission rates from both paved and unpaved roads. These rates are extremely sensitive in the input assumptions for silt content and silt loading. Using values

[7] SJVUAPCD Rule 4451 - Fugitives from Valves, Pressure Relief Valves, Flanges, etc. at Petroleum Refineries and Rule 4452 - Pump and Compressor Seals at Petroleum Refineries

[8] Emissions based on the following component counts: valves = 17,203; flanges = 15,121; relief valves = 1,126; threaded components = 122,232; other components =10,703.

which are inappropriately high or low can severely impact emissions estimates. For this analysis, two references were consulted to identify appropriate values: EPA's *AP-42* (EPA 1995), and *Improvement of Specific Emission Factors - Final Report*, prepared for the South Coast AQMD (SCAQMD) by the Midwest Research Institute (MRI 1996). *AP-42* provides emission rates for a variety of emissions sources, including fugitive dust from rural roads. Table 13.2.2-1 provided the default average silt content of 6 percent for unpaved, rural, dirt roads which was used in PART5.

Table D.3-5
PART5 Input Assumptions for NPR Analysis

Parameter	Assumption
Inspection/Maintenance program	No
Reformulated gasoline	No
Average precipitation (days/year)	140
Average vehicle weight (lbs)	6,000
Average number of wheels/vehicle	4
Unpaved road silt content	6%
Paved road silt loading	0.41 g/m2

The MRI report documents a study conducted for the SCAQMD to develop improved emission factors for construction activities and unpaved roads in the western United States. Table 11 in the MRI document reports surface sampling results from paved road surfaces in a variety of places and for a variety of facilities. The silt loading presented in this table for a low average daily travel (ADT) industrial, paved roadway in the Bakersfield area of 0.41 g/m2 was used as input to PART5.

Emission factors for CO, NO_x, TOG and ROG were estimated using the CARB's EMFAC7G (CARB 1995). EMFAC is a computer model designed to estimate emission rates for on-road cars, trucks, buses and motorcycles in California. Unlike EPA's MOBILE model, which includes national default values for the entire country that must be customized for each region, EMFAC includes region-specific data for the entire State of California, including fleet composition, mileage accumulation rates, I/M program in place and reformulated gasoline requirements. While users are offered flexibility in that they may modify the data provided, for this analysis the assumptions included for Kern County were used in the emission factor calculations.

Emission rates also vary with ambient temperature. CO emissions are much higher during low-temperature, winter conditions, while hydrocarbon and, to some degree, NO_x emissions tend to be higher during high-temperature, summer conditions. It is desirable to assign activity to appropriate hours of the day and then apply emission rates which reflect each hour's average temperature to that hour's activity; however, the detailed temperature data required to develop a 24-hour profile was not available for this analysis. As an alternative, an average summer temperature of 84.5°F was used for all emission rate estimates with the exception of CO; CO estimates were made using an average winter temperature of 48.2°F.

Vehicle Activity Estimates. Estimates of the existing on-road mobile source activity levels generated by the NPR facility were obtained from the Climate, Meteorology and Air Quality appendix (Appendix B) of the previous EIR on the facility (DOE 1993). Some additional information used to project emissions for the 2001 future year, including projected staff reductions, characteristics of the facility fleet and anticipated changes in production levels, were obtained from facility personnel. Table D.3-6 summarizes the on- and off-site vehicle activity assumptions used for the emissions analysis.

All heavy-duty trucks are assumed to be diesel-powered. Light-duty autos and trucks are assumed to follow the technology distribution (e.g., non-catalyst, catalyst and diesel) used by the EMFAC7G model for Kern County. Further, the distribution of non-HDDT VMT, trips and vehicles is assumed to be consistent with EMFAC7G assumptions for the county.

Table D.3-6
Vehicle Activity Assumptions for 1995 and 2001 Analysis Years

	On-Site (Daily Values)			Off-site (Daily Values)		
Parameter 1995	**Light-Duty Autos**	**Light-Duty Trucks**	**Heavy-Duty Trucks[1]**	**Light-Duty Autos**	**Light-Duty Trucks**	**Heavy Duty Trucks**
VMT						
Paved	5,784	9,108	1,200[2]	2,337	1,413	7,200[3]
Unpaved	304	2,054	na	na	na	0
Total VMT	9,770	11,162	1,200	2,337	1,413	7,200
Trips (Starts)	589	736	NA	393	237	na
Vehicles	439	435	na	--	--	na
Parameter 2001	**Light-Duty Autos**	**Light Duty Trucks**	**Heavy Duty Trucks[1]**	**Light-Duty Autos**	**Light-Duty Trucks**	**Heavy Duty Trucks**
VMT						
Paved	4,318	6,850	2,016	1,745	1,068	12,096
Unpaved	227	1,541	na	na	na	na
Total VMT	4,546	8,391	2016	1,745	1,068	12,096
Trips (Starts)	440	554	na	295	178	na
Vehicles	329	326	na	--	--	na

[1] All heavy-duty trucks assumed to be diesel-powered.
[2] Includes increase in production anticipated in the previous environmental assessment (DOE 1993)
[3] Includes increase in production anticipated in the previous environmental assessment (DOE 1993)

The values presented for 1995 are based on those developed for the previous environmental analysis in 1987; however, at that time it was projected that additional heavy-duty truck (HDDT) travel would be generated by increasing production in subsequent years. Since there were actual production increases between that study and 1995, the HDDT travel estimates include the additional projected VMT noted in that document (DOE 1993).

Estimates of 2001 travel activity were based upon information obtained from NPR staff. An anticipated staff reduction of 75 percent is anticipated at the facility after it would be privatized. As a result, the non-HDDT travel on- and off-site is also assumed to decrease by 75 percent under commercial operation. Production at the facility, on the other hand, is expected to increase by 68 percent over the same period. The values for HDDT travel in Table D.3-4 reflect the same increase.

Emission rates vary significantly with vehicle speed. The lack of facility-specific information regarding speed variations on various roadways and at differing times of day were not available for this analysis. As an alternative, it was assumed that on-site travel averaged a speed of 32.5 mph (the averages of the speed limits on Elk Hills and Skyline Roads). Off-site travel was assumed to occur at an average speed of 55 mph.

Mobile Source Emissions Estimates. As noted above, emissions are basically calculated by multiplying an emission factor by a measure of activity. For mobile sources, however, some emissions

estimates include various component elements tied to different aspects of activity. In the case of PM_{10}, total emissions are equal to those originating with the vehicle's function (e.g., exhaust, tire wear, brake wear,), plus emissions from dust created by the vehicle's travel on the roadway. For NPR, PM_{10} fugitive emissions were calculated for both paved and unpaved roadways in and around the facility using VMT totals disaggregated by roadway class and emission rates from PART5 (Table D.3-6).

Hydrocarbons (HC) also have various emissions components. In addition to exhaust, vehicles produce evaporative emissions both while running (evaporative running), when sitting idle while outside temperature changes (diurnal and resting evaporative) and when sitting after being driven and before cooling (hot soak). Large amounts of HC (and other species) emissions are generated when a vehicle is started, particularly after sitting for several hours (e.g., a "cold" start). The EMFAC model produces "variable start" emission rates (g/trip) by length between starts. For this analysis, an overnight period (12 hours) is assumed between each vehicle start.

The HC emissions totals presented later in this section include all of the above component elements, where appropriate. Note that both total hydrocarbons (TOG) and reactive hydrocarbons (ROG) are reported. Only the TOG emissions include diurnal, resting and running evaporative emissions components. This is consistent with EMFAC7G assumptions.

NO_x and CO emissions also have exhaust and start components. They are not emitted in appreciable quantities evaporatively. Tables D.3-7 through D.3-10 present the estimated total emissions from mobile sources for the 1995 and 2001 analysis years for all evaluated pollutant species.

Table D.3-7
1995 On-Site (NPR-1) Emissions Estimates

Source Category	Emissions (lbs/day)			
	ROG	NO_x	CO	PM_{10}
Light-duty autos				
Exhaust	8.45	12.61	130.93	0.79
Starts	6.67	2.30	166.55	
Hot soak.	--	--	--	--
Fugitive dust - paved	--	--	--	33.28
- unpaved	--	--	--	215.87
Total LDA Emissions	15.12	14.91	297.43	249.94
Light-duty trucks		--	--	--
Exhaust	18.17	33.91	263.34	1.75
Starts	4.78	2.74	127.75	
Hot soak.		--	--	--
Fugitive dust-paved	--	--	--	52.41
- unpaved	--	--	--	1456.76
Total LDT Emissions	22.95	36.65	391.09	1510.92
Heavy-duty trucks				
Exhaust	5.24	40.87	22.01	3.85
Fugitive dust -	--	--	--	
paved	--	--	--	6.90
Total HDT Emissions	5.24	40.87	22.01	10.75

Table D.3-8
1995 Off-Site (Kern County) Emissions Estimates

Source Category	Emissions (lbs/day)			
	ROG	NOx	CO	PM_{10}
Light-duty autos				
Exhaust	2.48	9.22	39.16	0.29
Starts	4.45	2.00	111.03	--
Fugitive dust	--	--	--	13.45
Total LDA Emissions	6.93	11.22	150.19	13.74
Light-duty trucks				
Exhaust	1.69	8.25	31.21	0.22
Starts	3.19	1.82	85.16	--
Fugitive dust (paved)	--	--	--	8.13
Total LDT Emissions	4.88	10.07	112.55	8.35
Heavy-duty trucks				
Exhaust	21.59	373.02	108.57	23.13
Fugitive dust	--	--	--	41.43
Total HDT Emissions	21.59	373.02	108.57	64.56

Table D.3-9
2001 On-Site (NPR-1) Emissions Estimates

Source Category	Emissions (lbs/day)			
	ROG	NOx	CO	PM_{10}
Light-duty autos				
Exhaust	2.57	5.19	47.25	0.56
Starts	4.84	2.29	125.52	--
Fugitive dust - paved	--	--	--	24.85
- unpaved	--	--	--	161.20
Total LDA Emissions	7.42	7.47	172.78	186.61
Light-duty trucks				
Exhaust	4.96	14.05	82.36	1.26
Starts	3.52	2.12	98.07	--
Fugitive dust - paved	--	--	--	39.41
unpaved	--	--	--	1093.28
Total LDT Emissions	8.48	16.17	180.44	1133.95
Heavy-duty trucks				
Exhaust	5.42	39.13	34.24	3.81
Fugitive dust	--	--	--	11.60
Total HDT Emissions	5.42	39.13	34.24	15.41

Table D.3-10
2001 Off-Site (Kern County) Emissions Estimates

Source Category	Emissions (lbs/day)			
	ROG	NOx	CO	PM_{10}
Light-duty autos				
Exhaust	0.83	3.78	17.63	0.22
Starts	3.23	1.53	83.68	--
Fugitive dust	--	--	--	10.04
Total LDA Emissions	4.06	5.30	101.31	10.36
Light-duty trucks				
Exhaust	0.44	3.42	10.48	0.16
Starts	2.34	1.41	65.38	
Fugitive dust	--	--	--	6.14
Total LDT Emissions	2.79	4.83	75.86	6.30
Heavy-duty trucks				
Exhaust	22.13	321.07	168.80	22.85
Fugitive dust	--	--	--	69.60
Total HDT Emissions	22.13	321.07	160.80	92.45

D.3.7. Atmospheric Emissions at NPR-2

Emission sources at NPR-2 include surface disturbances, stationary sources and mobile sources. Surface disturbances include earth working, drilling activity and traffic-generated PM_{10} in the form of fugitive dust. Stationary sources include compressor engines, electrical generators, boilers, heaters, flares, pump engines and miscellaneous field engines (DOE 1994). Table D.3-11 summarizes the permitted stationary air emission sources at NPR-2. Mobile sources include cars, trucks and heavy equipment. It should be noted that the expected emissions from NPR-2 are much less than those from NPR-1. This is because production levels at NPR-2 are on the order of 1,000 barrels per day, compared to NPR-1 which has potential production levels close to 80,000 barrels per day. Accordingly, the number of actual emission sources at NPR-2 is much less than those at NPR-1.

Future emissions and sources types are not expected to change under the proposed action. Continued production and development of known reserves at NPR-2 would require drilling and installation of new reserves wells, as well as remediation of existing wells. Because of the decline in oil production in the field, these operations are not expected to increase under the Proposed Action.

Table D.3-11
Permitted Emission Sources at NPR-2 for the Year 1997

Company	Source Description	Total Capacity	Units
Phillips Petroleum/Sacket Oil	9 Fixed Roof Petroleum Tanks	390,810	gallons
	1 Wash Tanks	3,612	gallons
	2 Stock Tanks	42,000	gallons
Chevron USA, Inc	Thermally Enhanced Oil Recovery System with Vapor Control		
	17 Fixed Roof Petroleum Tanks	762,447	gallons
Texaco Exploration and Production, Inc	5 Fixed Roof Petroleum Tanks	115,500	gallons
Vintage Petroleum, Inc	20 IC Engines	3,055	horsepower
	4 Fixed Roof Petroleum Tanks	341,407	gallons
	2 Fixed Roof Petroleum Test Tanks	16,800	gallons

D.4. AIR QUALITY IMPACT ANALYSIS

Air quality dispersion modeling was conducted to determine the concentration of air quality pollutants emitted from the NPR-1 site.

D.4.1. Stationary Source Modeling Approach

The Industrial Source Complex Short Term (ISC3ST) model was used to simulate dispersion of emission sources within the NPR facility and in surrounding areas. The ISC3ST model is recommended in the EPA Guidelines on Air Quality Models for dispersion modeling of complex industrial source facilities. (The model is included in Appendix A of the Guidelines, which describes EPA-preferred air quality models.) ISC3ST accepts hourly meteorological data (e.g., stability class, wind direction) and was used to predict hourly, 8-hour, 24-hour and annual average concentrations of CO, SO_2, NO_X and particulates. ISC3ST, which can not input line sources, can be used to simulate roadways sources by breaking up the roadway into consecutive rectangular area sources. ISC3ST also has the advantage of automatically generating source contributions for maximum receptor points. Due to the significant terrain on the NPR site (Figure D.4-1), ISC3ST was used with terrain elevations for both emission sources and receptor points.

For this modeling application, ISCST was set up using default regulatory options, as recommended by EPA guidance. Setting this option automatically selects the following:

- Stack tip downwash,
- Final plume rise,
- Buoyancy induced dispersion (BID),
- Default vertical potential temperature gradients,
- Use of the calm processing routine,
- Default wind profile exponents,
- The appropriate value for pollutant half-life (if needed) and
- The building wake effects algorithm (with building information).

Since the NPR site is located in a rural area, the "rural" option was used for modeling with ISC3ST. Use of this option incorporated rural mixing heights and rural dispersion factors into the analysis. For each of the modeled facilities, the meteorological input data used in the dispersion modeling was collected at the Kern Ridge meteorological site and included the following information:

- year, month, day, hour
- wind speed (m/s)
- wind vector (degrees)
- temperature (deg. K)
- stability category
- mixing height.

The anemometer height, longitude and latitude and station number for both the surface and upper air stations were required for development of the meteorological data file. Physical data on the locations and dimensions of the emission sources (e.g. UTM coordinates for each point source) and receptors were also input to ensure that the emission sources were modeled as accurately as possible. A rectangular network of receptors which extended out at each township/range/section corner kilometer (Figure D.4-1) was used for the dispersion modeling analysis. The rectangular grid was used for development of concentration isopleths around the facility; the only "public accessible" receptors, however, are those located along the Elk Hills road and on the border of the NPR-1 facility. With the varying terrain throughout the facility, terrain heights were input to ISC3ST for each of the modeled sources and for each receptor located around the facility (Figure D.4-2).

D.4.2. Stationary Source Modeling Results

The air quality dispersion modeling indicates that concentrations of most pollutants (SO_2, NO_X, CO) are well below both Federal and California standards, both within the facility boundaries and along public access corridors. Due to the impacts of routine fugitive particulate emissions associated with operation of the oil production facility, however, concentrations of particulates can be elevated at certain areas located within the NPR boundaries. The maximum predicted concentrations for all pollutants are shown in Table D.4-1 and discussed in more detail below.

Table D.4-1
Maximum Predicted Total Concentrations of Air Pollutants ($\mu g/m^3$) - 1995

		1995		2001			
Pollutant	**Averaging Period**	**Maximum On-site**	**Maximum Off-site**	**Maximum On-site**	**Maximum Off-site**	**California Standard**	**National Standard**
NO_x	Annual	69.8	0.45	515.8	1.00	n/a	100
SO_2	24 hr	3.14	0.26	150.2	0.66	131	365
	Annual	0.30	0.02	32.0	0.10	n/a	80
CO	1 hr	2,230	39.1	8393	107.3	23,000	40,000
	8 hr	1,513	7.4	5428	22.7	10,000	10,000
PM_{10}	24 hr	139.08	105.95	133.38	102.82	50	150
	Annual	36.21	33.38	36.64	33.18	30	50

Note: Total concentration includes background concentrations of 32 µg/m3 for the annual and 93 µg/m3 for the 24-hour standard

Figure D.4-1
Location of Sources and Receptors

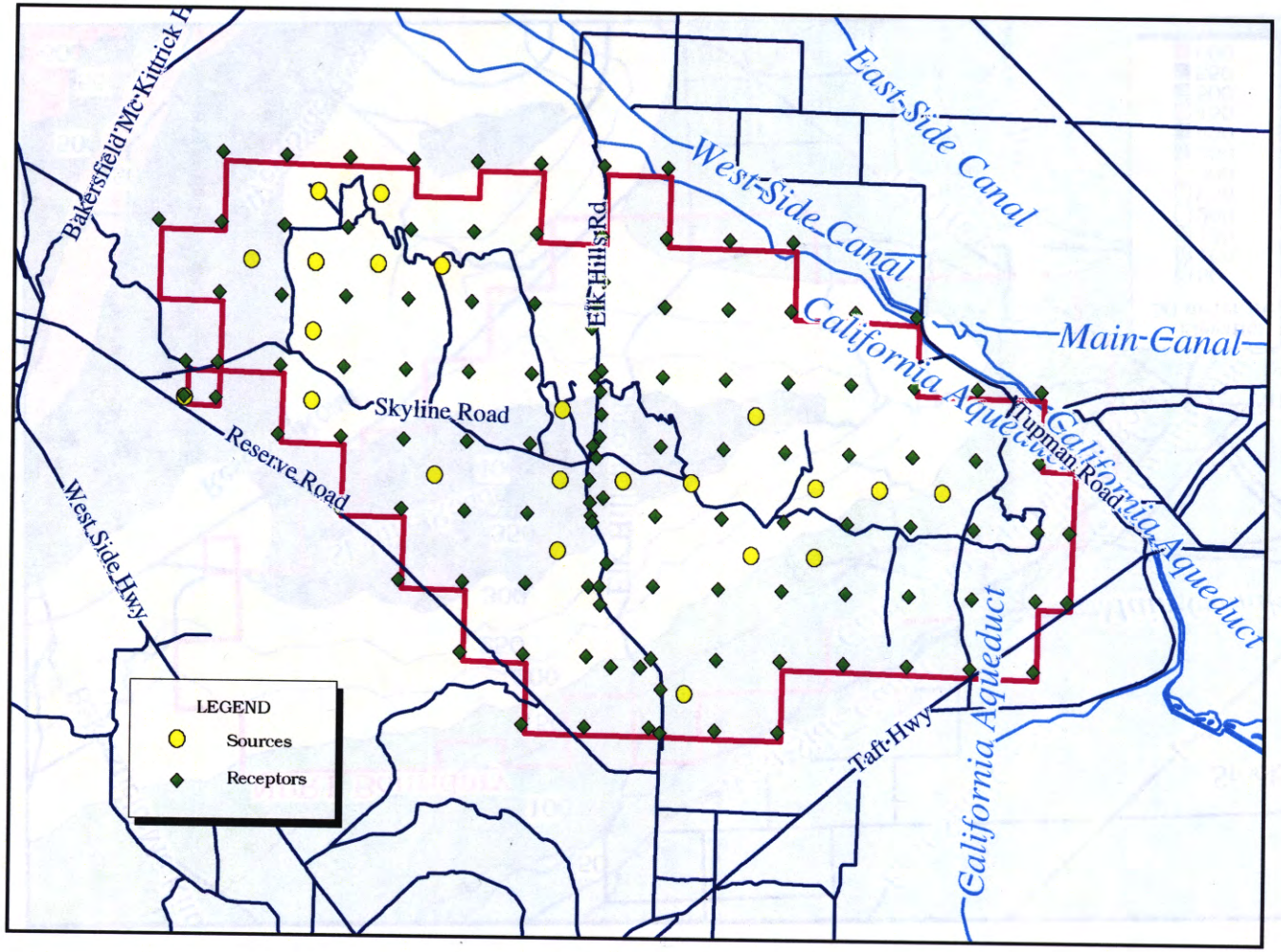
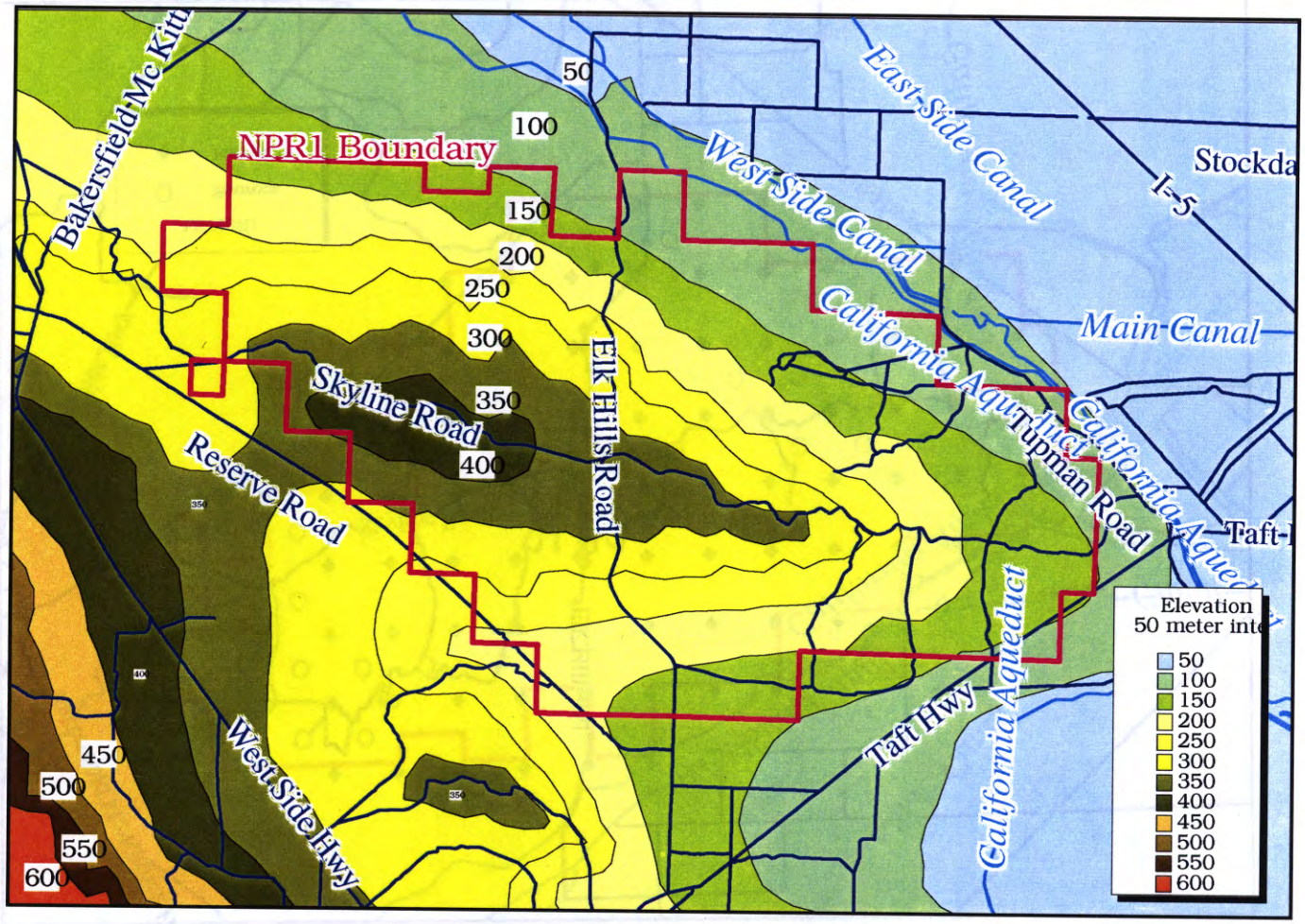


Figure D.4-2
Elevation of Terrain in the NPR-1 Area



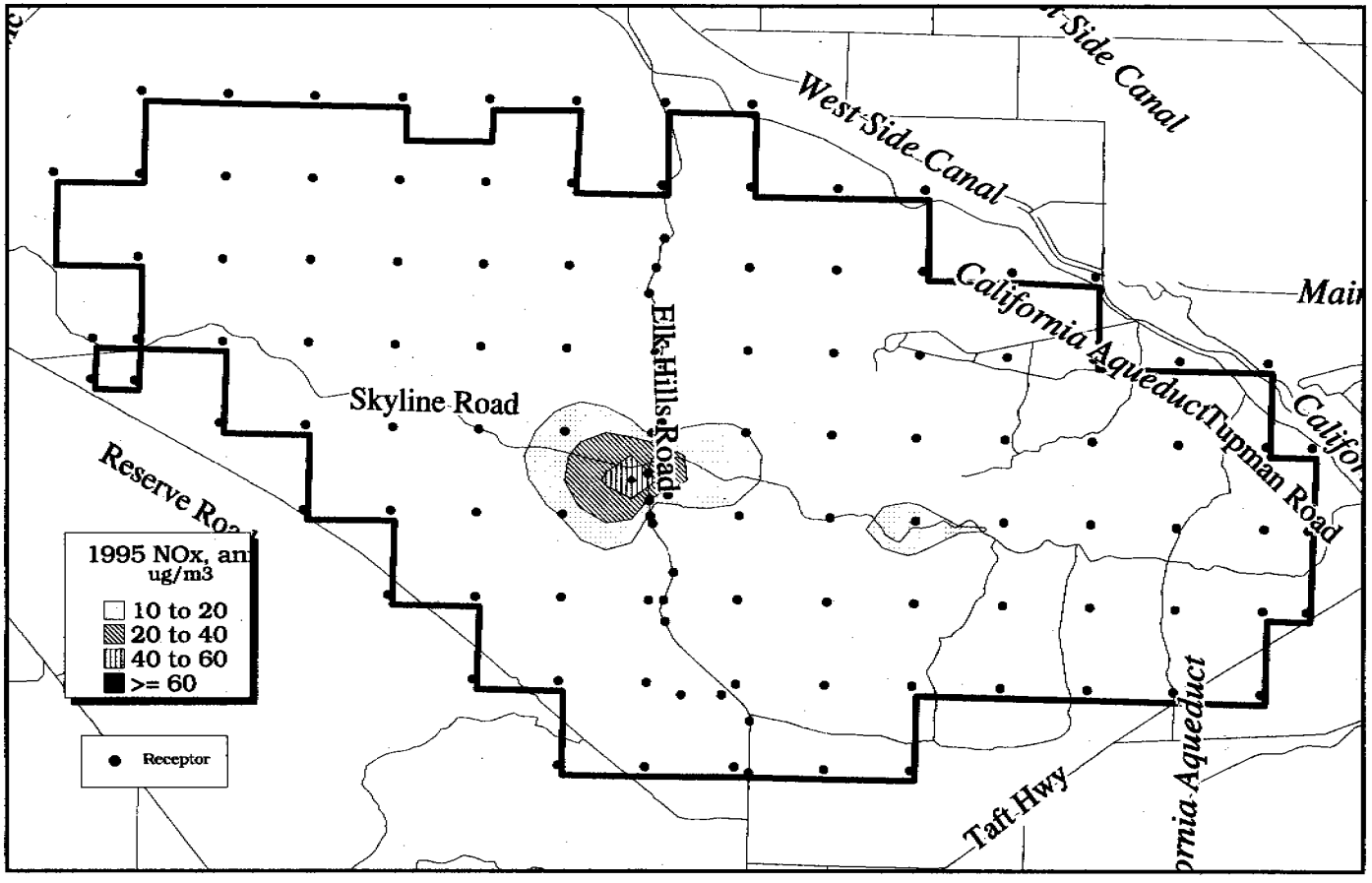
Nitrogen Oxide Impacts. Figures D.4-3 and D.4-4 present the results of the ISC3ST modeling for NO_x for 1995 and 2001, respectively. In 1995, predicted concentrations of NO_x are well below the California and Federal standards at all modeled receptors, both within the NPR facility (maximum on-site) and located along the border of the NPR-1 facility (off-site). Under the 2001 maximum allowable commercial case assumptions, however, predicted concentrations of NO_X are above the Federal standards within the facility but drop to levels below the standard at locations along the NPR-1 border.

Sulfur Dioxide Impacts. Figures D.4-5, D.4-6, D.4-7 and D.4-8 show the extent of predicted concentrations of SO_2 for 1995 and 2001. For both the 24-hour and annual averaging period, predicted concentrations of SO_2 are below 4.0 $\mu g/m^3$ in 1995. Under the maximum potential emission assumptions, predicted concentrations within the NPR-1 facility reach 150 $\mu g/m^3$ for the 24-hour average and 32 $\mu g/m^3$ for the annual average. While both of these values are below Federal ambient air quality standards, the 24-hour concentration is above the state ambient standard. However, predicted concentrations at public areas are well below both the Federal and state standards at levels less than 1.0 $\mu g/m^3$. Since state and Federal standards for all averaging periods are at levels above 80 $\mu g/m^3$, the NPR emission sources do not contribute any significant impacts on surrounding areas.

Carbon Monoxide Impacts. Figures D.4-9, D.4-10, D.4-11 and D.4-12 present the results of the ISC3ST modeling for CO. As can be seen in the figures, predicted concentrations of CO in 1995 and 2001 are well below state and Federal standards, even under maximum assumptions. Maximum predicted concentrations for 2001 under commercial operations are 8,393 $\mu g/m^3$ and 5,428 $\mu g/m^3$ for 1-hour and 8-hour averaging periods. In comparison to the more stringent state standards of 23,000 $\mu g/m^3$ (1-hour) and 10,000 $\mu g/m^3$ (8-hour), concentrations both on and off-site would be significantly below all applicable ambient air standards.

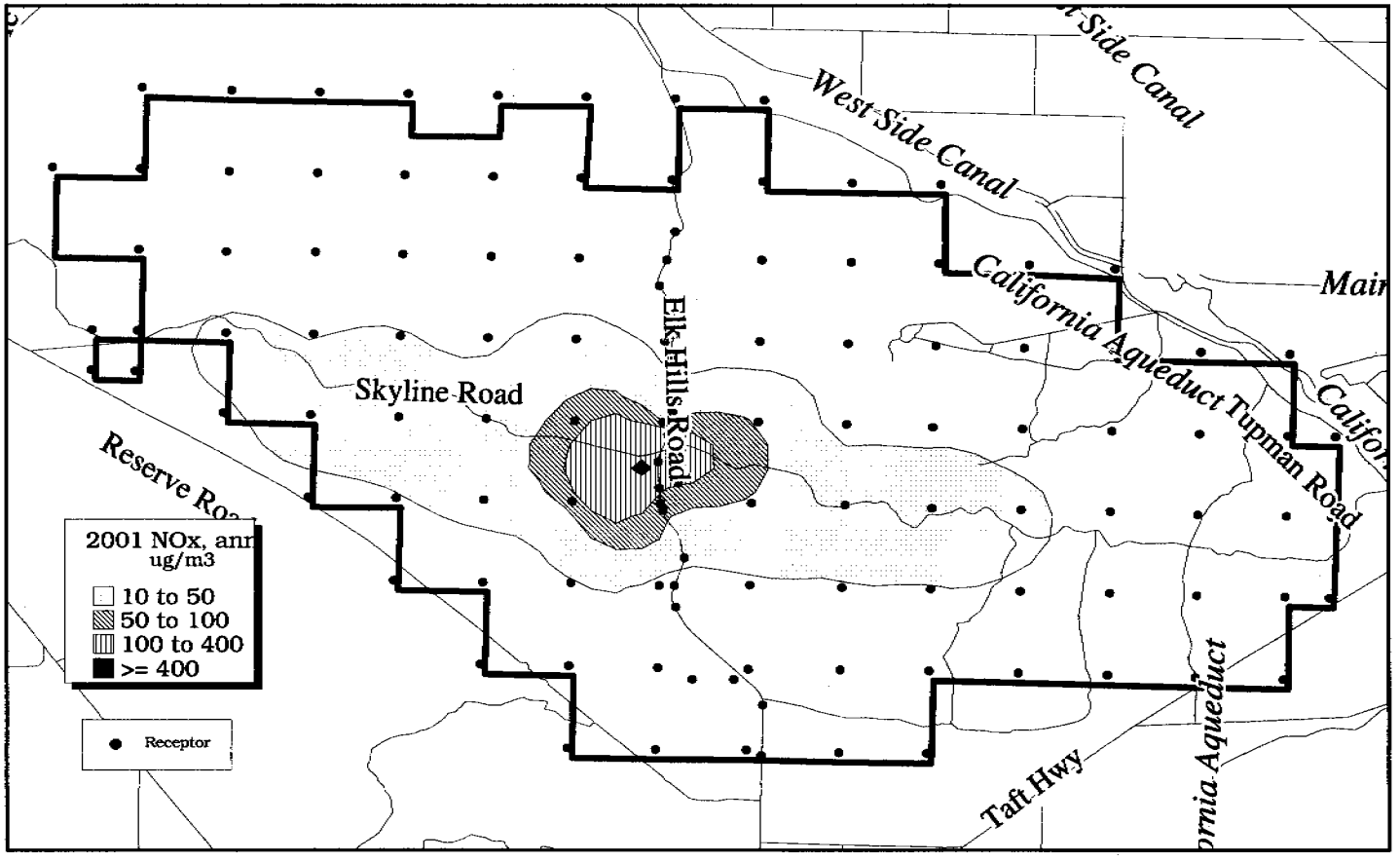
Particulate Impacts. Figures D.4-13, D.4-14, D.4-15 and D.4-16 show the extent of predicted particulate impacts throughout the NPR-1 facility due to the operation of both stationary and mobile (road dust) sources. An examination of the modeling results indicates that the majority of the particulate impacts are associated with dust from motor vehicles driving on paved and unpaved roads within the NPR-1 facility. The operation of these vehicles results in elevated level of particulates which could result in exceedances of state particulate standards. It should be noted, however, that these total predicted values include background values in exceedance of the state standards. Federal ambient standards, at 150 $\mu g/m^3$ for 24-hour and 50 $\mu g/m^3$ on an annual average, in comparison, should not be exceeded within the NPR-1 facility or in public areas off-site.

Figure D.4-3
Isopleths of Annual Average NO_x Concentrations in 1995



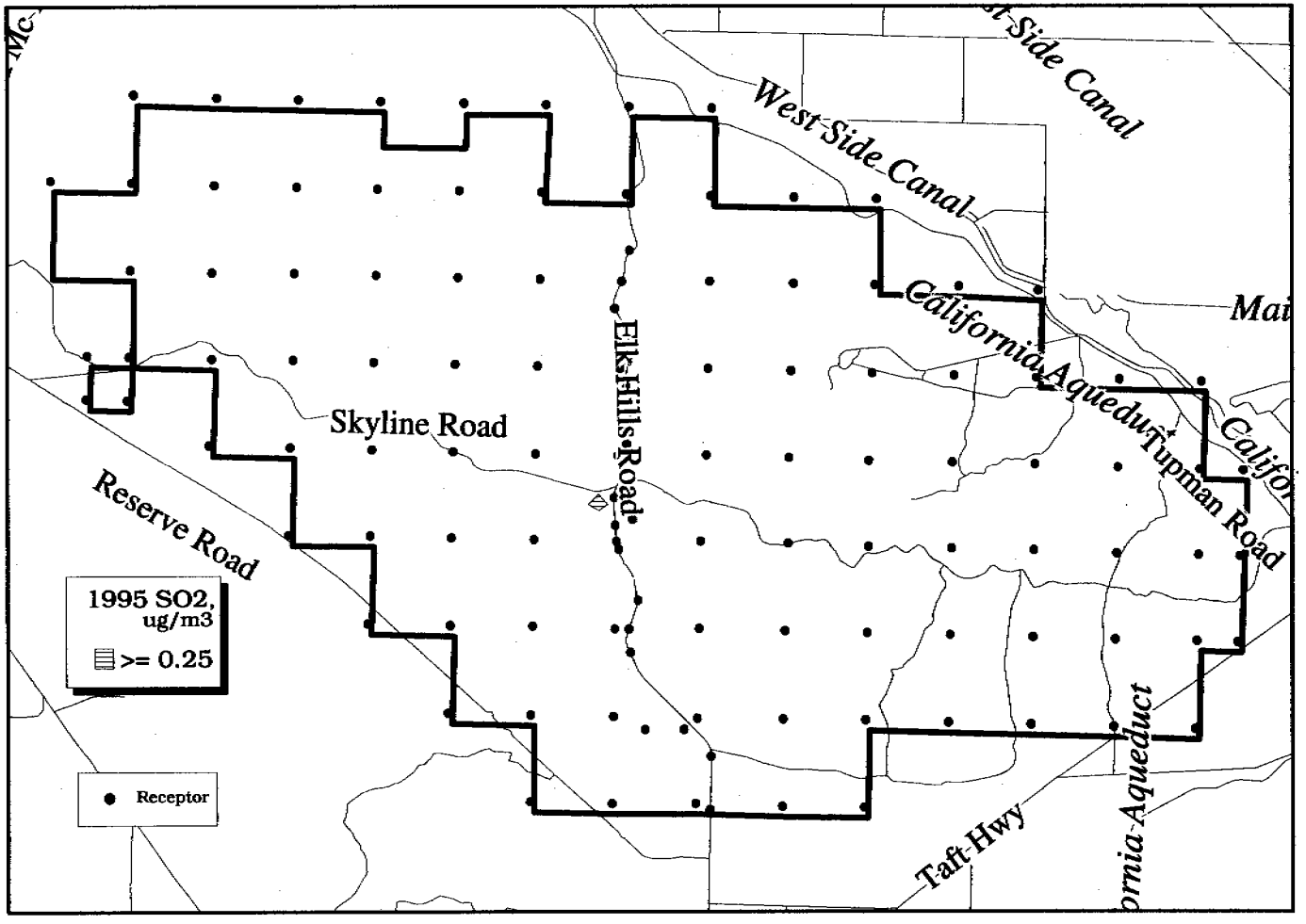
Concentration Isopleths for 1995 annual NOx

Figure D.4-4
Isopleths of Annual Average NO_x Concentrations in 2001



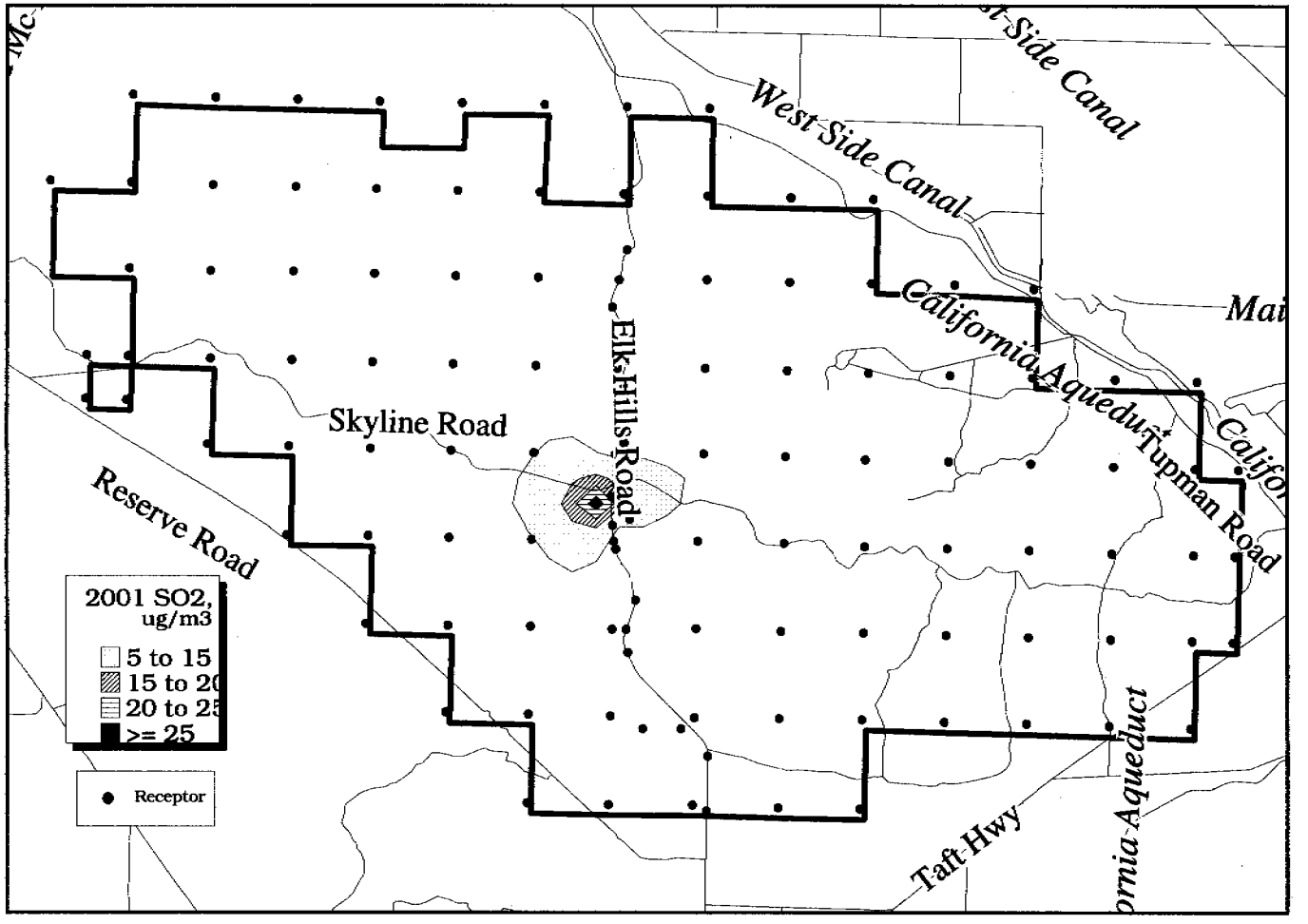
Concentration Isopleths for 2001 Annual NOx

Figure D.4-5
Isopleths of Annual Average SO_2 Concentrations in 1995



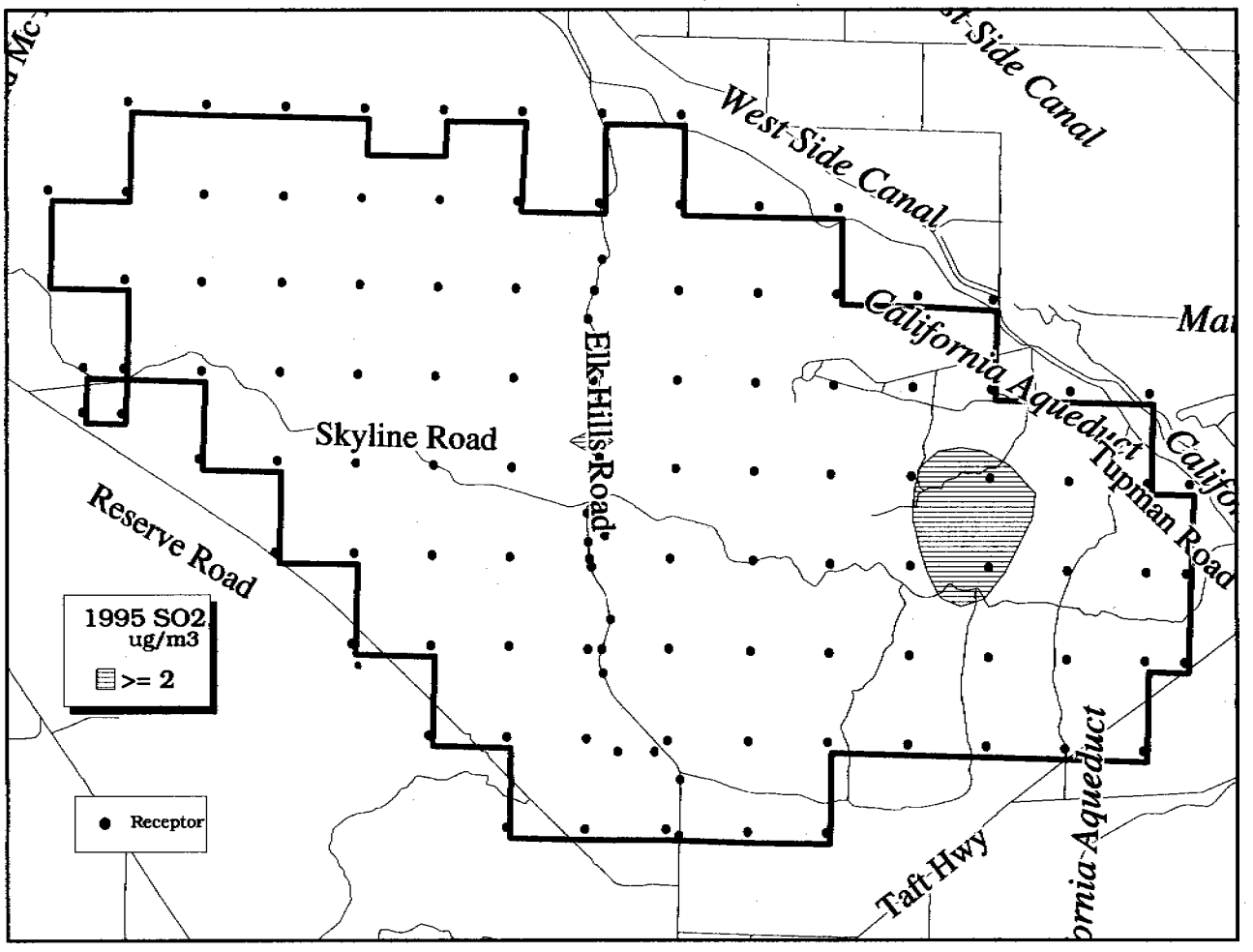
Concentration Isopleths for 1995 SO2, Annual

Figure D.4-6
Isopleths of Annual Average SO_2 Concentrations in 2001



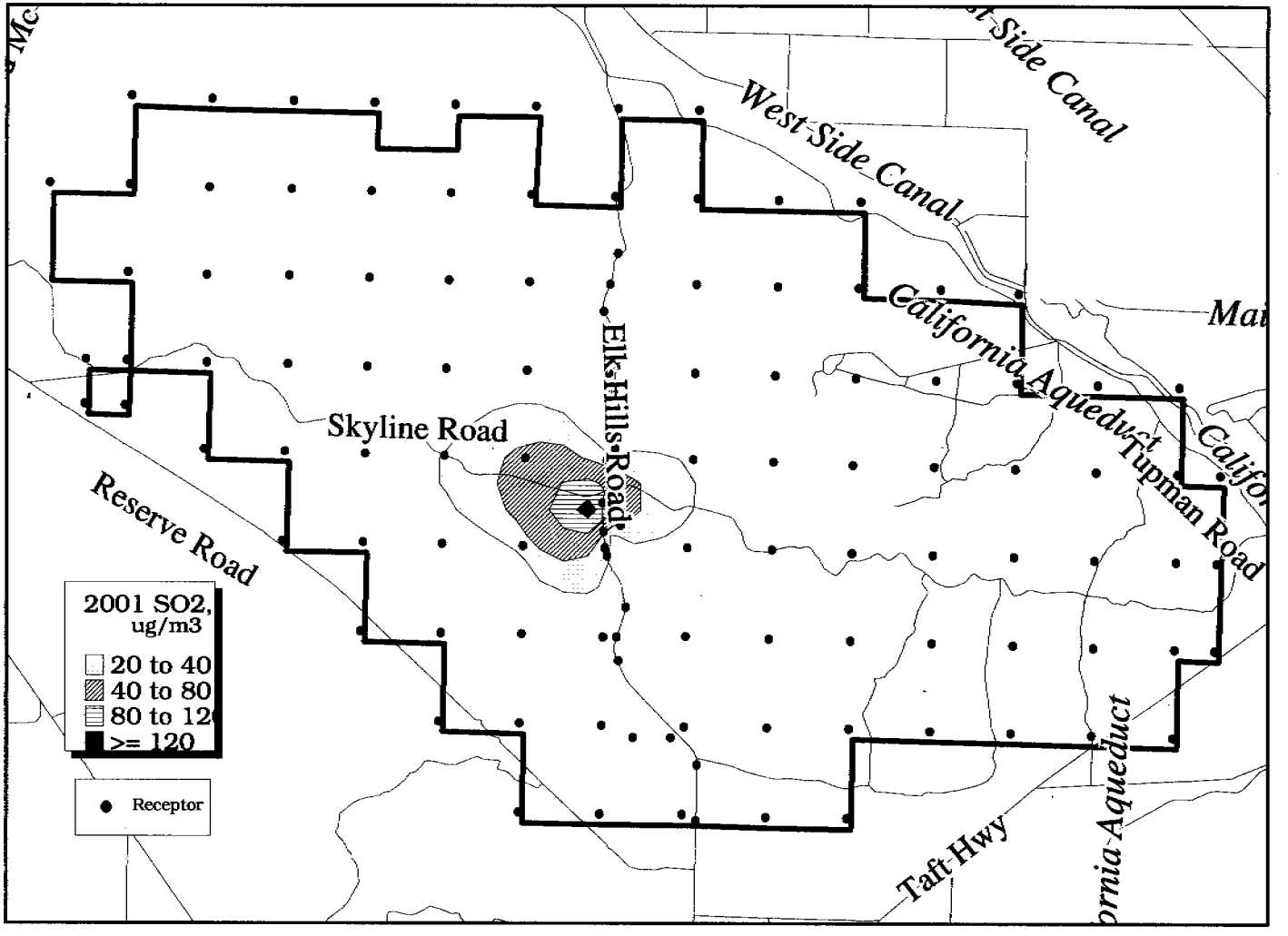
Concentration Isopleths for 2001 SO2, Annual

Figure D.4-7
Isopleths of 24-Hour Average SO_2 Concentrations in 1995



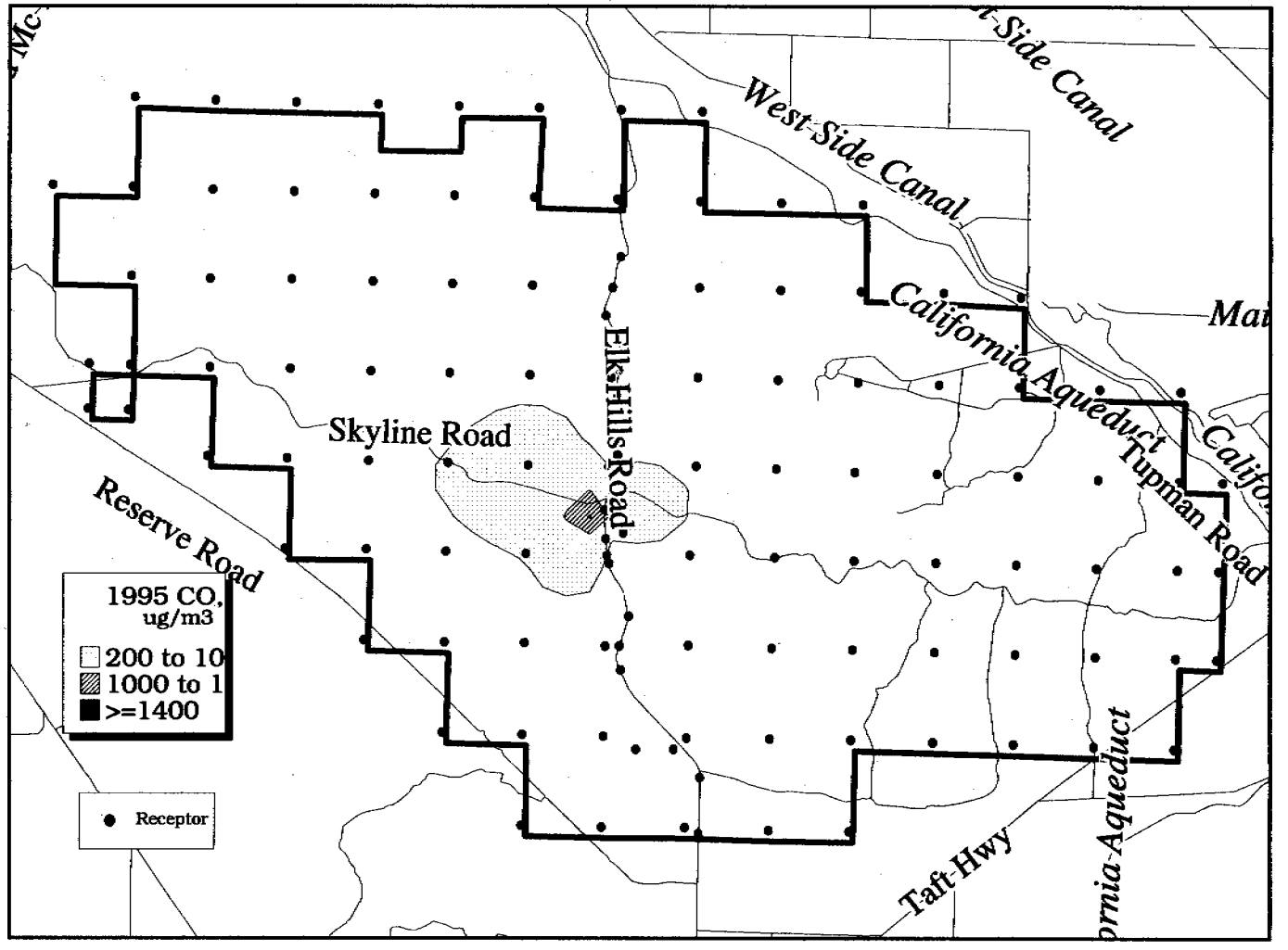
Concentration Isopleths for 1995 SO2, 24-hr

Figure D.4-8
Isopleths of 24-Hour Average SO_2 Concentrations in 2001



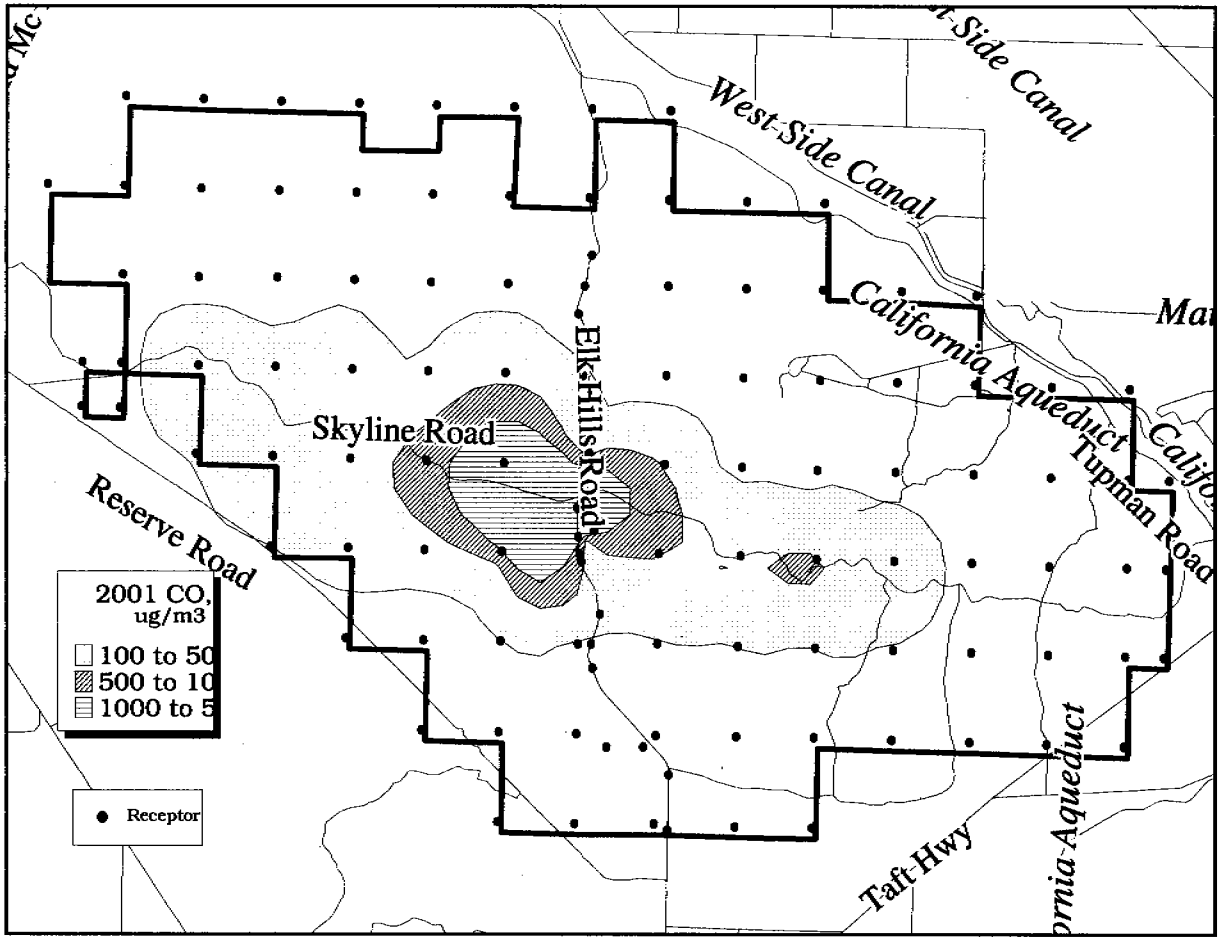
Concentration Isopleths for 2001 SO2, 24-hour

Figure D.4-9
Isopleths of 8-Hour Average CO Concentrations in 1995



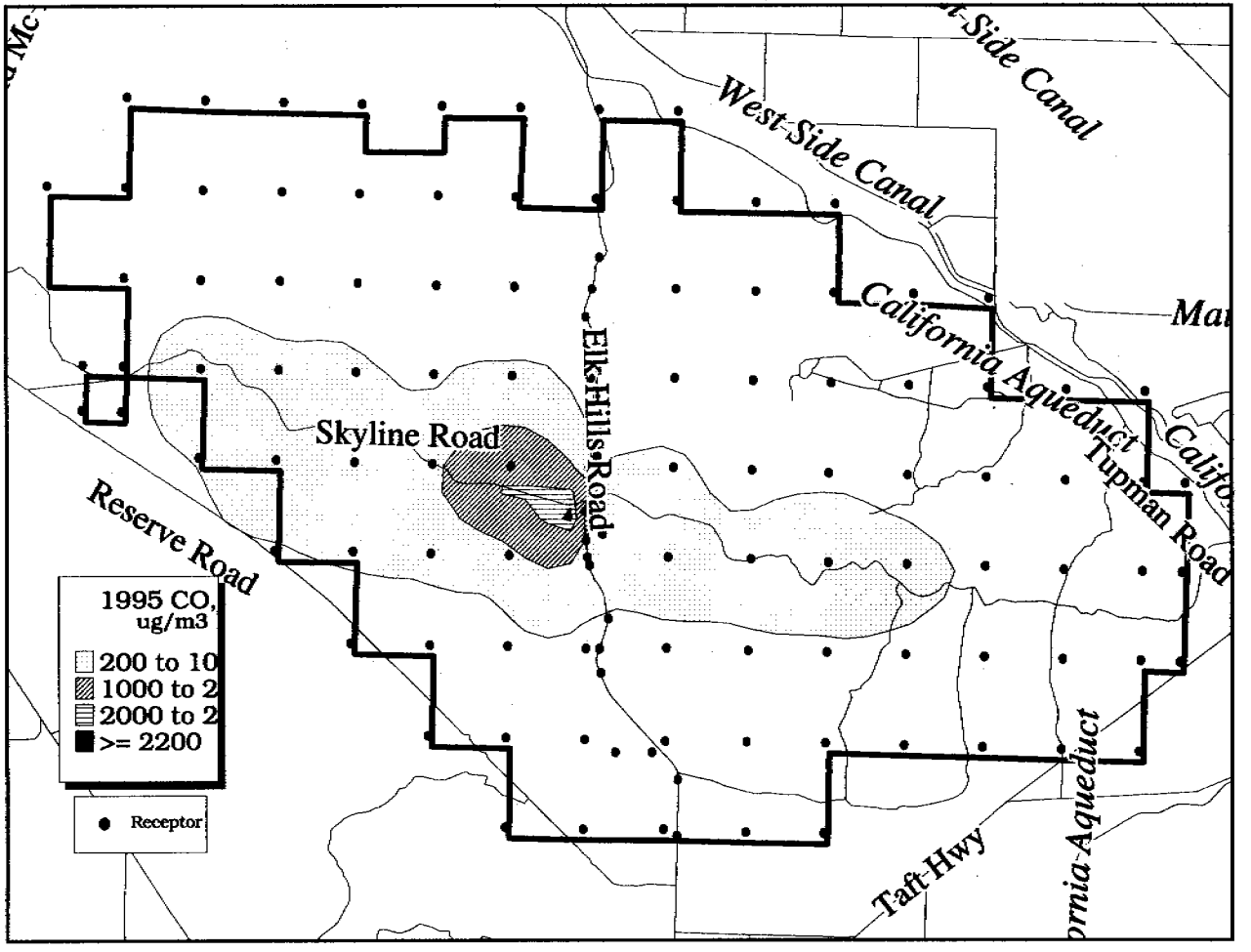
Concentration Isopleths for 1995 8-hr CO

Figure D.4-10
Isopleths of 8-Hour Average CO Concentrations in 2001



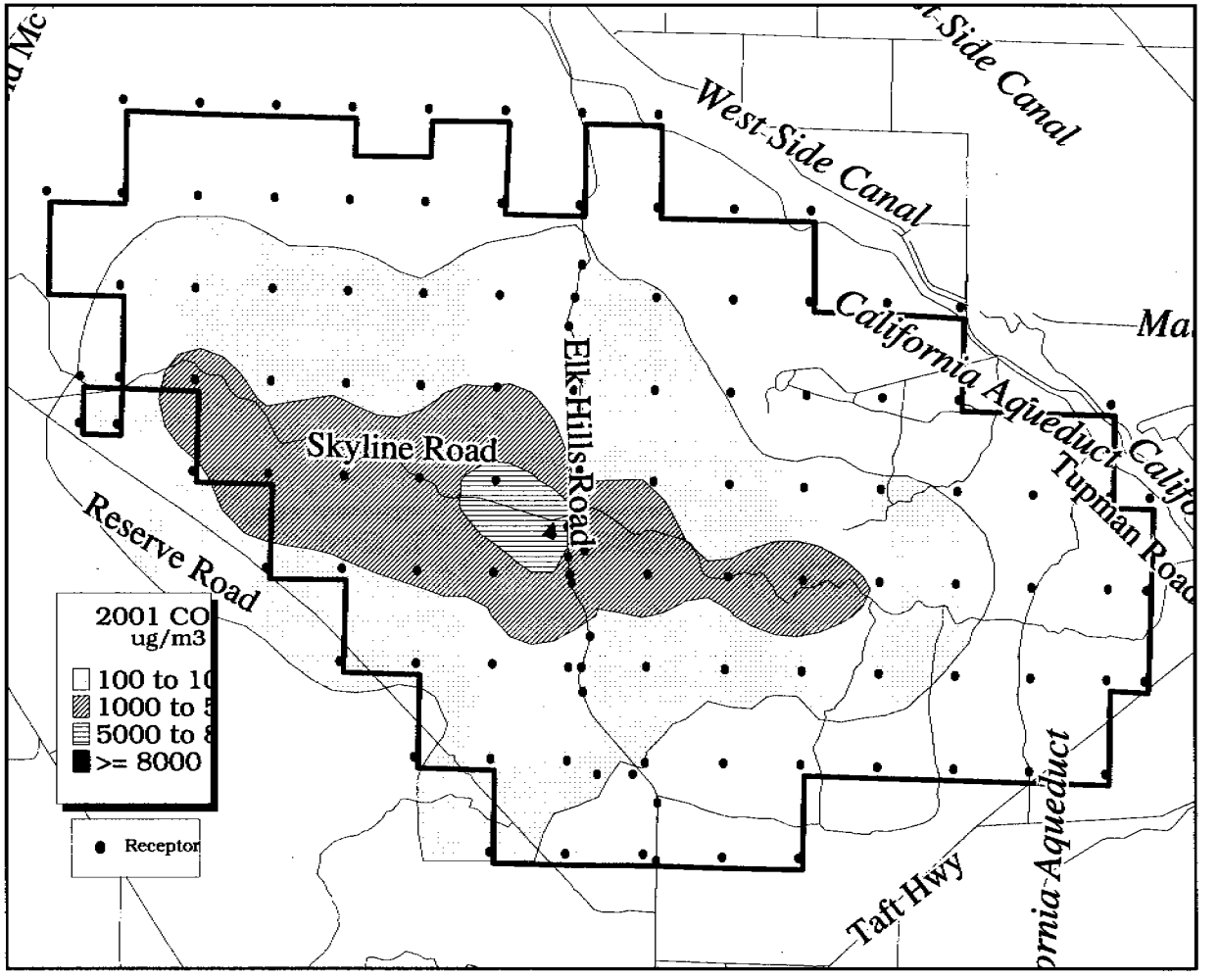
Concentration Isopleths for 2001 CO, 8-hr

Figure D.4-11
Isopleths of 1-Hour Average CO Concentrations in 1995



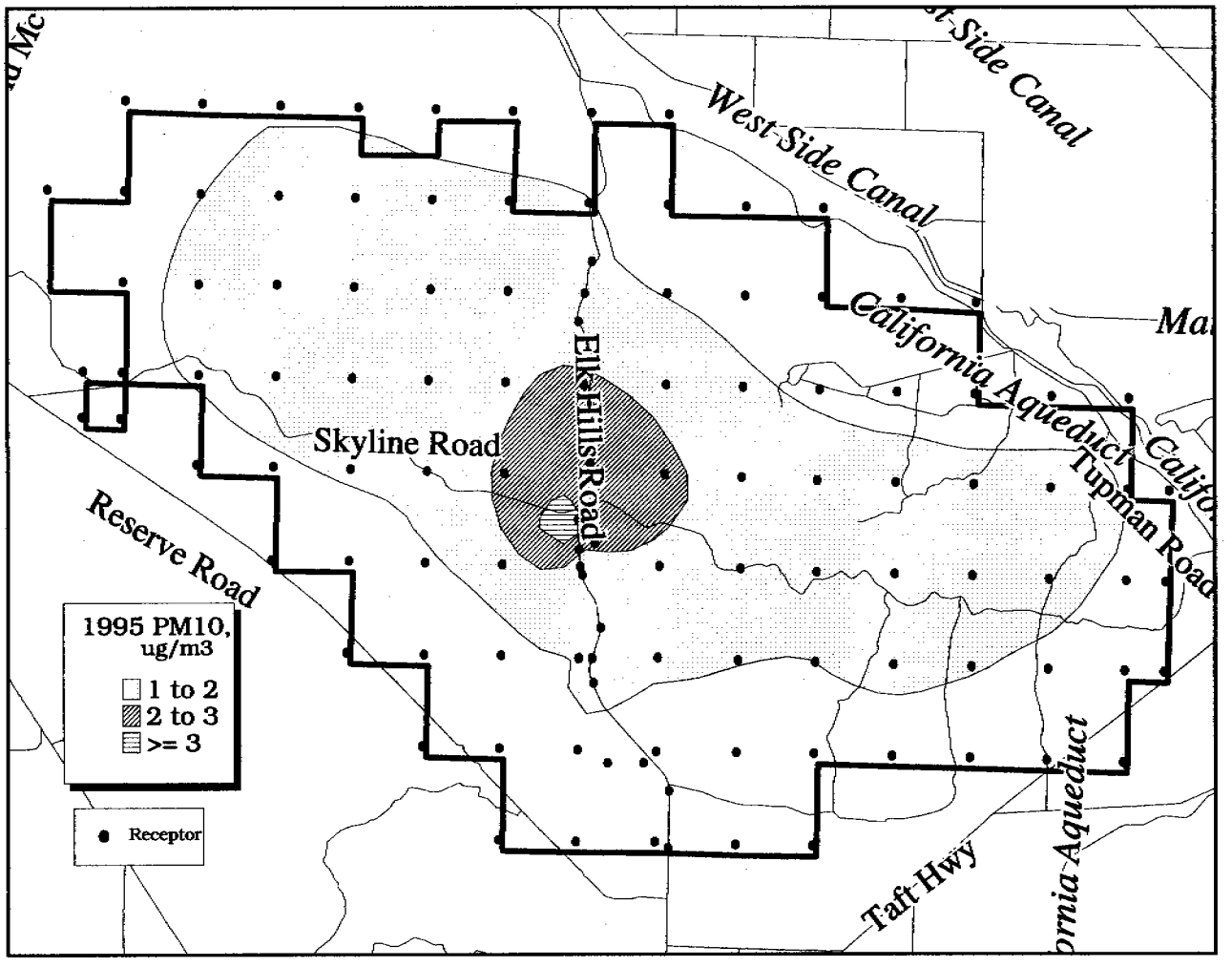
Concentration Isopleths for 1995 1-hr CO

Figure D.4-12
Isopleths of 1-Hour Average CO Concentrations in 2001



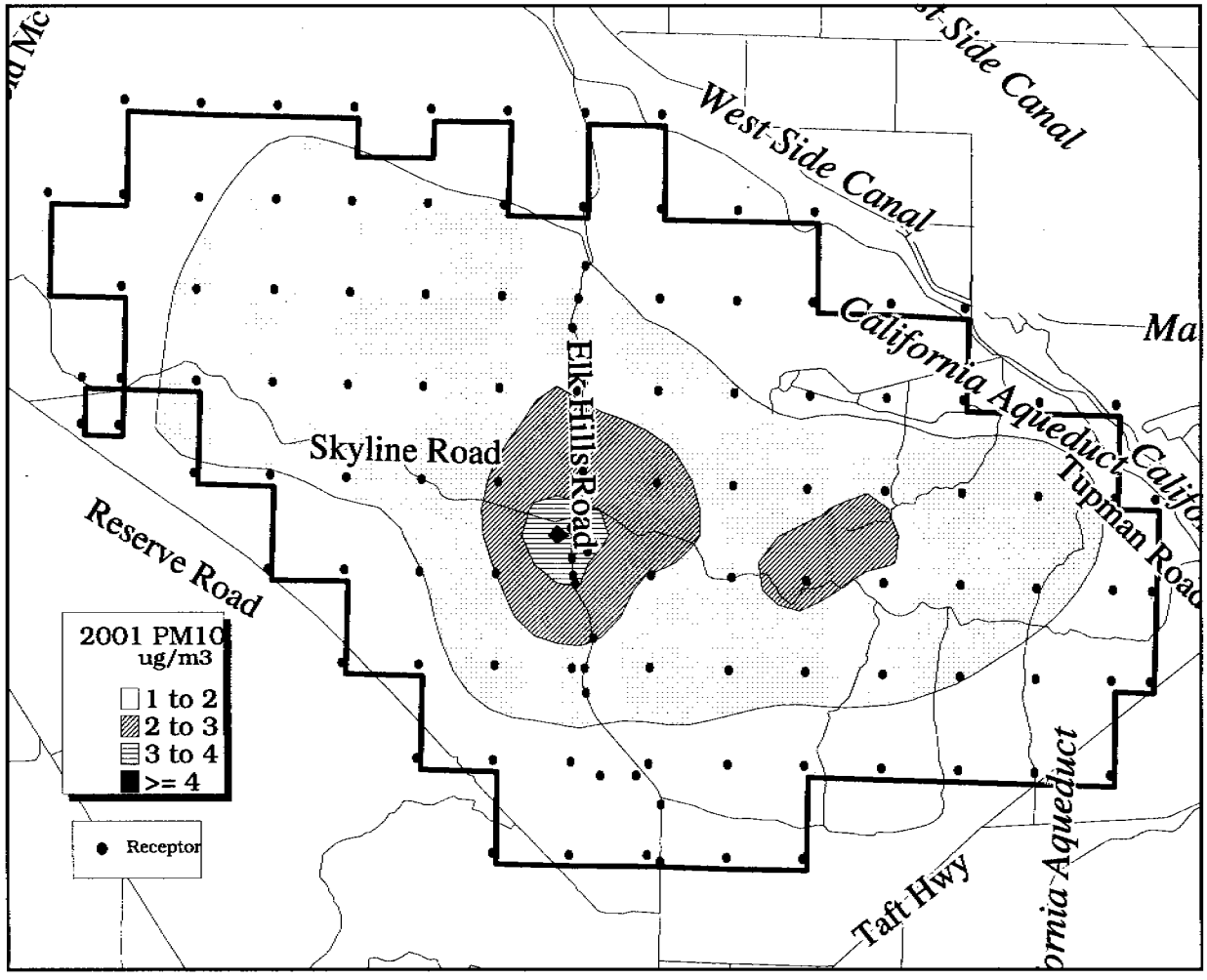
Concentration Isopleths for 2001 CO, 1-hr

Figure D.4-13
Isopleths of Annual Average PM_{10} Concentrations in 1995



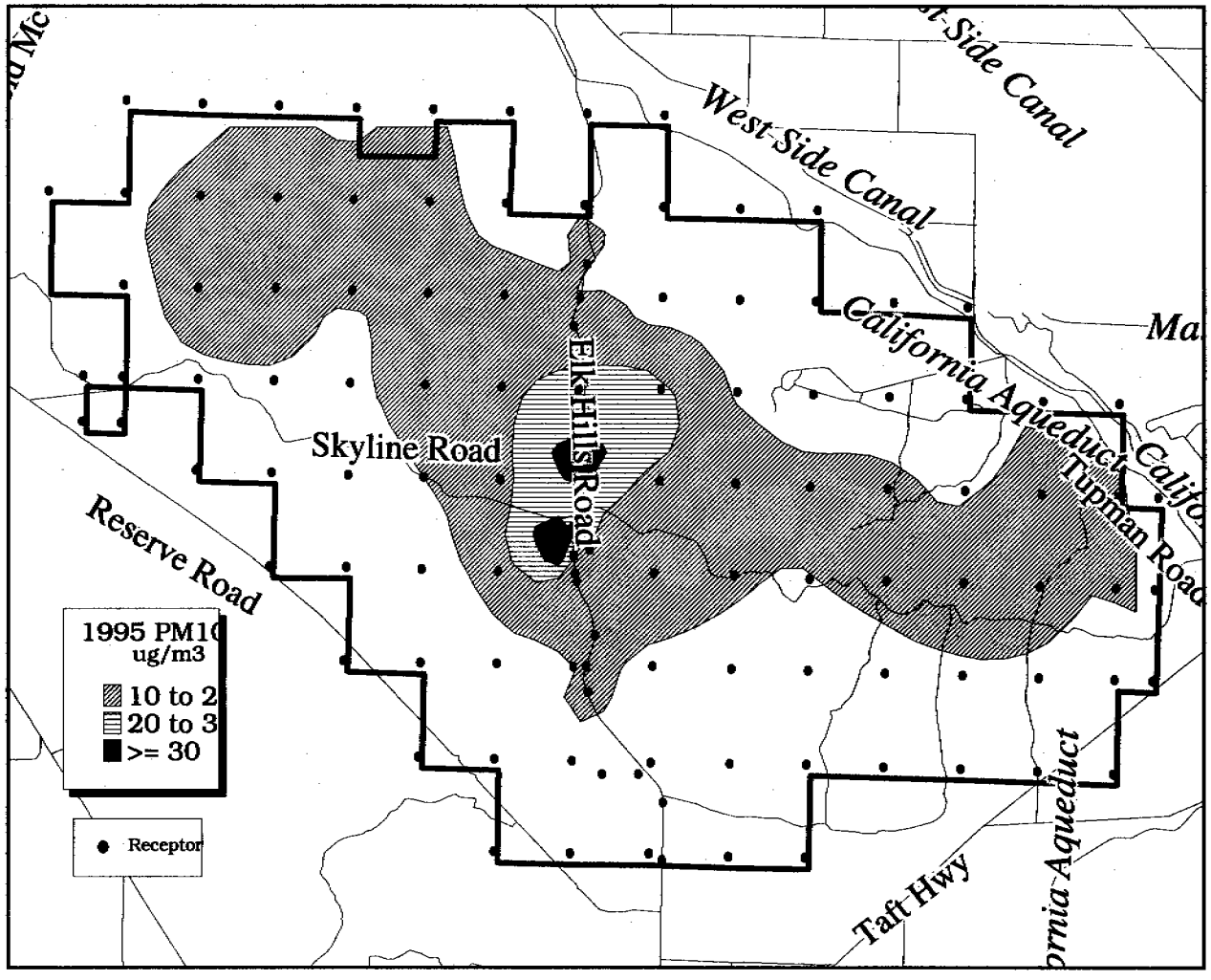
Concentration Isopleths for Annual 1995 PM10, Normal Conditions

Figure D.4-14
Isopleths of Annual Average PM_{10} Concentrations in 2001



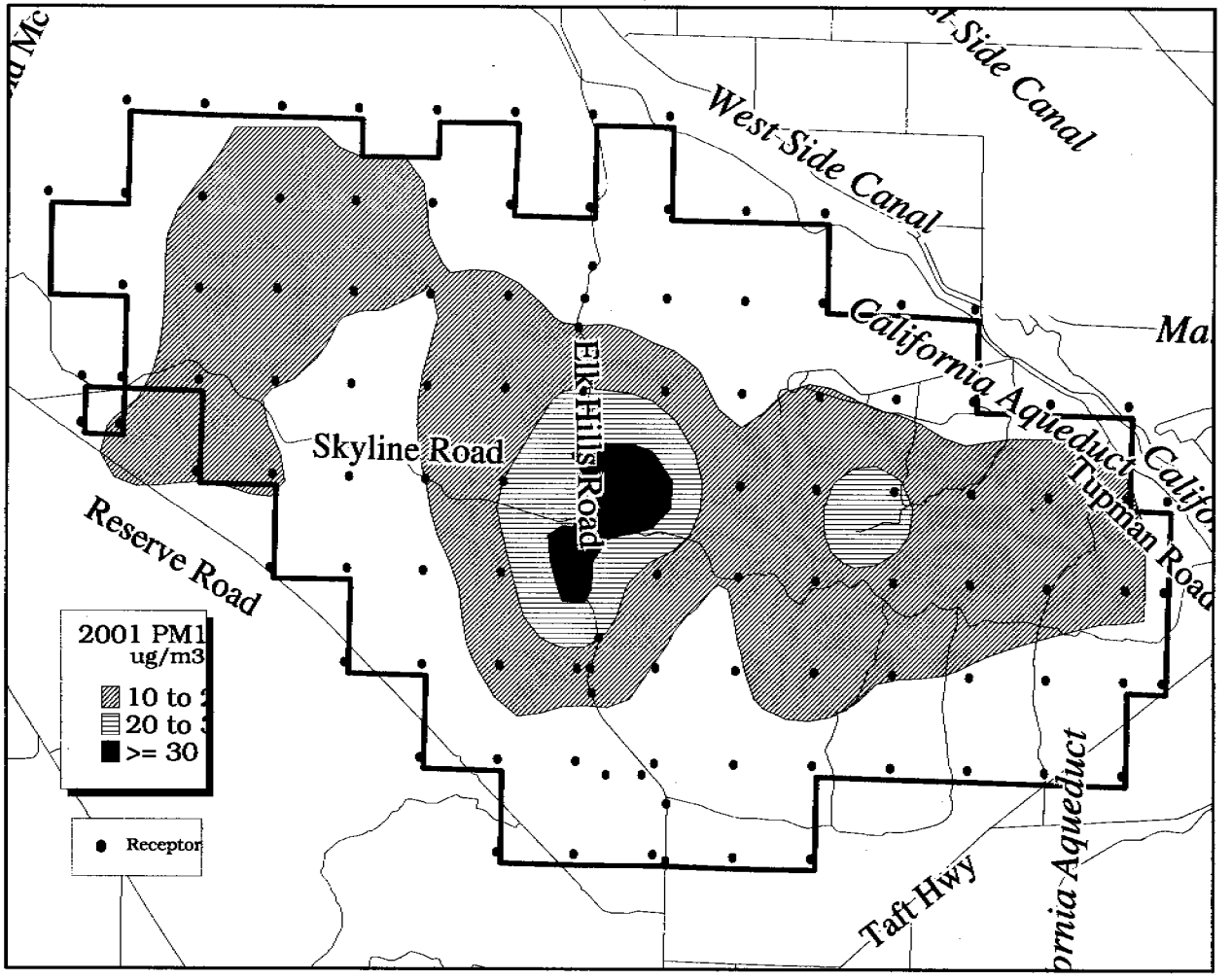
Concentration Isopleths for Annual 2001 PM10, Normal Conditions

Figure D.4-15
Isopleths of 24-Hour Average PM_{10} Concentrations in 1995



Concentration Isopleths for 1995 PM10, 24-hour, Normal Conditions

Figure D.4-16
Isopleths of 24-Hour Average PM_{10} Concentrations in 2001



Concentration Isopleths for 2001 PM10, 24-hour, Normal Conditions

D.4.3. Mobile Source Modeling Approach

In order to verify that the proposed future modifications to the NPR facility would not cause or contribute to new CO violations, the CALINE4 model was applied to the intersection of Elk Hills Road and Skyline Boulevard. CALINE4 is a line source air quality model developed by the California Department of Transportation to assess the air quality impacts near transportation facilities (FHWA 1984). CALINE4 uses source strength, meteorology and site geometry to predict pollutant concentrations for receptors located along a roadway. CALINE4 requires a number of traffic activity and meteorology-related input parameters in order to model CO concentrations. The key values utilized for this analysis are summarized in Table D.4-2.

Table D.4-2
Key Input Assumptions for CALINE4

Variable	1995 Value	2001 Value	Source Notes
Maximum OnG-Hour Volume Elk Hills NB Elk Hills SB Skyline EB Skyline WB	 160 160 175 175	 218 218 140 140	1995 values based on BPOI, 1989 vehicle counts; 2001 projects based on assumed operational changes
Lane Width	12 feet	12 feet	
Average Speed	30 mph	30 mph	Posted speed limit
Altitude	1340 feet	1340 feet	
Stability Class	D	D	Based on Fellows Monitoring Site data, 1983-1987
Sigma Theta	20 degrees	20 degrees	Caltrans guidance
Wind Direction	worst-case	worst-case	
Wind Speed	3.2 m/s	3.2 m/s	Mean wind speed observed for Stability Class D - Fellows Monitoring Site
Mixing Height	300 meters	300 meters	Caltrans guidance
Aerodynamic Roughness	100 cm	100 cm	Caltrans guidance
Temperature	40°F	40°F	Mean average winter temperature

The traffic volume assumptions used for the 1995 and 2001 CALINE4 modeling were estimated based upon the observed traffic volumes developed by Bechtel Petroleum Operations in 1989 and reported in the documentation of the previous environmental assessment in Figure B.22 (DOE 1993). The number of trips on- and off-site used for the emissions analysis and their distribution among vehicle types was used to allocate the volumes to different vehicle groups. Assuming the volumes reported in the previous analysis were assumed to represent 1995 conditions; 2001 traffic levels were estimated using assumptions related to changes in facility operations. Base trip volumes for automobiles and light trucks were modified to reflect a workforce reduction of 25 percent in 2001; heavy-duty truck volumes were increased to reflect a 68 percent increase in production levels in 2001.

The documentation of the previous environmental assessment included several tables of meteorological monitoring data collected in the area of the NPR facility in the late 1980's. The CALINE4 inputs for wind speed, atmospheric stability and prevailing wind direction were developed based upon the information in these tables (DOE 1993).

The four links, representing the intersection of Elk Hills Road northbound and southbound and Skyline Road eastbound and westbound, were input into CALINE4 along with an array of 20 receptors.

The receptors were distributed at varying distances from each link and from the intersection in order to capture the maximum 1-hour CO concentration generated during the peak hour (assumed to be 6 a.m.). The maximum predicted concentrations for 1995 and 2001 were 0.2 ppm in 1995 and 0.1 ppm in 2001, well below national and state standards when added to the maximum predicted CO concentrations from stationary sources.

D.4.4. References

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Appendix E
Biological Assessment for NPR-2

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This appendix contains the Biological Assessment of the effects of continued exploration, development, and operation at NPR-2 on threatened and endangered species.

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BIOLOGICAL ASSESSMENT OF THE EFFECTS OF CONTINUED EXPLORATION, DEVELOPMENT, AND OPERATION, NAVAL PETROLEUM RESERVE NO. 2, (BUENA VISTA HILLS) KERN COUNTY, CALIFORNIA, ON THREATENED AND ENDANGERED SPECIES

Submitted To:

U.S. Department of the Interior
Fish and Wildlife Service
Sacramento Field Office
Sacramento, California 95825

By:

U.S. Department of Energy
Naval Petroleum Reserves in California
Tupman, California 93276

May, 1994

ACKNOWLEDGEMENTS

This Biological Assessment was prepared for the U.S. Department of Energy, Naval Petroleum Reserves in California, by EG&G Energy Measurements, Inc., through the Nevada Operations Office under Contract No. DE-AC08-93NV11265.

Department of Energy
Naval Petroleum Reserves in California
P.O. Box 11
Tupman, California 93276

MAY 25 1994

Mr. Wayne White
State Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
2800 Cottage Way, Room E-1803
Sacramento, CA 95825-1846

Dear Mr. White:

Pursuant to Section 7 of the Endangered Species Act, the Department of Energy (DOE), Naval Petroleum Reserves in California (NPRC), requests a formal consultation and Biological Opinion for continued exploration, development, and operation of Naval Petroleum Reserve No. 2 (NPR-2). Attached is the Biological Assessment for NPR-2 activities prepared by EG&G Energy Measurements, Inc. (EG&G\EM), DOE's endangered species contractor, to initiate the consultation process.

The species considered for this Biological Assessment (BA) were obtained from your office in a letter dated June 14, 1993 (ref. 1-1-93-TA-974). These species include the endangered San Joaquin kit fox (Vulpes velox macrotis), blunt-nosed leopard lizard (Gambelia silus), giant kangaroo rat (Dipodomys ingens), Tipton kangaroo rat (Dipodomys nitra toides nitratoides), Kern mallow (Eramalche kernensis), and the threatened Hoover's wooly-star (Eriastrum hooveri). Candidate species included the San Joaquin antelope squirrel Ammospermophilus nelsoni), short-nosed kangaroo rat (Dipodomys nitratoides brevinasus), and hollisteria (Hollisteria lanata).

Based on the NPR-2 BA, it is our conclusion that the proposed activities will not jeopardize the continued existence of the referenced species, nor will these activities adversely affect critical habitat, as none have been designated. As part of the review process for the National Environmental Policy Act, a draft Environmental Assessment for NPR-2 was concurrently prepared, and is attached for your reference (Attachment 2). The project description presented within the attached NPR-2 BA is consistent with the draft NPR-2 Environmental Assessment. The NPR-2 BA also covers several mitigation measures which are intended to eliminate or minimize

impacts to listed species, limit areas where endangered species habitat may be disturbed, and restore habitat to approximate pre-disturbance conditions.

We request the opportunity to review the draft Biological Opinion. Should you have any questions regarding the Biological Assessment, please contact Mr. James C. Killen of my staff at (805) 763-6038, or Mr. Thomas T. Kato of EG&G\EM at (805) 763-6811.

Sincerely,

James C. Killen
for Director, Planning, Analysis
and Program Support Division

2 Attachments

cc: (Attachment 1 only)
Mr. Peter Cross
U.S. Department of the Interior
Fish and Wildlife Service
Sacramento Field Office
2800 Cottage Way, Room E-1803
Sacramento, CA 95825-1846

cc: (w/o attachments)
Mr. Thomas T. Kato
Manager, Applied Ecology Department
EG&G Energy Measurements, Inc.
P.O. Box 127
Tupman, CA 93276

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FIGURES

EXECUTIVE SUMMARY

The U.S. Department of Energy proposes to continue lease activities directly and indirectly related to petroleum development and exploration on 10,446 acres of Federally-owned lands currently under its jurisdiction within the boundary of Naval Petroleum Reserve No. 2 (NPR-2), located in Kern County, California, about 26 miles west of Bakersfield, California. Petroleum-related activities will include actions directly or indirectly related to petroleum production and exploration operations. Nonpetroleum-related activities, such as utility easements and agricultural use, also would be continued under the proposed action. The proposed action may affect the San Joaquin kit fox (*Vulpes velox macrotis* = *Vulpes macrotis mutica*, see Dragoo *et al.*, 1990), blunt-nosed leopard lizard (*Gambelia silus*), giant kangaroo rat (*Dipodomys ingens*), Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*), Kern mallow (*Eremalche kernensis*) and Hoover's wooly-star (*Eriastrum hooveri*). Three candidate species, the San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), and hollisteria (*Hollisteria lanata*), were found on NPR-2. Impacts to endangered and threatened species will be mitigated by the implementation of preactivity surveys, restoration of abandoned facilities to approximate pre-disturbance conditions, and implementation of operating guidelines that protect wildlife.

1. INTRODUCTION

1.1 BACKGROUND

Naval Petroleum Reserve No. 2 (NPR-2) was established by an Executive Order issued by President William H. Taft on December 13, 1912. NPR-2 was created about three months after Naval Petroleum Reserve No. 1 (NPR-1) because of the Navy's concern that Elk Hills did not contain adequate reserves to meet the demands of the new oil-burning fleet. Both NPR-1 and NPR-2 were included in the original 1909 Withdrawal Order issued by the Department of the Interior (DOI) closing public oil-bearing lands to appropriation. NPR-2 was not preserved as a whole because some drilling and leasing activities preceded the land withdrawals (10 USC Chapter 641, Section 7420).

NPR-2 is located in the southern San Joaquin Valley approximately 26 miles west of Bakersfield and adjacent to the southern boundary of NPR-1, Kern County, California (Figure 1). NPR-2 consists of 30,181 acres of hydrocarbon-bearing land in Townships B (T31S, R23E), C (T32S, R23E), D (T32S, R24E), G (T31S, R24E), and H (T32S, R 25E) (Mt. Diablo Meridian). The City of Taft occupies Sections 12C and 13C in the southern corner of NPR-2. State Highway 119, a major arterial highway through the region, bisects NPR-2. The Federal Government owns, and the U.S. Department of Energy (DOE) retains stewardship responsibilities over, 18 parcels of land with a combined area of 10,446 acres (Figure 2). The remaining 19,735 acres are privately owned by the City of Taft, Ford City, private companies, and private citizens. These properties are intermingled in a "checkerboard" arrangement.

Of the 10,446 acres administered by DOE, 9,224 acres have been leased to seven oil companies for petroleum development under 15 active oil and gas leases. The oil and gas rights to the remaining 1,222 acres have been retained by DOE. Of these, the surface rights to approximately 360 acres have been sold to private citizens for residential use.

The Federal Government issued revocable permits to various public and private parties for surface rights to conduct a variety of activities on NPR-2. These nonpetroleum-related activities occur throughout NPR-2 on leased and unleased lands and include agriculture and produced water disposal activities; maintaining oil and gas pipelines; operating the California Aqueduct and a pumping plant; and maintaining water pipelines, television cables, telephone lines, and powerlines.

1.2 PURPOSE OF THE BIOLOGICAL ASSESSMENT

DOE proposes to continue leases and third-party agreements on DOE-administered lands located within the boundaries of NPR-2. DOE has initiated reviews under the National Environmental Policy Act (NEPA) for continued leasing and third party/permittee activities on the portions of NPR-2 managed by DOE. NEPA requires all Federal agencies to consider the environmental consequences of their activities. On August 1, 1991, Bechtel

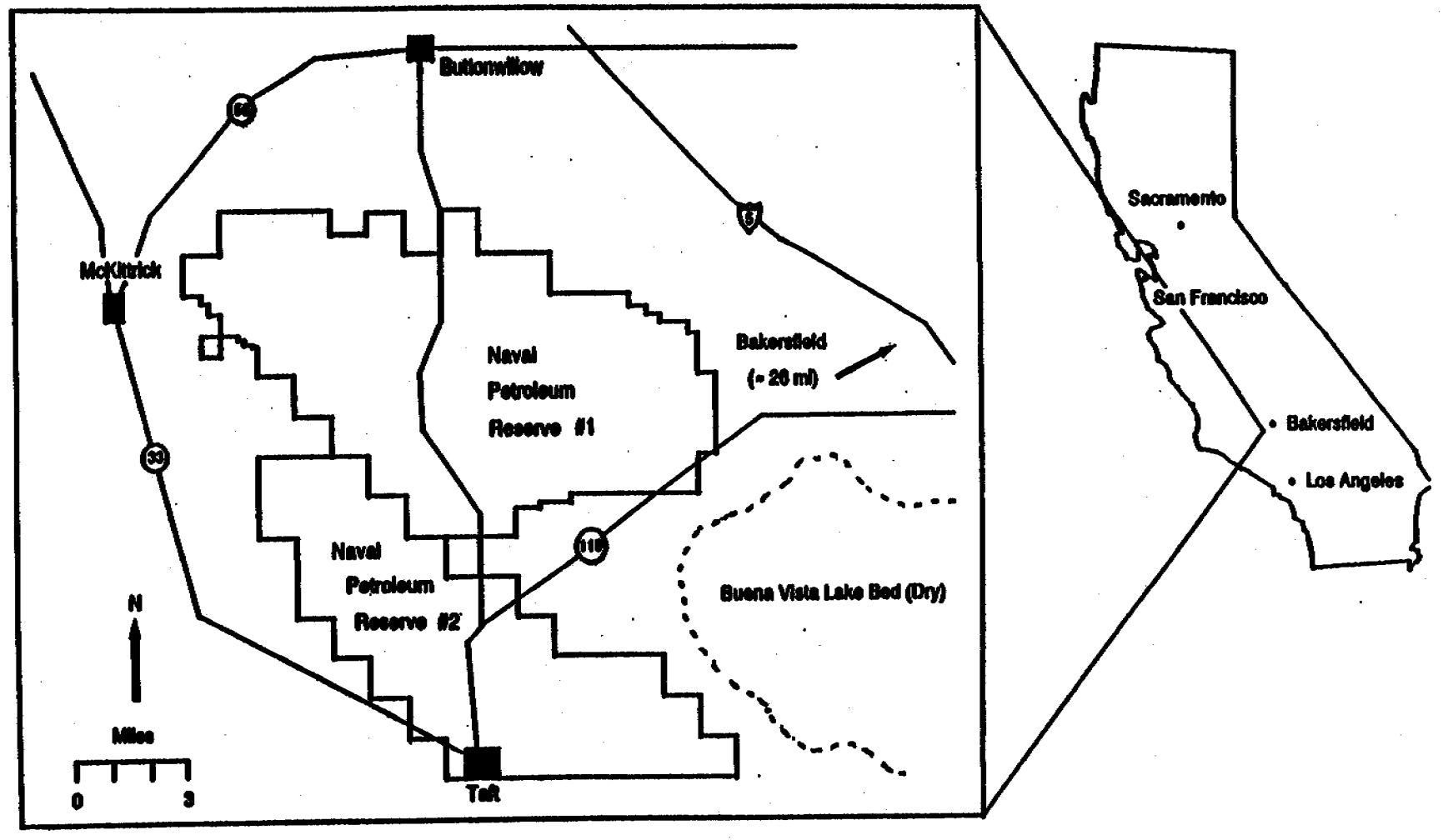

Figure 1. Location of U.S. Department of Energy's Naval Petroleum Reserves, Kern County, California.

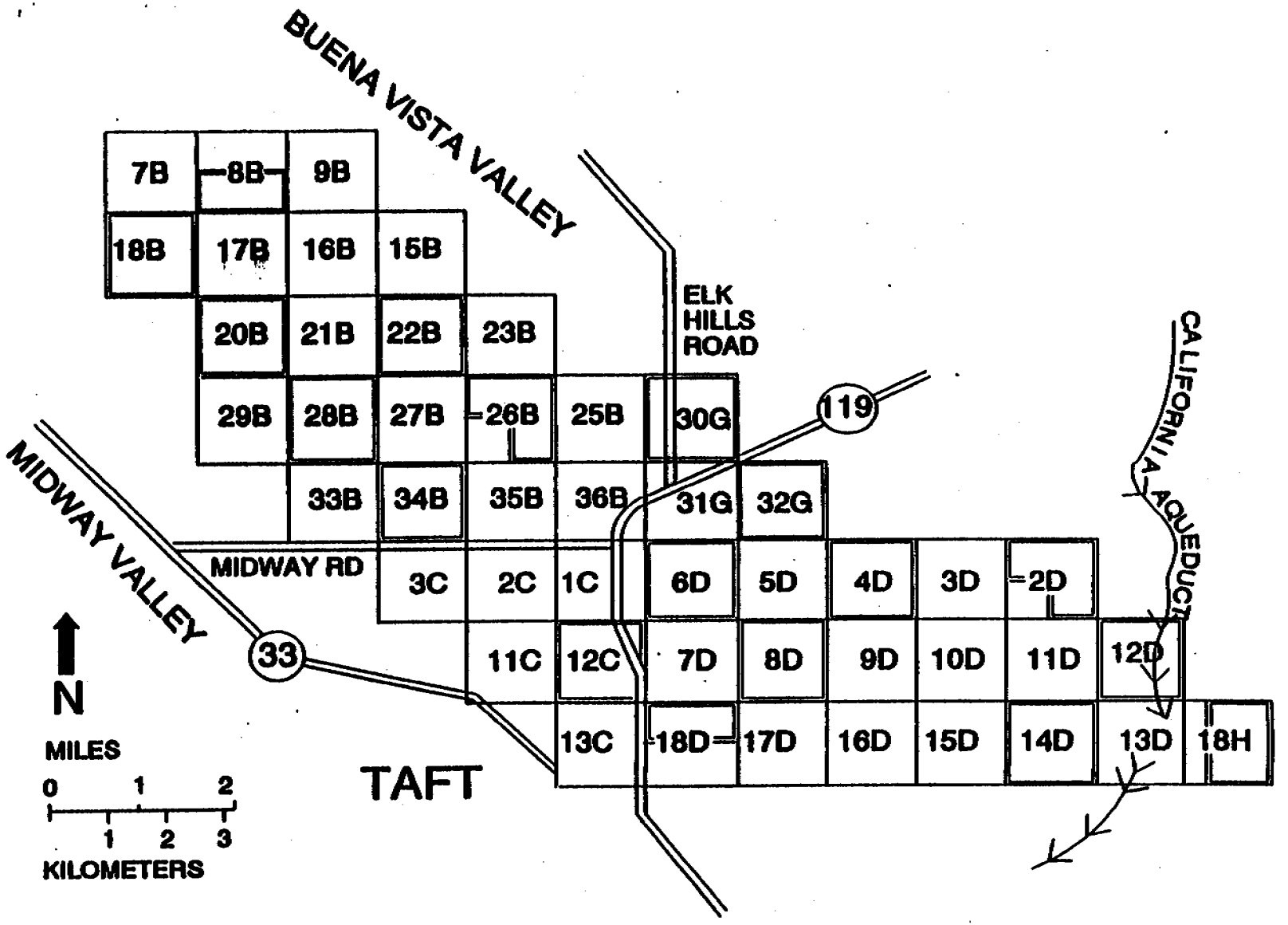

Figure 2. Naval Petroleum Reserve #2, Kern County, California showing location of numbered sections within townships coded by letters. Parcels of land enclosed by double lines are owned by the U.S. Department of Energy.

Petroleum Operations, Inc. (BPOI), the Unit Operator for NPR-1, was directed by the Director of the Naval Petroleum Reserves in California (NPRC) to prepare an Environmental Assessment to fulfill the environmental review requirements of NEPA. The purpose of this biological assessment is to evaluate the potential direct, indirect, and cumulative effects of continued DOE, leasing, and permittee activities on threatened and endangered species and their habitat on NPR-2.

Specific goals are to:

- Provide comprehensive information on the listed and candidate species occurring within the project area.
- Evaluate the potential impacts of the proposed activity on the listed and candidate species affected by the project.
- Determine whether the project will adversely affect listed or candidate species.
- Present mitigation measures to eliminate or substantially reduce the potential impacts on the listed species and their habitat.
- Provide sufficient relevant information for the U.S. Fish and Wildlife Service (FWS) to render a biological opinion for actions proposed on NPR-2.

2. PROJECT SETTING

2.1 TOPOGRAPHY AND PHYSIOGRAPHY

2.1.1 Topography

The major topographic feature of NPR-2 is the Buena Vista Hills, a low-lying but distinctive range that forms a northwest-southeast crest along its length. The Buena Vista Hills extend roughly parallel to the larger and more dissected Elk Hills to the north. Together these two sets of hills form a region of hilly terrain rising from the valley floor at the southwestern edge of the San Joaquin Valley just east of, but disjunct from, the steep Temblor range. NPR-2 also includes some flatter land along the edges of Buena Vista and Midway Valleys. Elevations range between 310 to 1,288 feet.

2.1.2 Soils

Soils on NPR-2 are typical of those developed from relatively fine-grained residual or alluvial materials under semi-arid to arid conditions. A characteristic soil tends to be very deep, well-drained, light-colored, and loamy in texture with abundant rock fragments. NPR-2 soils contain an abundance of alkaline salts and carbonates. These soils are also characterized by moderately slow permeability, slow surface runoff and slight erosion hazard on slopes (0-2%). In areas of slightly greater slope (9-15%) runoff is medium and the erosion hazard is moderate. Where slopes are greater than 30% surface runoff is rapid and the erosion hazard is moderate to severe. In some areas of NPR-2, especially where Torriorthents soils occur, plant growth may be naturally reduced. This is because the potential rooting depth of plants is restricted by excess salts which have not leached from the soil (U.S. Department of Agriculture, undated).

2.1.3 Climate

Annual weather patterns consist of hot, dry summers and cool, damp winters. Temperatures in the summer are often above 100°F and temperatures in the winter are seldom below 35°F. Average annual precipitation recorded at Taft is 4.9 inches. Approximately 89% of the precipitation occurs from November to April. Rainfall is usually gentle and individual storms are short-lived. Fog occurs more than 10% of the days during the winter months. A more complete description of the climate is presented in O'Farrell and Mitchell (1985).

2.2 NPR-2 FACILITIES AND OPERATIONS

The government agencies and private companies which conduct petroleum-related activities on DOE-administered NPR-2 lands include Chevron USA, Inc.; Fred S. Holmes Drilling/Western Well Services Company; Mobil Oil Corporation; Oakland Petroleum Operating Company; Phillips Petroleum; Texaco, USA; UNOCAL Corporation; Valley Waste Disposal Company; Vintage Petroleum Company; and numerous pipeline companies.

The private companies and government agencies conducting nonpetroleum-related activities on DOE-administered NPR-2 lands include BPOI, Bureau of Land Management, California Department of Food and Agriculture (CDFA), California Department of Transportation, California Department of Water Resources (DWR), EG&G Energy Measurements, Inc. (EG&G/EM), Continental Telephone Company, Kern County (Kern County Waste Management Department, Kern County Road Maintenance), West Kern Water District (WKWD), Pacific Gas and Electric Company (PG&E), City of Taft, City of Ford, and Warner-Amex. New agreements may be established between DOE and other companies and agencies.

2.3 TERRESTRIAL BIOTA

Various reports and data sources were reviewed to evaluate the biological resources of the project area, including the occurrence of listed and candidate species. Studies assessing the impacts of petroleum development on endangered species have been conducted on NPR-2 since 1981 and the results of some of these studies have been published in topical reports (O'Farrell and Sauls, 1987; O'Farrell et al., 1987a). Information was compiled or adapted, in part, from these reports. Data collected from ongoing studies was also reviewed for relevance. A survey for listed and candidate plant species was conducted in the spring of 1993. Other information was derived from the California Natural Diversity Database, existing literature records, and other biological assessments prepared for projects on or adjacent to NPR-2. Plant nomenclature follows Munz and Keck (1959).

2.3.1 Plant Communities

The predominant vegetation association on NPR-2 is described as San Joaquin saltbush association by Küchler (1977) and Lower Sonoran grassland by Twisselmann (1967). The most common shrub is desert saltbush (*Atriplex polycarpa*) which is especially dense in disturbed areas along roadsides and the edges of well pads. Other shrubs include spiny saltbush (*Atriplex spinifera*), cheesebush (*Hymenoclea salsola*), bladderpod (*Isomeris arborea*), buckwheat (*Eriogonum fasciculatum*), and snakeweed (*Gutierrezia bracteata*). Ground cover consists chiefly of introduced winter annuals such as red brome (*Bromus rubens*) and red-stemmed filaree (*Erodium cicutarium*). Portions of Sections 12D and 18H adjacent to the Buena Vista Lake Playa are dominated by the alkali sink association characterized by inkweed (*Sueda fruticosa*).

2.3.2 Animal Communities

NPR-2 supports an abundant and diverse vertebrate fauna. Surveys have documented the presence of 20 species of mammals, 45 species of birds, and 8 species of reptiles on NPR-2 (O'Farrell et al., 1987a).

The most common mammal species on NPR-2 are rodents and lagomorphs including: the short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), Heermann's kangaroo rat (*Dipodomys heermanni*), San Joaquin pocket mouse (*Perognathus inornatus neglectus*), deer mouse (*Peromyscus maniculatus*), San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*)(O'Farrell et al., 1987a).

The San Joaquin kit fox (*Vulpes velox macrotis = Vulpes macrotis mutica*, see Dragoo et al., 1990) and coyotes (*Canis latrans*) are the most commonly observed carnivores on NPR-2. Other less frequently observed carnivores are the badger (*Taxidea taxus*), bobcat (*Felis rufus*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*) (O'Farrell and Sauls, 1987).

Of the 45 species of birds known to occur on NPR-2, the most commonly observed are western meadowlarks (*Sturnella neglecta*), mourning doves (*Zenaida macroura*), sage sparrows (*Amphispiza belli*), horned larks (*Eremophila alpestris*), brewer's blackbird (*Euphagus cyanocephalus*), and California quail (*Lophortyx californicus*). The northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), great-horned owl (*Bubo virginianus*), and burrowing owl (*Athene cunicularia*) are commonly seen raptors (O'Farrell and Sauls, 1987).

Commonly observed reptiles include the side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), blunt-nosed leopard lizard (*Gambelia silus*), gopher snake (*Pituophis melanoleucus*), Pacific rattlesnake (*Crotalus viridis*), glossy snake (*Arizona elegans*), and San Joaquin coachwhip (*Masticophis flagellum*)(O'Farrell and Sauls, 1987).

2.3.3 Listed and Candidate Species of NPR-2

A list of endangered, threatened, and candidate species that may occur within the proposed project area was requested from FWS and can be found in Attachment A.

2.3.3.1 Plants

One endangered and one threatened plant species are known to occur on NPR-2 (Table 1). No evidence of two other endangered plants was found on NPR-2. One Category 2 species occurs on NPR-2 and eight others have been reported in the vicinity (Table 1).

Table 1. Listed and candidate plant species that occur or potentially occur on NPR-2.

Species		
Scientific Name	Common Name	Status[a]
Eremalche kernensis	*Kern mallow	FE
Eriastrum hooveri	*Hoover's wooly-star	FT
Caulanthus californicus	California jewelflower	FE
Lembertia congdonii	San Joaquin wooly-threads	FE
Hollisteria lanata	*Hollisteria	C2
Amsinckia furcata	Forked fiddleneck	C2
Atriplex cordulata	Heartscale	C2
Atriplex tularensis	Bakersfield saltbush	C2
Atriplex vallicola	Lost Hills saltbush	C2
Calochortus striatus	Alkali mariposa lily	C2
Cirsium crassicaule	Slough Thistle	C2
Delphinium recurvatum	Recurved larkspur	C2
Eriogonum temblorense	Temblor buckwheat	C2

*Species that occur on NPR-2.

[a]Status Codes:
Federal
FE = Federally listed as Endangered.
FT = Federally listed as Threatened.
C2 = Category 2 Candidate.

Source: Based on data from EG&G/EM, 1988; EG&G/EM, 1993; Calif. Department of Fish and Game, 1992; U.S. Department of Interior, 1993; EG&G/EM, unpublished data.

Hoover's Wooly-star

Hoover's wooly-star (*Eriastrum hooveri*) was listed as a threatened taxon by FWS in July 1990 (U.S. Department of the Interior, 1990). Through incidental sightings and preactivity surveys, approximately 15 populations of Hoover's wooly-star, with an estimated total of more than 6,000 individual plants, have been identified on NPR-2. Most of these populations were located along the northern perimeter of NPR-2 in sections 8, 9, 15, and 25 of Township B; sections 30 and 32 of Township G; and sections 2, 3, 12, and 13 of Township D (Dames & Moore, 1992; EG&G/EM, 1988; 1992; unpublished data).

Kern Mallow

Several suspected populations of Kern mallow (*Eremalche kernensis*) have been identified on DOE-administered NPR-2 lands. Due to taxanomic discrepancies between Kern mallow and a closely related Parry's mallow (*Eremalche parryi*), positive identification of these plants has yet to be determined. Until these plants can be positively identified, they will be considered Kern mallow. One population of Kern mallow was found in Section 18H during plant surveys conducted by EG&G/EM biologists in the spring of 1993. The plants were found growing in alkali soils in association with inkweed and annual saltbush species. Kern mallow also has been been observed in Sections 18B, 20B, 28B, 8D, and 32G (Louis Berger & Associates, Inc., 1991; Jones and Stokes Associates, Inc., 1990; 1991).

California Jewelflower

Surveys were conducted in the spring and summer of 1993 for California jewelflower (*Caulanthus californicus*), but it was not found on NPR-2 (EG&G/EM, unpublished data). Extant populations of California jewelflower are known in the Carrizo Plain area of eastern San Luis Obispo County, and in New Cuyama Valley, in Santa Barbara County. It was historically recorded along State Highway 119 near Valley Acres, within 1.5 miles of NPR-2 (California Department of Fish and Game, 1991). This population now appears extirpated (Taylor and Davilla, 1986).

San Joaquin Wooly-threads

San Joaquin wooly-threads (*Lembertia congdonii*) has not been located during plant surveys conducted in 1988, 1991, and 1993 (EG&G/EM, 1988; 1992; unpublished data).

Candidate Species

Only one candidate species is known to occur on NPR-2. Hollisteria (*Hollisteria lanata*) was located in the spring of 1993 in flat terrain in the northern portion of Section 12C, north of Ford City.

Bakersfield saltbush (*Atriplex tularensis*), Lost Hills saltbush (Atriplex vallicola), heartscale (*Atriplex cordulata*), and alkali mariposa lily (*Calochortus striatus*), occur in alkali sink scrub, alkali meadow and alkali grassland vegetation associations. On NPR-2, habitat for these species would most likely be found in Sections 18H and 12D, east of the California aqueduct. However, none of these species have been reported on NPR-2, nor were they located during plant surveys conducted in 1993.

The remaining four candidate species have not been located and are unlikely to occur on NPR-2, primarily because there is no suitable habitat available. Forked fiddleneck (*Amsinckia furcata*) is known from the valley and foothill grasslands from San Benito County to Kern County. Recurved larkspur (*Delphinium recurvatum*) is known from locations north of NPR-1 along the California aqueduct and in the Carrizo Plains. Habitat similar to those two locations is not found on NPR-2. Slough thistle (*Cirsium crassicaule*), although known to occur in the area, prefers shallow water, stream banks, and wet places. None of this habitat occurs within NPR-2. The Temblor buckwheat (*Eriogonum temblorense*) usually occurs on the arid slopes in woodland or grassland habitats, often on shale scree. This type of habitat is not found on NPR-2 and the occurrence of Temblor buckwheat on NPR-2 is unlikely.

2.3.3.2 Animals

Six listed animal species are known to occur or possibly occur on NPR-2 (Table 2). Additionally, 19 candidate species have been reported to occur on or near NPR-2. Of the 19 candidate species, two have been reported to occur on NPR-2, potential habitat exists for 10 others, and suitable habitat is not present for the remaining seven species (Table 2).

San Joaquin Kit Fox

Information on the ecology and status of the San Joaquin kit fox can be found in McGrew (1979), Morrell (1972; 1975), and O'Farrell (1983). San Joaquin kit fox dens are relatively abundant and widely distributed on NPR-2. A study conducted in 1981 found between one and 14 typical-subterranean dens in all but two sections (26B, 32G) of DOE-administered NPR-2 lands. Estimated density of typical dens was 33.5 ± 9.3 ($\bar{x}$ ±SE) per square mile for DOE-administered lands on NPR-2 (O'Farrell and Sauls, 1987). The relative density of typical dens was 9.6/1000 acres for DOE-administered lands. Studies since 1981 have documented the occurrence of typical dens in Section 32G (EG&G/EM, unpublished data).

Kit foxes on DOE lands within NPR-2 have been consistently monitored by live-trapping during the winter months since 1983. The number of individual foxes captured during winter live-trapping sessions on DOE-administered NPR-2 lands has ranged from 13 (1991) to 37 (1984). The number of individual foxes captured in the winter of 1993 was 35 (EG&G/EM, unpublished data).

Blunt-Nosed Leopard Lizard

Information on the life history and status of the blunt-nosed leopard lizard can be found in the recovery plan for this species (U. S. Department of the Interior, 1985). Blunt-nosed leopard lizards have been sighted in 12 of 18 sections of DOE-administered lands (O'Farrell and Sauls, 1987; EG&G/EM unpublished data). No blunt-nosed leopard lizards have been observed in the steep uplands of DOE lands on NPR-2 where most petroleum developments are concentrated (Kato et al., 1987; O'Farrell and Sauls, 1987; EG&G/EM unpublished data).

Incidental sightings of blunt-nosed leopard lizards were most frequently reported on the alluvial plains that surround the Buena Vista Hills, and were especially numerous in Sections 8B and 9B located in the Buena Vista Valley (Kato et al., 1987). Activities and facilities related to petroleum development were minimal or nonexistent in these areas. Lizards were seen more often in washes than in the general shrub-grassland habitat. Lizards also were often observed along roads in Buena Vista Valley.

Table 2. Listed and candidate animal species that occur (*) or potentially occur on NPR-2.

Species			Status[a]
Scientific Name		Common Name	
Mammals			
Vulpes macrotis mutica	*	San Joaquin kit fox	FE
Dipodomys ingens	*	Giant kangaroo rat	FE
Dipodomys nitratoides nitratoides	*	Tipton kangaroo rat	FE
Ammospermophilus nelsoni	*	San Joaquin antelope squirrel	C1
Dipodomys nitratoides brevinasus	*	Short-nosed kangaroo rat	C1
Eumops perotis californicus		Greater mastiff bat	C2
Plecotus townsendii townsendii		Pacific western big-eared bat	C2
Sorex ornatus relictus		Buena Vista Lake shrew	C2
Reptile			
Gambelia silus	*	Blunt-nosed leopard lizard	FE
Clemmys marmorata pallida		Southwestern pond turtle	C1
Clemmys marmorata marmorata		Northwestern pond turtle	C2
Amphibians			
Scaphiopus hammondi hammondi		Western spadefoot toad	C2
Birds			
Charadrius alexandrinus nivosus		Western snowy plover	FT
Agelaius tricolor		Tri-colored blackbird	C2
Buteo regalis		Ferruginous hawk	C2
Charadrius montanus		Mountain plover	C2
Invertebrates			
Desmocerus californicus dimorphus		Valley elderberry longhorn beetle	FT
Coelus gracilis		San Joaquin dune beetle	C1
Aegialia concinna		Ciervo aegialian scarab beetle	C2
Helminthoglypta callistoderma		Striped-skinned snail	C2
Lytta hoppingi		Hopping's blister beetle	C2
Lytta moesta		Moestan blister beetle	C2
Lytta molesta		Molestan blister beetle	C2
Lytta morrisoni		Morrison's blister beetle	C2
Pholisora libya		San Joaquin sootywing skipper	C2

[a]Status Codes:
Federal
FE = Federally listed as Endangered.
FT = Federally listed as Threatened.
C1 = Category 1 Candidate.
C2 = Category 2 Candidate.

Source: Based on data from EG&G/EM, 1988, 1993; Calif. Department of Fish and Game, 1992; U.S. Department of Interior, 1993.

Giant Kangaroo Rat

The giant kangaroo rat (*Dipodomys ingens*) is the largest species of kangaroo rat. Information on the life history and threats to the giant kangaroo rat can be found in U.S. Department of the Interior (1987).

Beginning in 1981, DOE sponsored surveys to determine the distribution and population status of the giant kangaroo rat on NPR-2. Giant kangaroo rat burrow systems were observed in eight sections (8B, 18B, 22B, 34B, 2D, 12D, 30G, 18H) under the jurisdiction of DOE (O'Farrell et al., 1987b; O'Farrell and Sauls, 1987). The greatest densities were found in Section 8B on a gently sloping alluvial plain of sparse shrubs. The estimated density of burrows (28.2 per acre) in this section (O'Farrell et al. 1987b) exceeded that reported for optimum habitat elsewhere (Grinnell, 1932). Isolated burrow systems (as few as one burrow system per section) were located in Sections 34B, 12D, 18H, and 30G (O'Farrell et al., 1987b).

Tipton Kangaroo Rat

Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*) are known to occur in Section 18H and potentially occur on that portion of Section 12D that borders the California aqueduct. The western boundary of distribution of the Tipton kangaroo rat was defined by Williams (1986) as being approximately coincident with the route of the California aqueduct. A small mammal trapping survey for Tipton kangaroo rats was conducted in August and September 1988 (EG&G/EM, 1988). Four traplines with 25 traps each were set in Section 18H and one trapline in Section 12D. Both were operated for three consecutive nights. Total captures ranged between three and 10 rats per trap-night in Section 18H, but none were captured in Section 12D.

Western Snowy Plover

The western snowy plover's (*Charadrius alexandrinus*) known breeding sites include the coast of California and China Lake. The species is known to nest along the levees of some wastewater and percolation ponds approximately ten miles northeast of NPR-2 (Mark Chichester, Texaco, personal communication). Western snowy plover may possibly travel through the fringes of NPR-2; however, the possibility that the species would nest there is remote.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is endemic to moist valley oak woodlands along the margins of rivers and streams. This type of habitat is not present on NPR-2, therefore this species is not expected to occur there nor has it been reported on NPR-2.

Candidate Species

The two candidate species known to occur on NPR-2 are the San Joaquin antelope squirrel and the short-nosed kangaroo rat. San Joaquin antelope squirrels are widely distributed and abundant on NPR-2. San Joaquin antelope squirrels were the second most commonly observed vertebrate on transect surveys conducted in 1981; 761 were counted in 45 sections. Estimated relative density was 34.4/1000 acres and was not related to intensity of development. The only section where San Joaquin antelope squirrels were not observed was one adjacent to urban areas in the north end of Taft in 12C (O'Farrell and Sauls, 1987). Small mammal trapping on NPR-2 was conducted between July 1983, and August 1984. San Joaquin antelope squirrels represented 17% of all individuals captured (O'Farrell et al., 1987a).

The distribution and relative abundance of short-nosed kangaroo rats on NPR-2 was determined by live-trapping along transect lines. Trapping was conducted between July 1983, and August 1984, for a total of 11,700 trap-nights. Short-nosed kangaroo rats were found to be both numerous and widely distributed on NPR-2. Short-nosed kangaroo rats comprised 26.2% of all individual small mammals captured (O'Farrell et al., 1987a).

The greater mastiff bat (*Eumops perotis californicus)* is known from a collection record near Bakersfield. It has not been observed on NPR-2 and no natural cavities or other features exist that could potentially provide roosting sites for this species.

Potential habitat for the Pacific western big-eared bat (*Plecotus townsendii townsendii*) and is found on NPR-2. The preferred habitat of Pacific western big-eared bat includes caves, mine tunnels, and buildings. Big-eared bats have not been observed on NPR-2; however, abandoned buildings, or other similar facilities could provide potential roosting sites for this species.

Grinnell (1932) noted that Buena Vista Lake shrews (*Sorex ornatus relictus)* were found in marshy areas around the perimeter of Buena Vista Lake, and he speculated that shrews were found in marshy areas throughout the San Joaquin Valley and most of the Tulare Basin (Grinnell, 1933). A survey for Buena Vista Lake shrews was conducted in 18H of NPR-2 where the only potential habitat occurs (EG&G/EM, 1988). Pitfall traps were placed at 15-yard intervals along five transect lines. No Buena Vista Lake shrews were captured.

Both the southwestern and northwestern pond turtle (*Clemmys marmorata pallida* and *C. m. marmorata*) are subspecies of the western pond turtle and are aquatic turtles of ponds, marshes, rivers, and streams. None of this type of habitat is present on DOE-administered lands on NPR-2; therefore, neither subspecies is expected to occur.

The western spade-foot toad (*Scaphiopus hammondi hammondi*) occupies lowlands and is frequently found in washes, floodplains of rivers, alluvial fans, playas, and alkali flats. No spade-foot toads have been observed on NPR-2 although habitat may exist for them in some areas.

Tri-colored blackbirds (*Agelaius tricolor*) are residents of the San Joaquin Valley and nests in the tules or cattails of marshes. Tri-colored blackbirds have been observed foraging on adjacent NPR-1 (EG&G/EM, unpublished data). Suitable nesting habitat does not exist for them on NPR-2. The ferruginous hawk (*Buteo regalis*) is a common winter visitor to the southern San Joaquin Valley. Important wintering sites for the species include the Carrizo Plains and Cuyama Valley. Ferruginous hawks have occasionally been observed foraging or traveling through NPR-1 (O'Farrell and Scrivner, 1987) and could occur on NPR-2 on an uncommon basis. Mountain plover (*Charadrius montanus*) is an upland species of dry, short-grass prairies and plains. Mountain plover could occur on NPR-2 as winter visitors, but do not nest nor breed in the area (Mark Chichester, Texaco, personal communication).

Both the San Joaquin dune beetle (*Coelus gracilis*) and the Ciervo aegialian scarab beetle (*Aegialia concinna*) are relictual fossil species found in beach dunes. This type of sandy substrate is necessary for the development of the larvae of these species. The San Joaquin dune beetle is presently restricted to five limited sites along the western edge of the San Joaquin Valley (Ciervo Hills, Kettleman City, and Big Panoche Hills) and is believed to be extirpated from its type locality (Antioch dunes). The Ciervo aegialian scarab beetle is presently found in the Ciervo dunes north of Coalinga. No evidence of either species of dune beetles was found during surveys conducted for other invertebrates nor does suitable habitat exist for them on NPR-2 (EG&G/EM, 1988; Allen Hardy, California Department of Food and Agriculture, personal communication).

The striped-skinned snail (*Helminthoglypta callistoderma*) is a little-known terrestrial snail that apparently has been collected fewer than 12 times at about 10 localities, all in the southeastern San Joaquin Valley. Surveys for striped-skinned snails were conducted in Section 18H of NPR-2 because it has some especially moist sites which would provide suitable habitat for the species, but none were found (EG&G/EM, 1988).

Selander (1960) lists 128 species of blister beetles of the genus *Lytta* from North America. Five species of *Lytta* are Category 2 candidates for Federal listing; four of these occur in the southern San Joaquin Valley. The Moesta blister beetle, Molestan blister beetle, and Morrison's blister beetle are known to occur within 20 miles of NPRC; Hopping's blister beetle occurs within 40 miles. Plants and bees associated with species of *Lytta* are located within NPR-2. Surveys for blister beetles were not conducted on NPR-2; however, surveys of adjacent NPR-1 (EG&G/EM, 1988) failed to locate the species of *Lytta*.

Very little information exists concerning the San Joaquin sooty-wing skipper (*Pholisora libya*). The species is presently undescribed (Chris Nagonna, U.S. Fish and Wildlife Service, personal communication). Habitat destruction is the principal reason for the proposed listing (the larvae of the species feeds on saltbush). The San Joaquin sooty-wing skipper is presently known to occur in McKittrick; however, its status on NPR-2 is unknown.

3. PROPOSED ACTION

The following description of the proposed action is taken from the (draft) "Environmental Assessment for Continued Exploration, Development, and Operation, Naval Petroleum Reserve No. 2, Kern County, California".

3.1 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is to continue or expand oil-production activities and facilities to minimize the current declining trend in oil production on the 10,446 acres of DOE-administrated lands within NPR-2. The proposed action will permanently disturb 87.5 acres (new facilities), temporarily disturb 75 acres (pipelines), and transiently disturb 125 acres (geophysical surveys) over a 25 year period disturbing 0.8%, 0.7%, and 1.2% of NPR-2 DOE lands, respectively. Permanent disturbances will affect approximately 1% of the remaining undisturbed DOE-administered NPR-2 lands. It is estimated that an additional 656 acres of previously developed land will be abandoned and restored as wildlife habitat, representing 6.3% of DOE lands on NPR-2. The proposed action also would include expansion of environmental compliance activities and continuance of nonpetroleum-related activities. The following general types of activities would occur under the proposed action:

- Petroleum-related activities, including actions directly or indirectly related to petroleum development and exploration.

- Nonpetroleum-related activities such as utility easements and agricultural use.

Proposed petroleum-related activities on NPR-2 would be conducted under DOE leases, farm-out agreements, third party-operator agreements, and revocable permits. Oil production and exploration operations would continue through existing agreements that are consistent with energy production requirements, royalty maximization for the U.S. Government, and Federal, State, and local regulations. However, oil and gas development are expected to be minimal since reserves are highly depleted (BPOI, 1991). All oil would be retained by the lessee or competitively sold on the open market. Other petroleum-related activities would include produced water disposal, and oil and gas pipeline maintenance and construction activities.

Nonpetroleum-related activities would be conducted under leases, cooperative agreements, third-party-operator agreements, revocable permits, memoranda of understanding, and contractual agreements. These activities would include continuation of various surface uses and site management. Nonpetroleum-related surface uses would consist of produced water injection, agriculture, utility easements and rights-of-way, roadways, and city uses.

Under the proposed action, DOE would administer NPR-2 in compliance with applicable laws and regulations. This would include managing non-leased lands (e.g., 12C, 18H, and 8B); conducting oil exploration and development activities; administering leases; ensuring correct royalty payments; and performing environmental surveillances. DOE would continue in their role of coordinating, monitoring, and approving activities of private and public organizations conducting activities on the 10,446 acres of DOE lands within NPR-2. In addition, DOE may drill up to ten new wells under the proposed action.

3.1.1 Proposed Petroleum-Related / Nonpetroleum-Related Activities

Under the proposed action, petroleum-related activities on the portions of NPR-2 administered by DOE would include, but not be limited to, the following:

- Drilling and installing new infill and offset exploratory wells.
- Withdrawing oil, gas, and water from production wells.
- Shut-in, abandoning, and reabandoning wells.
- Conducting well workovers and well maintenance.
- Constructing, operating, maintaining, and replacing support facilities.
- Abandoning, storing, disassembling, and salvaging equipment and facilities.
- Conducting seismic surveys, engineering evaluations, and field observation of production activities.
- Conducting regulatory compliance activities including reclamation of habitat and surveys for archaeological and natural resources.
- Reassigning and relinquishing leases, farm-out agreements, and third-party-operator agreements.
- Transporting, injecting, and temporarily sumping produced water.

Proposed nonpetroleum-related activities on NPR-2 would include the following:

- Constructing, operating, maintaining, and replacing equipment and facilities including new pipelines, utility distribution lines, and roads.
- Abandoning, storing, disassembling, and salvaging equipment and facilities.

- Conducting regulatory compliance activities including reclamation of habitat, archaeological and natural resource surveys, facility closure, and site cleanup.

- Agricultural activities and pesticide spraying.

The following estimates of the quantity and magnitude of potential activities under the proposed action serve as an upper boundary. These estimates are based on best available information from recent past use and projections provided by current users of NPR-2. The activities and their levels, which are described below (and summarized in Table 3), may not occur because of oil market conditions or policy decisions within the Federal Government.

Continued production and development of known reserves at NPR-2 would require drilling and installing new reservoir wells commonly known as infill and offset wells. Development drilling consists of the drilling, redrilling, deepening, completion, recompletion, and testing of wells to enhance the producing reservoirs. Infill wells when converted to production wells would require pipelines, pumps, tanks, and other permanent equipment. Drill rigs would be temporary structures at the well site. Under the proposed action, approximately 75 new wells would be drilled permanently disturbing approximately 75 acres.

Currently, there are 208 active wells, 34 tank settings, and six oil/water sumps on DOE-administered lands within NPR-2. The number of active wells is expected to decrease to about 108 wells under the proposed action. The number of inactive or abandoned wells would increase by 175. It is anticipated that oil production would decline to 800 to 1,281 bbl/day. Produced water generated annually would range between 2.0 and 3.0 million bbl/yr. No longer economically productive wells may be placed on shut-in or abandoned status. About 175 wells would be shut-in and 175 wells would be reabandoned. Support facilities for hydrocarbon development on NPR-2 include: facilities at the well site (such as oil and gas meters, gauging facilities, utility lines, tank settings, pipelines, pumps, and sumps) roads; buildings; transport pipelines; storage and equipment yards; gas compression plant; oil/water/gas dehydration/Lease Automatic Custody Transfer (LACT) units; compressors; and tanks.

A wide array of facilities and equipment would be constructed, operated, maintained, or replaced under the proposed action that reflect the diverse nature of operations on NPR-2. Approximately five temporary tank settings would be installed disturbing 5.0 acres of land. New and existing tank settings would be inspected and maintained routinely. About 2.25 miles of new roads would be constructed, permanently disturbing an additional 7.5 acres of land, and over 200 miles of existing roads would be maintained by grading. Between 1993 and 2018, approximately 22.5 miles of new pipeline would be constructed, temporarily disturbing about 75 acres. Over 300 miles of existing pipelines would be inspected and repaired as needed at least annually. The California Aqueduct and pumping station would be maintained. This would include: inspecting and repairing roads and fences; inspecting the aqueduct; and patching portions of the concrete apron, as needed. The pump stations, building, pumps, and support systems would continue to be operated and maintained. Pump station maintenance would include changing,

recycling, and disposing of lubricants used for the equipment (500-600 gal/yr). Antenna transmission facilities, communication cables, and power transmission lines also would be inspected and maintained. Permanent and temporary power and water connections would also be installed. These utility lines would be connected to existing nearby sources.

Facilities and equipment such as compressors, pumps, and gas plants, that become unnecessary may be secured for later reactivation (stored or mothballed), abandoned, disassembled, and/or salvaged. Typical storing or mothballing techniques may include shutting in wells; emptying storage tanks, pipelines, and equipment of all products; refilling pipelines and storage tanks with water containing a corrosion inhibitor or with a vapor corrosion inhibitor; and fencing buildings and facilities to provide isolation. Facilities or equipment that becomes unnecessary or inoperable are abandoned, disassembled, or salvaged. The affected land may be reclaimed. Under the proposed action, the six existing oil/water sumps, covering a total of three acres, would be reclaimed and closed. In addition, all or portions of the gas plant owned and operated by Texaco would be shut down, abandoned, reclaimed, and closed. Approximately 5.25 miles of roads would be closed and reclaimed, revegetating 17.5 acres of land. Approximately 37.5 miles of existing pipeline and 18 tank settings would be abandoned, salvaged, or disposed, and 118 acres would be revegetated. In addition, 175 wells and well pads would be abandoned, and approximately 175 acres would be reclaimed and revegetated.

During conduct of the proposed action, it may be necessary to conduct geophysical (seismic) surveys to identify geologic structures at depth. Geophysical surveys would administer shock waves which are detected on an array of cone penetrameters. Disturbances from geophysical surveys will be superficial and transient. Seismic surveys are expected to transiently disturb an additional 125 acres during the 25-year period under the proposed action.

Table 3. Proposed NPR-2 activities under the proposed action (1993 to 2018) and activities conducted in 1992[a].

Type of Activity	Estimated Activities Prior to 1993	Projected Activities 1993 to 2018
Petroleum-Related Activities		
Maximum Daily Oil Production (bbl)	1430	1281→800
Active Wells (approximate)	208	208→108
New Wells/Acres	5/5	75/75
Abandon, Idle, Shut-in Wells/Acres	5/5	175/175
Reabandon Wells/Acres	5/7.5	125/187.5
Operate Existing Sumps/Acres	6/3	0/0
Abandoned Sumps/Acres	0	6/3
Tank Settings/Acres	34 existing/26 active 34 acres	34/34→16/16
New Tank Settings/Acres	1/1	5/5
Abandon Tank Settings/Acres	0/0	23/23
Existing Major Facilities (operational)	1) 1 gas plant	1) Gas plant may be shut down and abandoned
Nonpetroleum-Related Activities		
New, Abandoned Facilities (Acres Disturbed)	5	75
Existing Major Facilities (Operational)	1) WKWD Pumping Station 2) DWR California Aqueduct 3) DWR Buena Vista Pumping Plant	1) WKWD Pumping Station 2) DWR California Aqueduct 3) DWR Buena Vista Pumping Plant
Activities Common to Petroleum and Nonpetroleum Actions		
New Roads (Miles/Acres)	0.2/0.5	2.25/7.5
Road Abandonment (Miles/Acres)	0.2/0.5	5.25/17.5
New Pipelines (Miles/Acres)	1.5/4	22.5/75
Pipeline Abandonment (Miles/Acres)	1.5/4	52.5/175
Seismic Surveys (Acres Disturbed)	5	125
Amount of Area Disturbed		
Total Acres Disturbed (new developments plus abandonments)	37.5	943.5
Acres Disturbed from New Developments	15.5	287.5
Acres Disturbed from Abandonments[b]	22	656
Total Disturbed Habitat by the end of time period (Acres)[c]	2,022	2,309.5
Percent of Total Area Disturbed by end of time period	19.4%	22.1%

Sources of Information: Environmental Plan for Naval Petroleum Reserves No. 2, January 1991, Naval Petroleum and oil Shale Reserves Annual Reports 1986 to 1991: and NPRC FY 1991-1997 LRP, Naval Petroleum Reserves in California.

[a]Based on best available information from recently completed activities and projections provided by current users.
[b]Previously disturbed acres available for habitat reclamation.
[c]An unquantified amount of habitat will be reclaimed.

4.1 DIRECT AND INDIRECT EFFECTS

The primary potential effect of the proposed action to the threatened, endangered, and candidate species of NPR-2 would be the loss or alteration of habitat. Construction of proposed facilities and some third-party projects would result in the long-term loss of about 88 acres of habitat and a proportionate reduction in carrying capacity would be expected. The installation of pipelines would temporarily disturb about 75 acres. Conducting seismic surveys would transiently disturb approximately 125 acres. Loss of vegetative cover could result in soil erosion, especially if construction occurred on steep or unstable slopes. Soil erosion effects on surrounding vegetation could be severe because NPR-2 soils are loose and prone to erosion (U.S. Department of Agriculture, 1992). Soil erosion could indirectly effect animals if erosion decreased productivity of forage plants or disrupted drainages or washes that are preferred hunting or foraging areas. Animals within the project area may be killed or injured by entrapment in burrows or crushing by equipment during construction activities. Other individuals may be displaced as a result of habitat loss or fragmentation, noise levels, or presence of workers. Dispersing individuals tend to have low survivorship (Emlen, 1984; Ralls et al., 1986), especially if surrounding areas are at or near carrying capacity. Also, potential oil spills or fires may affect vegetation. Accidental oil spills could kill plants and preclude natural revegetation in areas covered by the spills. Animals occasionally could become mired in spilled oil (O'Farrell et al., 1986) or could ingest oil field chemicals present in contaminated sumps or assimilated by forage (Suter et al., 1992). Accidental fires may cause short-term changes in vegetation structure, especially the loss of shrubs, but would be expected to have little long-term effect as herbaceous annuals typically resprout during the following growing season (Heady, 1977; O'Farrell and Mitchell, 1985; Sims, 1988). Accidental fires associated with facility operation and maintenance or wildfires could affect animal communities if animals were burned or died within their burrows, or if fires reduced forage. Road kills also would be expected if the number of short-term workers increased on site, especially during construction activities.

4.1.1 Threatened and Endangered Species

4.1.1.1 Plants

Effects to listed plant species will be minimal. Most construction activities are not expected to impact listed plant species because the majority of these activities are proposed for the developed uplands. Kern mallow and Hoover's wooly-star, the only listed plants known to occur on NPR-2, are found in the valley floor and peripheral areas of NPR-2. Pipeline projects and seismic surveys have a greater probability of impacting these two species. Such projects have historically been located on the valley floor and peripheral areas of NPR-2. Additionally, under the proposed action up to ten new wells could be developed in Section 18H where Kern mallow is known to occur (Section 2.3.3.1). Where avoidance may not be possible, plants in the construction area or within the pipeline or seismic survey

corridor may be destroyed. The magnitude of impacts will vary considerably depending upon location. However, preactivity surveys will be conducted prior to such activities and impacts will be avoided or minimized.

4.1.1.2 Animals

San Joaquin Kit Fox

Potential impacts to the San Joaquin kit fox that could result from NPR-2 activities include direct mortality, loss of dens, loss or alteration of habitat, human disturbance, and exposure to oil field chemicals. Construction of well pads, access roads, and associated oil field structures may trap or bury foxes if the construction occurs on or near a den site. Kit foxes utilize a variety of den sites, from single-entrance dens to large multiple-entrance dens typically used to rear pups. All den sites are thought to be ecologically important. The probability of this occurring is low, primarily because of DOE's policy of requiring preactivity surveys prior to construction activities.

Habitat loss is the most significant factor affecting the decline of kit fox populations in the San Joaquin Valley (O'Farrell, 1983). Proposed facilities and third-party projects are expected to permanently displace about 88 acres of habitat. Habitat on NPR-2 represents some of the highest quality known habitat remaining on public lands in the San Joaquin Valley (O'Farrell et al., 1986). Although the quantity of habitat lost would be relatively small, a reduction in carrying capacity could occur and adversely affect the kit fox population. However, the impact of petroleum development on kit foxes will probably be minimal because most development activities will likely occur in areas previously disturbed, and DOE will continue their policy of conducting preactivity surveys prior to construction activities. Disturbances would typically cover two to three acres or less and would be dispersed over much of the 18 sections of land administered by DOE over a 25-year period. The impact on the carrying capacity of the land would be minimal. Also, during this same time period, about 656 acres of existing facilities would be abandoned and returned to wildlife habitat, thus, potentially increasing the carrying capacity of the land.

Kit foxes may also become trapped and die in well cellars that are not properly covered. In 1990, the remains of two other kit fox pups were recovered from an abandoned well cellar in Section 30G. Following the discovery of the two dead pups in 1990, DOE requested an action plan and a schedule for implementation from each lessee on NPR-2 DOE-administered lands to strengthen measures for protecting endangered species from well cellar hazards and intensified their monthly well cellar cover inspections to ensure these measures were implemented (DOE, 1990).

The production, transportation, processing, and storage of large quantities of crude oil may result in some spills. The washes and drainages in which spilled oil collects are also primary travel routes and foraging areas for kit fox and other wildlife. Kit foxes could also drown in pooled oil, or become mired in tarry substances. In 1982, two kit fox puppies were found dead in spilled oil on NPR-2 as a result of activities by a lessee. Policies implemented by DOE to promptly clean up oil spills and spill prevention, containment, and countermeasure (SPCC) plans should help minimize potential impacts of oil spills to kit foxes (Section 5).

Vehicle-related mortalities could occur as a result of project related traffic. In the past, vehicles have been the cause of about 6% of known kit fox deaths annually (O'Farrell et al., 1987a).

Kit foxes do not appear to be particularly sensitive to human disturbance (Egoscue, 1962; O'Farrell and Gilbertson, 1986; O'Farrell, 1987); as evidenced by observations of kit fox activity in the immediate vicinity of operating facilities on NPR-2 and frequent use of developed areas.

Suter, et al. (1992) found that most elements found in kit fox fur were lower on NPR-2 than in areas with no oil field development. Arsenic was the only element that raised toxicological concern. Although the concentration of arsenic from one sample of fox fur from NPR-2 (n = 12) was high enough to cause toxic effects in humans, Suter et al., (1992) suggested that this fox may not have been at risk. Suter, et al. (1992) stated that "elements that are high on the oil fields still do not...suggest biologically significant exposures to oil development-related materials or toxic effects."

Blunt-nosed Leopard Lizard

Potential impacts to the blunt-nosed leopard lizard that could result from the proposed action include direct mortality, loss or alteration of habitat, and harassment. Most proposed facilities are expected to be developed in the uplands. Thus, potential impacts to the blunt-nosed leopard lizard would mostly likely result from activities that affect washes along the periphery of the hills and valley sections of NPR-2. This would include most pipelines and seismic surveys. Potential impacts to the leopard lizard could result from the destruction of small mammal burrows during construction activities (Kato and O'Farrell, 1986). Preactivity surveys and flexibility in locating and designing well pads would make it possible to avoid most blunt-nosed leopard lizard habitat, and thus the proposed activities would not likely displace or kill any lizards or remove potential habitat (Kato and O'Farrell, 1986; Kato et al., 1985). In addition, accidental oil spills or wastewater discharges during operation of facilities and pipelines could adversely affect the blunt-nosed leopard lizard. Since these lizards use washes, discharge of wastewater into natural drainages could drown lizards, coat them with waste oil, or contaminate portions of the lizards' habitat or food supply (Kato and O'Farrell, 1986). Blunt-nosed leopard lizards could also become trapped in improperly covered well cellars. A dead blunt-nosed leopard lizard was recovered from the bottom of an inadequately covered well cellar in Section 30G in 1990. Policies implemented by DOE to adequately cover all well cellars, contain and promptly clean up oil spills, reduce vehicle speeds, and restrict off-road vehicle travel will help minimize potential impacts to blunt-nosed leopard lizards (Section 5).

Giant Kangaroo Rat

Potential impacts to the giant kangaroo rat that could result from NPR-2 activities include direct mortality, loss of burrow systems, loss or alteration of habitat, and harassment. The construction and maintenance of well pads, access roads, pipelines, and other oil field structures may trap or bury giant kangaroo rats in their burrows. The probability of this occurring is low because most of the proposed activities are expected to occur in the uplands away from giant kangaroo rat burrow concentrations and because of DOE's policy of requiring preactivity surveys. Giant kangaroo rats could also drown or become mired in

spilled oil or tarry substances. No giant kangaroo rats are known to have been killed in spilled oil or sumps on DOE lands. However, in 1986, 12 giant kangaroo rats were killed when the lessee on Section 18B discharged wastewater into a natural drainage (O'Farrell and Kato, 1987). Surface disposal of produced wastewater on DOE-administered NPR-2 lands was discontinued in the late 1980s; therefore, the potential for a reoccurance of wastewater discharges into natural drainages impacting giant kangaroo rats, as well as other wildlife, is remote. Giant kangaroo rats may also be killed by vehicles, due to traffic in project areas. This is highly unlikely because most giant kangaroo rats occur in the valleys where there is little traffic. Giant kangaroo rats are nocturnal and their greatest period of activity would occur during a time when there would be the least amount of traffic.

The probability of the loss of giant kangaroo rat burrow systems is low because developments would occur in the uplands away from concentrations of burrow systems. Pipeline activities would have the greatest potential to impact burrows because these projects are traditionally located on the peripheral areas of NPR-2 in preferred giant kangaroo rat habitat. Preactivity surveys would be performed prior to projects in order to eliminate or minimize the impacts to giant kangaroo rat burrow systems. Seismic surveys could also adversely affect giant kangaroo rat populations. Although no construction is involved with these activities, impacts could result from the collapse of burrows and harassment of giant kangaroo rats along the survey route.

Habitat loss is the most significant factor responsible for the decline in giant kangaroo rat populations in the San Joaquin Valley (U.S. Department of the Interior, 1987). However, NPR-2 activities will not significantly contribute to the decline in available habitat because most developments will occur in the uplands away from concentrations of giant kangaroo rats.

Tipton Kangaroo Rat

Potential impacts to the Tipton kangaroo rat that could result from the proposed action would be similar to those identified above for giant kangaroo rats. As mentioned in Section 2.3.3.2, Tipton kangaroo rats are known to occur in section 18H. Pending the outcome of an exploratory test well in Section 18H, up to ten additional wells and associated roadways and pipelines could be developed in this section. As with giant kangaroo rats, preactivity surveys would be conducted prior to construction activities in order to eliminate or minimize impacts to Tipton kangaroo rat populations. Where avoidance measures are not possible within a project area, burrow systems may be destroyed and individual Tipton kangaroo rats may be displaced or killed. Policies implemented by DOE to adequately cover well cellars, contain and clean up oil spills, reduce vehicle speeds, and restrict off-road vehicle travel will help to minimize potential impacts to Tipton kangaroo rats (Section 5).

4.1.1.3 Candidate Species

Hollisteria, the only candidate plant species found on NPR-2, is not expected to be impacted by construction activities because it is found in the Valley floor and not in the developed uplands where these activities are likely to occur. Effects from pipeline projects and seismic surveys should be similar to those for listed species (see Section 4.1.1.1).

Impacts to the San Joaquin antelope squirrel and the short-nosed kangaroo rat could result from the proposed action. Impacts may include direct mortality, reduction of carrying capacity, exposure to oil field chemicals, and harassment. Seismic surveys could result in direct mortality or harassment of animals. The significance of impacts of all proposed projects would depend on the location of projects. Preactivity surveys would be required to determine if species are present, and if so, to employ mitigation measures to minimize the impact to the species. Impacts are not expected to be significant because of the relative abundance and widespread distribution of these species on NPR-2.

4.1.1.4 Endangered Species Program

Threatened, endangered, and candidate species also could be affected by trapping and/or radiocollaring during endangered species monitoring and research activities. Livetrapping kit foxes and small mammals on DOE-administered NPR-2 lands may continue and could result in the inadvertent injury or death to individual kit foxes, giant kangaroo rats, Tipton kangaroo rats, short-nosed kangaroo rats, and San Joaquin antelope squirrels. Efforts to minimize impacts during livetrapping activities have been made, such as baiting traps in the late afternoon and not trapping during periods of extreme temperatures. Trapping and radiocollaring efforts follow guidelines established by the U.S. Fish and Wildlife Service and the California Department of Fish and Game. Potential effects of radiocollaring kit foxes at NPRC were addressed in two investigations (O'Neil and Greer, 1988; EG&G/EM, unpublished data), the latter of which involved an extensive and comprehensive analysis of survival, physical condition, and reproductive data. Neither of the investigations produced evidence of a significant negative impact on kit fox populations at NPRC due to radiocollaring. Kit fox and small mammal trapping and/or radiocollaring activities are conducted by qualified individuals under the authority and terms and conditions of permits issued by the U.S. Fish and Wildlife Service and a Memorandum of Understanding from the California Department of Fish and Game.

4.2 POSITIVE EFFECTS

The abandonment, reabandonment, salvaging, or disposal of well pads, tank settings, buildings, and access roads would temporarily disturb approximately 656 acres during habitat restoration efforts. Habitat restoration of these previously disturbed areas should have a positive effect on both plant and animal communities.

4.3 CUMULATIVE IMPACTS

In 50 Code of Federal Regulations 402.02 cumulative effects are defined as, "...those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation." Any future actions that at some point will be subjected to either the Section 7 consultation process or Section 10 permitting procedures, and could not occur unless they were able, in their own right, to avoid jeopardizing the continued existence of the affected species, are excluded from this cumulative effects analysis. Because of the large number of endangered

and threatened species and their essential habitats within the vicinity of NPR-2, and the probability of incidental take associated with habitat disturbing actions, DOE is unaware of any state or private activities not outlined in the proposed action that will not be subject to either the Section 7 or Section 10 processes.

4.4 SIGNIFICANCE OF EFFECTS

Based on this biological assessment, DOE has determined that the proposed activities on NPR-2 may affect the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Hoover's wooly-star, Kern mallow and the habitats of these species. This determination is based on the projection that proposed developments will impact approximately 288 acres of previously undisturbed land over the next 25 years. Of this total, approximately 88 acres will be permanently developed for facilities. New pipeline installation will temporarily disturb approximately 75 acres, and the remaining 125 acres will be transiently disturbed by geophysical surveys.

DOE believes that the effects of the proposed action will not threaten the continued existence of the six listed species because proposed long-term developments represent only 1% of the undeveloped habitat that remains on DOE-administered NPR-2 and individual disturbances would be relatively small and dispersed. Assuming development occurs equally over time, this equates to about 3.5 acres of habitat loss per year. This loss will be offset in part by the reclamation of abandoned facilities resulting in 656 acres of reclaimed habitat throughout the twenty-five year period. Most proposed developments will take place in previously developed uplands of NPR-2 and should have little effect on any of the listed species. Geophysical surveys will result in only minor, transient effects such as the crushing of vegetation by vehicles, to only 125 acres over a 25 year period.

5. MITIGATION

A basic philosophy of the proposed mitigation strategy is that the conservation of endangered species and their habitats is compatible with petroleum developments if certain policies and procedures are sustained by DOE. The following mitigation measures are recommended to reduce or avoid potential adverse impacts to the threatened and endangered species as a result of the proposed action. All NPR-2 activities on lands under the jurisdiction of DOE including those of lessees and third-party/permittees are required to comply with these measures.

5.1 PREACTIVITY SURVEYS

Preactivity (preconstruction) surveys, that are now conducted for all proposed construction and operational activities that will disturb the soil surface and vegetation, should continue to be conducted in the future. Kato et al. (1985) discussed in detail the methodology and use of preactivity surveys. The objectives of preactivity surveys are to (1) minimize the extent of habitat loss, (2) conserve San Joaquin kit fox dens, (3) minimize damage to washes used by blunt-nosed leopards lizards, (4) conserve giant and Tipton kangaroo rat burrow systems, and (5) protect Kern mallow and Hoover's wooly-star populations (Kato et al., 1985; Kato and O'Farrell, 1987; O'Farrell and Scrivner, 1987; EG&G/EM, 1991). Site design, the amount of undisturbed habitat in the area, and the type of disturbance is evaluated by a qualified biologist(s) for each project. Recommendations are then made to minimize the loss of habitat. Areas where kit fox dens, giant kangaroo rat burrows, Tipton kangaroo rat burrows, Kern mallow, or Hoover's wooly-star are found are avoided, if possible, and the project is relocated a sufficient distance from these dens or burrows to minimize indirect impacts. Attempts are made to minimize any disturbance of broad sandy washes, which are the preferred habitat of the blunt-nosed leopard lizard. When applicable, post construction compliance (follow-up) surveys are conducted by qualified biologists after a project is completed to ensure that mitigation recommendations were followed.

5.2 HABITAT RECLAMATION

The objective of habitat reclamation will be to minimize erosion and reestablish vegetation on disturbed areas resulting from the proposed action, in order to restore habitat for threatened and endangered species. Many facilities, roads, and pipelines are scheduled for abandonment between 1993 and 2018 and it is estimated that approximately 656 acres will be abandoned and restored as wildlife habitat during this time period.

5.3 EMPLOYEE EDUCATION AND AWARENESS PROGRAM

DOE and some of the major companies (e.g., Chevron, Texaco, PG&E) operating on NPR-2 have endangered species awareness and training programs for their employees and contractors. DOE will work cooperatively with lessees, third-parties, and permittees to implement an endangered species awareness and training programs for employees working on DOE-administered NPR-2 lands.

5.4 OIL SPILLS

Oil spill procedures presently in place should continue to minimize the possibility that kit foxes, giant kangaroo rats, blunt-nosed leopard lizards, and other less conspicuous species of wildlife will be accidentally drowned or become mired in oil spills. DOE, lessees, and third-party operators are required to develop and implement SPCC plans in accordance with the Federal Clean Water Act (40 CFR §112) and will be required to take whatever actions are necessary to prevent oil spills from occurring. Should an accidental spill occur, the lessee and/or DOE will activate their SPCC plans. Additionally, DOE is contacted and a preactivity survey is conducted at the earliest opportunity to minimize impacts to threatened and endangered species during cleanup activities.

5.5 SUMP COVERS

All sumps that may receive oil will be covered with an appropriate material that prevents or retards access by wildlife. There are currently six existing oil/water sumps on DOE-administered NPR-2 lands, the majority of which are closed or placed in inactive status awaiting closure. Under the proposed action, all six sumps would be closed and reclaimed. Until closure, covers on active sumps will be maintained by lessees in accordance with the California Division of Oil, Gas, and Geothermal Resourses (DOGGR) regulations (Cal. Code Regs., tit.14, §1770,1780). The integrity of sump netting and containment berms is periodically monitored by DOE and lessees are notified when deficiencies are found (BPOI, 1991).

5.6 WELL CELLAR COVERS

All new, active, and shut-in well cellars will be adequately covered and maintained in accordance with DOGGR regulations (Cal. Code Regs., tit.14, §1774[a]) to insure that wildlife do not become accidentally trapped. DOE will work cooperatively with lessees and third-parties to ensure that all well cellars are properly covered and maintained. DOE currently inspects well cellar covers monthly on DOE-administered NPR-2 lands and notifies lessees when hazards are found (BPOI, 1991).

5.7 WASTE WATER DISPOSAL

Compliance with existing state and federal regulations should reduce the risk that discharges of waste water into natural drainages will drown wildlife or degrade their habitat. DOE requires that all lessees take whatever actions are needed to prevent discharges from occurring, such as developing and implementing SPCC plans. Most wastewater produced during hydrocarbon production is transported for reinjection either onsite or offsite into Class II disposal wells. The remaining produced water would be temporarily stored in tanks and/or sumps and then ultimately transported offsite for reinjection. Secondary containment and adherence to SPCC plans also would reduce the chance of an inadvertent discharge of wastewater from tank setting or LACT facilities.

Water used to hydrostatically test pipelines and other vessels will be released very slowly to minimize the possibility of flooding washes. Washes will be monitored during releases to ensure the effectiveness of this measure.

5.8 PESTICIDES

All rodenticides, insecticides, fungicides, herbicides, and other pesticides will be stored and applied in accordance with state and federal regulations. The California Department of Food and Agriculture conducts a state-wide pesticide spraying program for controlling the sugar beet leafhopper, which is a vector for the curly top virus. Portions of DOE-administered NPR-2 lands are spot-treated, as needed, usually once a year by aerial spraying of the pesticide malathion. Section 7 requirements for this action were evaluated under a separate environmental assessment (CDFA, 1991; U.S. Department of the Interior, 1991).

5.9 OPERATIONAL GUIDELINES

DOE will work with lessees, third-parties, and permittees to develop and implement operational guidelines that will help to minimize effects of project activities on threatened and endangered species. Such guidelines will include controlling vehicle speeds on secondary roads, illicit hunting and livestock grazing, and off-road vehicle travel not preceded by a preactivity survey. These policies will apply to DOE, lessee, third-party, and permittee employees.

5.10 COMPLIANCE

DOE will establish procedures to ensure that these mitigation measures are carried out by lessees, third parties, and permittees. Compliance with any existing Biological Opinion terms and conditions, or informal mitigation measures for ongoing activities will continue to be implemented by the project proponent and monitored by the appropriate DOE monitor. DOE will work cooperatively with any new operators or lessees who begin

operations on NPR-2, as a result of lease reassignments/relinquishments or new farm out agreements, so that they will be aware of policies to minimize effects to endangered species.

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Appendix F
Biological Opinion

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Appendix G
Qualitative Description of Impacts to the Biological Resources on NPR-1

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G. QUALITATIVE DESCRIPTION OF IMPACTS TO THE BIOLOGICAL RESOURCES ON NPR-1

This appendix provides a qualitative description of impacts without mitigation on NPR-1 under the No Action Alternative (Government Development Case) and Proposed Action and Alternatives (Commercial Development Case). Impacts for all alternatives are broadly similar but would vary in severity and extent, particularly in two ways:

- The Proposed Action involves the loss of affirmative Federal obligations under the Endangered Species Act to protect, conserve and help recover threatened and endangered species. These obligations would be maintained under the No Action Alternative.

- The Proposed Action is likely to result in greater habitat loss than the No Action Alternative. Under the No Action Alternative, between 303 and 600 acres of habitat are projected to be disturbed. Under the Proposed Action, between 555 and 766 acres of habitat would be disturbed. These compare to 828 acres assumed as the basis for the 1995 Biological Opinion (B.O.) from FWS.

For a summary of the impacts of each alternative with mitigation and the mitigations used, please refer to Section 4.5 of this document.

G.1. PLANT COMMUNITIES

Impacts from loss of vegetation due to construction, maintenance and exploratory activities would be less than significant. DOE currently can allow use of their land by third parties; for example, DOE can permit a third party to build a pipeline across their land. As a Federal agency, DOE's approval of such third-party uses triggers NEPA, and DOE is required to evaluate impacts from those third-party projects. All proposed Federal facilities (involving approximately 1,066 acres) and all non-Federal third-party projects for which DOE would be required to evaluate impacts to threatened and endangered species (involving approximately 120 acres) would permanently displace vegetation for the life of the respective projects. Most impacts to vegetation resulting from underground third-party projects (involving approximately 571 acres) would be temporary with approximately 420 acres of such disturbances being revegetated. (These acreage numbers are based on information in the NPR-1 SEIS/PEIR (DOE 1993).) Most activities associated with seismic explorations would result in only temporary disturbances to vegetation; access roads (where needed) and sites used for explosive charges would be longer-lasting. This would be considered a less than significant impact because Valley Grassland and Saltbush Scrub Grassland are common plant communities at NPR-1.

Impacts from accelerated erosion-caused damage would not be significant. NPR-1 soils are often loose and prone to erosion (Soil Conservation Service undated). Soil erosion could occur nevertheless if major precipitation events (generally rare) occurred during construction of facilities, especially if construction occurred on steep or unstable slopes. Under these circumstances, if construction activities exposed saline soils, erosion could transport this material and kill or inhibit the growth of intolerant species.

Impacts from spills of oil and other chemicals from existing and proposed facilities would be less than significant. Such spills could adversely affect local plant communities by killing or injuring plants within spill areas, removal of plants during spill clean-up and uptake of contaminants by plants.

Impacts from accidental range fires would be less than significant. Fires caused by construction, operations and maintenance activities adversely impact plant communities by killing some shrubs and by

changing plant community species composition and structure. A beneficial effect of range fires may be the encouragement of native grasses and forbs over otherwise more invasive and dominant exotic species.

Impacts from livestock grazing would be less than significant. Grazing is prohibited on NPR-1, but some trespass grazing occurs annually along the southwestern and northeastern flanks of Elk Hills. Adverse impacts of grazing include killing of plants, especially native forbs and grasses. Beneficial impacts of grazing may include reduction in density of exotic grasses and forbs which may result in an increase in native grass and forb populations. The potentially beneficial or adverse impacts of grazing would not be expected over most of NPR-1 because livestock grazing is prohibited.

G.2. ANIMAL COMMUNITIES

Impacts from habitat loss, alteration and fragmentation would be less than significant. Between approximately 303 and 600 acres for the lower and upper bounds of the Government Development Case and between 1,091 and 1,512 are expected to be disturbed on NPR-1 over the next 40 years as a result of the construction of wells and their access roads, and a proportionate reduction in carrying capacity is anticipated. Under the Commercial Development Case, between approximately 555 and 766 acres of disturbed habitat are expected for the lower and upper bounds, respectively. Significant seismic surveys would result in temporary disturbance of animal communities. This disturbance should be limited to the period of time the surveying activities are actually in progress.

Impacts from direct mortality, injury, or displacement would be less than significant. Animals within construction areas would be killed during construction or could disperse to other areas; dispersing individuals tend to have a lower survivorship (Emlen 1984; Ralls et al. 1986). Road kills and injuries are also expected, especially in construction areas (3.5.3.). Animals could also be trapped and killed in well cellars and other oil field facilities. Raptors may be injured or killed from electrocution when perching on utility poles providing electricity to oil field equipment.

Impacts from accelerated soil erosion would not be significant. Erosion resulting from construction activities could destroy or alter habitat, or decrease the productivity of forage plants.

Impact from spills of oil, waste water and other chemicals would be less than significant. Operations and maintenance activities could impact animal communities when animals become trapped or injured by spilled oil.

Impacts from fire potentially would be less than significant. Accidental fires could affect animal communities if animals are harassed, burned, or killed, or if fires reduce forage. Animals that are more dependent on saltbush would be particularly impacted. Periodic range fires may also have beneficial impacts.

Impacts from livestock grazing are not expected to have significant impacts on the animal communities.

G.3. THREATENED AND ENDANGERED SPECIES

G.3.1. Plants

G.3.1.1. Hoover's Woolly-star (federally threatened, state special)

As discussed in Section 3.5.4, one federally listed threatened plant, Hoover's woolly-star, has been observed at numerous locations on NPR-1 (EASI 1996). Potential impacts to Hoover's woolly-star would be similar to those affecting general plant communities at NPR-1.

Impacts from habitat loss, alteration, or fragmentation would be less than significant. This impact is unlikely to be significant, because Hoover's woolly-star is a colonizing species.

Impacts from seed reserve reductions would be significant. Individuals or local populations occurring within project areas could be destroyed or crushed, and Hoover's woolly-star seed reserves could be disturbed or locally eliminated.

Impacts of seed removal during land clearing would be significant. If disturbances occurred after this annual plant had matured, then impacts could be limited to removal of seed during land clearing.

G.3.1.2. Kern Mallow (federally endangered, state special)

Impacts to the Kern mallow would be significant. The federally listed endangered Kern mallow has not been observed during special-status plant surveys conducted at NPR-1 (Anderson et al. 1994; EASI 1996). However, suitable habitat for this species exists in the lowland areas of the Reserve. Because all of the listed or other special-status plant species are highly adapted desert annuals, the amount and timing of yearly precipitation plays a strong role in determining when, and if, each of these species germinates and flowers. Some species can produce seeds that may stay in a latent stage for large periods of time and exist without germinating or flowering, and can be easily be missed in surveys. Individual or local populations occurring within project areas could be destroyed or crushed, and Kern mallow seed reserves could be disturbed or locally eliminated.

G.3.1.3. San Joaquin Woolly-Threads (federally endangered, state special) and California Jewelflower (federally endangered, state endangered)

No impacts are expected to the federally endangered San Joaquin woolly-threads and California Jewelflower. Neither species has been observed during special-status plant surveys conducted at NPR-1 (Anderson et al. 1994; EASI 1996), and habitat for these species on the Reserve is probably suboptimal.

G.3.2. Animals

Four animal species that are listed as federally and/or state endangered or threatened are likely to be affected by the Proposed Action. These include the San Joaquin Kit Fox, giant kangaroo rat, blunt-nosed leopard lizard and San Joaquin antelope squirrel.

G.3.2.1. San Joaquin Kit Fox (federally endangered and state threatened)

Impacts on the San Joaquin kit fox that could result from the No Action Alternative are similar to those described and evaluated for past activities at NPR-1 (O'Farrell et al. 1986; DOE 1992; DOE 1993). These impacts, or potential impacts, include mortality or injury due to construction or maintenance activity;

mortality or injury due to vehicle strikes; loss of dens; loss or alteration of habitat; harassment; being trapped in or ingesting of oil-field chemicals; fire; and grazing. Impacts associated with on-going activities were presented in Section 3.5.3.2. Impacts related to the Proposed Action and to the Alternative to the Proposed Action would be similar in nature but would be greater.

Impacts from habitat loss, alteration and fragmentation would be significant. The No Action Alternative would result in the loss of 303 to 600 acres and the Proposed Action would affect 555 to 766 acres of kit fox habitat due to construction of well pads and access roads. This amount of habitat loss exceeds earlier project descriptions (DOE 1993). Direct impacts associated with habitat loss and fragmentation would be similar.

Impacts from mortality or injury would be significant. Mortality or injury resulting from construction, maintenance and operation activities averaged about 2.5 foxes per year (excluding foxes killed on public roads that cross NPR-1). Under the No Action Alternative, a similar number of fox mortalities or injuries would be expected. Vehicle-related mortality would still occur, but would be mitigated by controlling speed limits and minimizing night driving. Some inadvertent human harassment would continue.

Impacts from the ongoing Endangered Species Program would be beneficial overall. As described in Section 3.5.4, activities associated with the Endangered Species Program may result in mortality or injury to kit foxes during studies that involve trapping or radiocollaring. Adverse impacts such as mortality or injury would be addressed separately in Federal Fish and Wildlife Permits and Memoranda of Understanding with the California Department of Fish and Game.

Impacts from destruction of kit fox dens would be significant. The number of known and potential kit fox dens purposefully or inadvertently destroyed would also be expected to remain similar.

Impacts from spills of oil, oil field chemicals and waste water would be significant. Accidental oil spills could result in death or injury to foxes that become mired in oil or ingest contaminants or consume prey that have become contaminated. Spills would be cleaned up immediately in accordance with the SPCC plan, thus minimizing, if not eliminating, the risk of exposure or ingestion of oil-field chemicals.

Impacts from fire would be less than significant. Impacts of accidental range fires are not well understood, they could include direct mortality or injury, loss of prey species and alteration of habitat. A current study at NPR-1 is attempting to evaluate the effects of fire on kit fox and their habitat, and may be a positive impact. Because foxes use underground dens for shelter, and fires are sporadic, the likelihood of direct impacts are low.

Impacts from grazing would not be less than significant. Even though impacts due to grazing are also not well understood, but could include indirect mortality, injury, loss of prey species and alteration of habitat.

Impacts from institutional controls and guidelines would be beneficial. Site policies such as speed limits, control of off-road vehicle travel, prohibitions on hunting and public access and prohibitions on domestic pets would have beneficial impacts.

G.3.2.2. Giant Kangaroo Rat (federally and state endangered)

Active burrow systems of the giant kangaroo rat have been found on 30 sections of NPR-1 and are distributed along the northeast and southwest flanks of NPR-1, as well as in numerous smaller locations in the developed uplands (see Section 3.5.4). Potential impacts to the giant kangaroo rat as the result of

construction, operations and maintenance activities, include: (1) loss of habitat, including alteration of soil conditions that increase difficulty of constructing burrows and the formation of dense vegetative cover resulting from land management practices; (2) mortality or injury resulting from vehicles; (3) burrow destruction; (4) being caught in oil spills; (5) exposure to contaminants; (6) impacts due to fire; and (7) impacts due to grazing of domestic animals.

Impacts of activities undertaken in the No Action Alternative would be similar in nature to those described in Section 3.5.4 and in the 1993 SEIS/PEIR (DOE 1993), but could be more extensive due to the increase in land requirements. Although the majority of giant kangaroo rats inhabit the less developed periphery of NPR-1, exploratory, development and operational activities in the uplands could affect important local populations.

Impacts from habitat loss, alteration and fragmentation would be significant. The majority of new well pads and associated roads would be constructed throughout the upland portions of NPR-1; some would occur in areas inhabited by giant kangaroo rats. Specific impacts, or the proportion of land requirements (303 to 600 acres for the Government Development Case and 555 to 766 acres for the Commercial Development Case) which would directly impact giant kangaroo rats cannot be evaluated since the specific locations of continuing developments are not known, and new populations of giant kangaroo rats continue to be found in some of the developed areas of NPR-1 (e.g., 11G).

Impacts from direct mortality and injury would be significant. Construction and maintenance activities, and use of vehicles associated with on-going operations may result in injury or mortality of giant kangaroo rats. Mortality or injury may also occur if individuals are trapped or buried in burrows that are collapsed during construction or maintenance activities. The only injuries or mortalities assumed to have resulted from these types of impacts recorded at NPR-1 were associated with routine maintenance of the perimeter firebreak and well pad construction near a colony of giant kangaroo rats in Section 11G.

Impacts from the Endangered Species Program would be beneficial overall. As described in Section 3.5.4, activities associated with the Endangered Species Program may result in mortality or injury to giant kangaroo rats during studies that involve trapping. These impacts would be similar under the No Action Alternative. Adverse impacts such as mortality or injury would be addressed separately in Federal Fish and Wildlife Permits and Memorandums of Understanding with the California Department of Fish and Game.

Impacts from the loss of burrows would be significant. Ground disturbing activities may result in the loss of giant kangaroo rat burrows.

Impacts from accelerated soil erosion would not be significant. Erosion resulting from construction activities could destroy or alter habitat, or decrease the productivity of forage plants.

Impacts from spills of oil, oil field chemicals and waste water would be significant. Giant kangaroo rats may be injured or killed if drowned or mired in spills of oil, oil field chemicals, or from discharges of oil field waste water. These types of impacts have been documented on NPR-2 and have been observed for other species of kangaroo rats on NPR-1.

Impacts from fire would be less than significant. Impacts of accidental range fires are not well understood, but could include direct mortality or injury, loss of forage and alteration of habitat. Because giant kangaroo rats use underground burrows for shelter, and fires are sporadic, the likelihood of direct impacts are low.

Impacts from grazing would not be significant. Even though impacts due to grazing are also not well understood, they could include indirect mortality or injury resulting from collapsed burrows, loss of forage and alteration of habitat.

Impacts from noise would be significant. Noise from routine operations and well drilling and ground vibrations from seismic explorations could impact giant kangaroo rats by affecting their behavior or damaging their sensitive auditory systems. During surveys conducted on NPR-1, most giant kangaroo rat burrows (73 percent) occurred within 100 meters of a disturbance (operating well, road, etc.), but impacts from well drilling or seismic explorations are not well known.

G.3.2.3. Tipton Kangaroo Rat (federally and state endangered)

Impacts on the federally endangered Tipton kangaroo rat are not likely to be significant. Distribution of the Tipton kangaroo rat on NPR-1 is restricted to Section 23S. Because Section 23S is not currently developed, and future development is unlikely, impacts to the rat are not likely to be significant.

G.3.2.4. Blunt-nosed Leopard Lizard (federally and state endangered)

Potential impacts to the blunt-nosed leopard lizard as the result of activities associated with the No Action Alternative at NPR-1 would be similar to those described in Section 3.5.4.

Impacts from habitat loss, alteration and fragmentation would be significant. The majority of new well pads and associated roads would be constructed throughout the upland portions of NPR-1; however, some would occur in lowland areas inhabited by blunt-nosed leopard lizards. Specific impacts, or the proportion of land requirements (303 to 600 acres for the Government Development Case and 555 t 766 acres for the Commercial Development Case) that would directly impact blunt-nosed leopard lizards, cannot be evaluated since the specific locations of continuing developments are not known. However, most blunt-nosed leopard lizard habitat is located along the periphery of NPR-1 where few developments are likely.

Impacts from direct mortality or injury would be significant. Eight blunt-nosed leopard lizards were killed or injured as a result of on-going activities at NPR-1 between 1980 and 1995. Mortalities and injuries related to the No Action Alternative would be expected to be similar in nature and frequency.

Impacts from the Endangered Species Program would be beneficial overall. As described in Section 3.5.4, activities associated with the Endangered Species Program may result in mortality or injury to blunt-nosed leopard lizards during studies that involve capturing and handling. Adverse impacts such as mortality or injury would be addressed separately in Federal Fish and Wildlife Permits and Memoranda of Understanding with the California Department of Fish and Game.

Impacts from destruction of small mammal burrows and other burrows would be significant. Burrows of small mammals and other animals are used by blunt-nosed leopard lizards for escape cover, over-nighting and over-wintering and laying eggs. Numerous small mammal burrows are destroyed during routine construction and maintenance activities. Such activities in blunt-nosed leopard lizard habitat, especially in the vicinity of washes, would be expected to adversely affect blunt-nosed leopard lizards.

Impacts from oil spills or wastewater discharges would significant. Spills of oil or wastewater into blunt-nosed leopard lizard habitat could result in drowning, coating them with oil or other oil-field chemicals, or contaminating portions of their habitat or food supply.

Impacts from erosion-caused degradation of preferred habitat would not be significant. Erosion resulting from construction activities could destroy or alter habitat, or result in burial of burrows. Because accelerated erosion would most likely impact drainages which are considered optimal habitat on NPR-1, these impacts would be expected to occur where construction activities are situated near large drainages. However, few new developments would be likely in such areas.

Impacts from pest management programs would be potentially significant. DOE is a participant with the Bureau of Land Management in evaluating the impacts of a State of California, Department of Food and Agriculture (CDFA) pest management program to control the beet leafhopper, which occurs on lands administered by these agencies. Impacts of this program are addressed in separate consultations with FWS and require mitigation measures in addition to ones presently implemented for routine operations at NPR-1. These mitigation measures have been included as mitigations for the Proposed Action, but CDFA would be responsible for any consultations with FWS or CDFG required in order to continue spraying activities on private land.

G.3.2.5. San Joaquin Antelope Squirrel (state threatened)

Impacts from habitat loss, alteration and fragmentation would be significant. The majority of new well pads and associated roads would be constructed throughout the upland portions of NPR-1, in areas inhabited by San Joaquin antelope squirrels. This species is widely distributed on NPR-1, and the land requirements of 303 to 600 or 555 to 766 acres (Government and Commercial Development Cases, respectively) would result in the loss, alteration and fragmentation of this species' habitat.

Impacts from direct mortality and injury would be significant. Construction and maintenance activities, and use of vehicles associated with on-going operations may result in injury or mortality of San Joaquin antelope squirrels. Mortality or injury may also occur if individuals are trapped or buried in burrows that are collapsed during construction or maintenance activities. Roadkills are more likely to occur to this species than other listed mammals at NPR-1 because they are active during the day when most vehicle traffic occurs.

Impacts from the Endangered Species Program would be beneficial overall. As described in Section 3.5.4, activities associated with the Endangered Species Program may result in mortality or injury to giant kangaroo rats during studies that involve trapping. These impacts would be similar under the No Action Alternative. Adverse impacts such as mortality or injury would be addressed separately in Federal Fish and Wildlife Permits and Memoranda of Understanding with the California Department of Fish and Game.

Impacts from loss of burrows would be significant. Ground disturbing activities may result in the loss of San Joaquin antelope squirrel burrows.

Impacts from spills of oil, oil field chemicals and waste water would be significant. San Joaquin antelope squirrels may be injured or killed if drowned or mired in spills of oil, oil field chemicals, or from discharges of oil field waste water.

Impacts from noise would be potentially significant. Noise from routine operations and well drilling, and ground vibrations from seismic explorations could impact San Joaquin antelope squirrels by affecting their behavior.

Impacts from fire would be a less than significant. Impacts of accidental range fires are not well understood, but could include direct mortality or injury, loss of forage and alteration of habitat. Because

San Joaquin antelope squirrels use underground burrows for shelter, and fires are sporadic, the likelihood of direct impacts are low.

Impacts of grazing would not be significant. Even though impacts due to grazing are also not well understood, they could include indirect mortality or injury resulting from collapsed burrows, loss of forage and alteration of habitat.

Impacts from accelerated soil erosion would not be significant. Erosion resulting from construction activities could destroy or alter habitat, or decrease the availability of food, or increase the potential for predators.

G.3.2.6. Swainson's Hawk (state threatened)

No significant impacts to the Swainson's hawk are anticipated. The hawk is not known to nest on NPR-1; and suitable nesting habitat does not occur on the site. Foraging areas for the Swainson's hawk are most likely to be along the periphery of NPR-1, in areas where few developments would occur.

G.3.2.7. Western Snowy Plover (federally threatened, state special)

Western snowy plovers are not known to nest on NPR-1, and no significant impacts to this species are anticipated.

G.3.2.8. Longhorn Fairy Shrimp (federally endangered), Vernal Pool Fairy Shrimp (federally threatened), Vernal Pool Tadpole Shrimp (federally endangered)

No significant impacts to these species are anticipated. Although no surveys for these crustaceans have been conducted at NPR-1, seasonally ponded water--a requirement for these species--is infrequent at NPR-1.

G.3.2.9. Valley Elderberry Longhorn Beetle (federally threatened)

No significant impacts to the valley elderberry longhorn beetle are anticipated. Although no surveys for valley elderberry longhorn beetles have been conducted on NPR-1, suitable habitat for this species (the occurrence of elderberry bushes, *Sambuca* spp.) does not occur on the site.

G.3.3. Species of Concern

Impacts to species of concern would be significant. Several California species of special concern and former Federal Category 2 species[1] are known to occur on NPR-1, or suitable habitat for these species exists (see Section 3.5.3.2). Impacts under the No Action Alternative at NPR-1 would be expected on eleven plant species of concern, four mammal species of concern, one bird species of concern and insignificant impacts are also expected on four other bird species of concern and two reptile species of concern. Depending on the location of the disturbance, the anticipated 303 to 600 or 555 to 766 acres (Government and Commercial Development Cases, respectively) of habitat loss could impact these species in varying degrees

[1] U.S. Fish and Wildlife Service has eliminated Category 2 as an official designation under the Endangered Species Act. We therefore include these former Category 2 species as "species of concern," although they do may not have any formal state designation or protection.

G.3.4. Plants

Impacts to plant species of concern would be significant. The No Action Alternative at NPR-1 would be expected to impact to eleven plant species of concern. These species are: Kern tarplant, oil neststraw, Lost Hills saltbush, heartscale, crownscale, San Joaquin bluecurls, Temblor buckwheat, hollisteria, cottony buckwheat, recurved larkspur and gypsum-loving larkspur. Sources of impacts to these species would be similar to those described for the plant community in general and would include mortality due to construction and other ground disturbing activities, accelerated erosion, spills of oils and other oil field chemicals, accidental range fires, livestock grazing and habitat loss and fragmentation. Anticipated habitat loss would impact these species in varying degrees depending on the location of the disturbance. This would be considered a significant impact.

G.3.5. Mammals

Impacts to four mammalian species of concern would be significant. The No Action Alternative at NPR-1 would be expected to impact four mammal species of concern including the short-nosed kangaroo rat, southern grasshopper mouse, San Joaquin pocket mouse and American badger.

G.3.5.1. Short-nosed Kangaroo Rat

Impacts to the short-nosed kangaroo rat would be significant. Sources of impacts to short-nosed kangaroo rats would be similar to those described for the animal community and include habitat loss, alteration and fragmentation; mortality, injury, or displacement; spills of oil, oil field chemicals and waste water; fire; grazing; and accelerated soil erosion. The short-nosed kangaroo rat is widely distributed on NPR-1. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.5.2. Southern Grasshopper Mouse

Impacts to the southern grasshopper mouse would be significant. Sources of impacts to the southern grasshopper mouse would be similar to those described for the animal community and include habitat loss, alteration and fragmentation; mortality, injury, or displacement; spills of oil, oil field chemicals and waste water; fire; grazing; and accelerated soil erosion. The distribution of the southern grasshopper mouse is not well known. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.5.3. San Joaquin Pocket Mouse

Impacts to the San Joaquin pocket mouse would be significant. Sources of impacts to the San Joaquin pocket mouse would be similar to those described for the animal community and include habitat loss, alteration and fragmentation; mortality, injury, or displacement; spills of oil, oil field chemicals and waste water; fire; grazing; and accelerated soil erosion. The distribution of the San Joaquin pocket mouse is not well known. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.5.4. American Badger

Impacts to the American badger would be significant. Sources of impacts to the American badger would be similar to those described for the animal community and include habitat loss, alteration and fragmentation; mortality, injury, or displacement; spills of oil, oil field chemicals and waste water; fire;

grazing; and accelerated soil erosion. The American badger is widely distributed on NPR-1. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.5.5. Greater Western Mastiff Bat

Impacts to the greater western mastiff bat would not be expected since they have not been observed on the site.

G.3.6. Birds

Impacts to bird species of concern would be significant. Eleven bird species of concern are known to occur on NPR-1. Significant impacts are expected to only one of these species, the western burrowing owl.

G.3.6.1. Western Burrowing Owl

Impacts to the western burrowing owl would be significant. The western burrowing owl is widely distributed on NPR-1 and is known to nest on the site. Burrowing owls may create their own dens, or may use dens once occupied by San Joaquin kit foxes or American badgers. The No Action Alternative at NPR-1 would be expected to impact the burrowing owl. Sources of impacts would be similar to those described for the animal community and include habitat loss, alteration and fragmentation; mortality, injury, or displacement; spills of oil, oil field chemicals and waste water; fire; grazing; and accelerated soil erosion. Anticipated habitat loss would impact this species.

G.3.6.2. Prairie Falcon

Impacts to the prairie falcon would be less than significant. Prairie falcons are known to nest on NPR-1 in steep cut banks formed along large washes. The No Action Alternative at NPR-1 would be expected to impact the prairie falcon in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact these species to varying degrees depending on the location of the disturbance, but would likely be minimal due to the relative scarcity of this species on NPR-1 and the unlikely siting of ground disturbing activity near steep cut banks

G.3.6.3. Other Raptors

Impacts to other raptors would be less than significant. The golden eagle may occasionally nest on site on utility company owned and operated transmission towers. Five other species of raptors may be occasional visitors to the site.

G.3.6.4. Horned Lark

Impacts to the horned lark would be less than significant. The horned lark is found throughout NPR-1. The No Action Alternative at NPR-1 would be expected to impact the horned lark in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.6.5. Loggerhead Shrike

Impacts to the loggerhead shrike would be less than significant. The loggerhead shrike is found throughout NPR-1. The No Action Alternative at NPR-1 would be expected to impact the loggerhead shrike

in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact this species to varying degrees depending on the location of the disturbance.

G.3.6.6. Le Conte's Thrasher

Impacts to the Le Conte's thrasher would be less than significant. Le Conte's thrasher is found in flatter terrain along the periphery of NPR-1. The No Action Alternative at NPR-1 would be expected to impact this species in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact Le Conte's thrasher to varying degrees depending on the location of the disturbance, but would likely be minimal due to the distribution of this species in flatter terrain. Impacts of fire to this species may be more significant given its use of shrubs.

G.3.6.7. Tri-colored Blackbirds and Little Willow Flycatcher

These species are infrequently observed on NPR-1 and the No Action Alternative at the site is not expected to impact them.

G.3.7. Reptiles and Amphibians

Impacts to reptiles of concern are expected to be less than significant and no amphibians of concern are known to occur on NPR-1.

G.3.7.1. California Horned Lizard

Impacts to the California horned lizard would be less than significant. The California horned lizard occurs primarily in the flatter terrain along the periphery of NPR-1. The No Action Alternative at NPR-1 would be expected to impact this species in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact California horned lizards to varying degrees depending on the location of the disturbance, but would likely be minimal due to the distribution of this species in flatter terrain.

G.3.7.2. San Joaquin Whipsnake

Impacts to the San Joaquin whipsnake would be considered less than significant. The San Joaquin whipsnake occurs throughout NPR-1. The No Action Alternative at NPR-1 would be expected to impact this species in a manner similar to those impacts described for the animal community. Anticipated habitat loss would impact whipsnakes to varying degrees depending on the location of the disturbance.

G.3.8. Invertebrates

Impacts to four species of blister beetle and the striped-skin snail are not expected because these species have not been observed on NPR-1.

United States Department of the Interior

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Fish and Wildlife Enhancement
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IN REPLY REFER TO:

In Reply Refer To:
1-1-95-F-102

November 8, 1995

Mr. Danny A. Hogan, Director
U.S. Department of Energy
Naval Petroleum Reserves in California
P.O. Box 11
Tupman, California 93276

Subject: Reinitiation of Formal Consultation Concerning Oil Production at Maximum Efficient Rate on Elk Hills Naval Petroleum Reserve, Kern County, California

Dear Mr. Hogan:

This responds to your October 9, 1991, request for reinitiation of formal consultation pursuant to section 7(a) of the Endangered Species Act of 1973, as amended (Act), on a proposal by the U.S. Department of Energy (DOE or the Department) to continue oil production activities at Maximum Efficient Rate (MER) on Elk Hills Naval Petroleum Reserve (NPR-1 or the Reserve), Kern County, California. At issue are effects of proposed MER production on the federally endangered San Joaquin kit fox (*Vulpes macrotis mutica*), blunt-nosed leopard lizard (*Gambelia silus*), giant kangaroo rat (*Dipodomys ingens*), Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*), Kern mallow (*Eremalche kernensis*), and San Joaquin wooly-threads (*Lembertia congdonii*), and the federally threatened Hoover's woolly-star (*Eriastrum hooveri*). Your request for formal consultation was received by this office on October 15, 1991. The U.S. Fish and Wildlife Service (Service) provided a draft biological opinion to DOE on May 28, 1993. Formal comments from DOE on the draft opinion were received on December 8, 1994. Subsequent meetings between representatives from the Service, DOE and Chevron U.S.A. (Chevron) were held on February 8, March 3, April 20, and May 18, 1995, to discuss the content of the biological opinion.

The Service addressed effects on federally listed species of MER production activities on NPR-1 in two prior biological opinions dated February 1, 1980 (Case No. 1-1-80-F-2) and December 16, 1987 (Case No. 1-1-80-F-2R). The 1980 biological opinion concluded that MER oil production on NPR-1 may jeopardize the continued existence of the San Joaquin kit fox and blunt-nosed leopard lizard, but included six reasonable and prudent alternatives that, if implemented, would allow MER production to continue. The Department agreed to implement these alternatives and to complete a future consultation to evaluate their success in minimizing adverse effects of MER production on federally listed species.

The subsequent 1987 biological opinion concluded that MER production on NPR-1 would not jeopardize the continued existence of the San Joaquin kit fox, blunt-nosed leopard lizard, Tipton kangaroo rat and giant kangaroo rat--which was listed as federally endangered in 1988. This conclusion was based, in part, on development and implementation by DOE of a comprehensive mitigation program designed to minimize adverse effects of MER production on federally listed species. In addition to this program, the 1987 opinion required the Department to implement several reasonable and prudent measures, including replacement of endangered species habitat lost as a result of project related actions.

The 1987 biological opinion also cited the Department's intent to develop a Supplemental Environmental Impact Statement (SEIS) concerning future oil production activities on NPR-1. The intent to develop such an update resulted from planning activities conducted concurrently with the 1987 consultation that determined that future oil development activities on NPR-1 could exceed some environmental impacts projected in the Department's original EIS completed in 1979 (DOE 1979). Accordingly, the Department published a Notice of Intent to prepare a supplemental EIS on NPR-1 activities in the Federal Register on April 4, 1988, completed a draft supplemental EIS (DSEIS) in May, 1992 (DOE 1992), and a final supplemental EIS (FSEIS) in July, 1993 (DOE 1993).

It is this supplemental EIS, together with Federal listing of several plant species--the Hoover's woolly-star, San Joaquin wooly-threads, and Kern mallow on July 19, 1990--that necessitates reinitiation of formal consultation and preparation of this revised biological opinion.

This biological opinion is based on the DSEIS (DOE 1992); the FSEIS (DOE 1993); a biological assessment prepared for currently proposed activities on NPR-1 (DOE 1991); several other reports (see Literature Cited section); meetings and discussions between the Service, Department, Chevron, and Energy Advisory Services, Inc.(EASI), the Department's biological contractor (formerly EG&G Energy Measurements); and information in our files.

BIOLOGICAL OPINION

Description of the Proposed Action

Elk Hills Naval Petroleum Reserve (or Naval Petroleum Reserve No. 1) was established in 1912 for national defense purposes, but was largely maintained in reserve shut-in status until 1976. Because of oil shortages in the early 1970's, Congress passed the Naval Petroleum Reserve Production Act in 1976, which provided for oil production on NPR-1 at the "Maximum Efficient Rate." Maximum Efficient Rate under this statute was defined as the maximum rate that optimizes both economic return and hydrocarbon recovery. The proposed action addressed in this biological opinion is continuing MER production on NPR-1 in compliance with the Naval Petroleum Production Act and as described in the DSEIS (DOE 1992).

NPR-1 consists of approximately 47,409 acres about 25 miles southwest of Bakersfield, California. Of this, 37,049 acres (78 percent) are administered by the Department of Energy; the balance of 10,360 acres (22 percent) is owned by Chevron (DOE 1992). To the south of and partially contiguous with NPR-1 lies Buena Vista Hills Oil Field which encompasses Naval Petroleum Reserve (NPR-2). Of approximately 30,000 acres comprising NPR-2, DOE administers about 10,000 acres and the balance is owned by private oil companies. The government's share of NPR-2 has been developed under lease by private oil companies since the 1920's. Together, NPR-1 and NPR-2 constitute what is known as the Naval Petroleum Reserves in California (NPRC).

Topographically, Elk Hills consists of a ridge about 16 miles long by six miles wide that runs east to west in the southern San Joaquin Valley. NPR-1 is surrounded on three sides by oil and gas fields and agricultural lands. On the north side, NPR-1 is immediately contiguous with a large area (approximately 30,000 acres) of relatively undisturbed endangered species habitat known as the Lokern Road area. Vegetation on NPR-1 consists primarily of saltbush scrub and grassland habitats.

Elk Hills is the seventh largest oil field in the United States (DOE 1991). It is a highly profitable field, cumulative net government revenues exclusive of Chevron's share from 1976 to 1990 totalling $11.6 billion (DOE 1992).

Hydrocarbon products recovered or produced on NPR-1 include crude oil, natural gas, and natural gas liquids including propane, butane, and natural gasoline. Of estimated original recoverable oil reserves on NPR-1, 860 million barrels have been produced--630 as the result of MER production since 1976 (DOE 1992). Oil production on NPR-1 peaked in 1981 at approximately 180,000 barrels per day and averaged approximately 74,000 barrels per day in Fiscal Year 1991 (DOE 1992). The Department estimates that oil production on NPR-1 could continue to be profitable until 2010 to 2025, perhaps longer (DOE 1992).

Existing Facilities

Existing operational facilities on NPR-1 include the following (DOE 1991): (1) 1,253 active wells (production, water source, gas injection, waterflood injection, wastewater disposal injection, and steam injection); (2) 1,055 existing wells that are shut-in (idle) or abandoned; (3) approximately 2,500 miles of pipelines and 1,000 miles of roads; (4) one crude oil tank farm; (5) 121 tank settings; (6) five LACT (lease automatic custody transfer) facilities used to separate oil from water and transfer oil to Chevron and Department purchasers; (7) 45 product storage tanks; (8) four gas-processing plants used to separate natural gas liquid products from natural gas; (9) five wastewater disposal facilities; (10) two gas injection plants; (11) 11 gas compression plants; (12) one steam injection facility used for thermally enhanced oil recovery; (13) several emergency wastewater sumps and two landfill facilities; (14) three building complexes for offices, maintenance, and storage; and (15) a variety of other supporting systems and infrastructure.

The majority of waste materials generated on NPR-1 are non-hazardous and include produced water, spent drilling fluids, and solid wastes such as paper, construction debris, and garbage (DOE 1991). Hazardous materials utilized or generated on NPR-1 include used oil, lubricants, and batteries; herbicides and pesticides; and solvent wastes (DOE 1991). Most produced water is re-injected on-site into subsurface formations; drilling fluids are placed into on-site land areas located in Sections 10G and 27R (the land area in Section 10G is temporarily idle). A hazardous waste facility in Section 27R was formally closed in 1992. Hazardous wastes are removed to off-site disposal facilities or are recycled (DOE 1991).

Despite careful handling, spills of oil or other chemicals occasionally occur on NPR-1. Since 1989, these have been handled in accordance with a Spill Prevention Control and Countermeasure Plan (BPOI 1989), which provides for an emergency response team, cleanup procedures, and documentation. Nonetheless, an unquantified number of acres on NPR-1 has been affected by such spills since 1976 and the Department currently is cleaning up approximately 64 sites known to have been contaminated by chromium, arsenic, and other materials (all 64 of these sites already have been remediated) (DOE 1991).

Activities necessary to achieve and maintain MER production on NPR-1 were first described in the original project EIS (DOE 1979). These activities have resulted in the construction of numerous oil production, processing, and storage facilities, associated infrastructure, and administrative facilities on NPR-1 since 1976 (see Environmental Baseline section). Because of evolving conditions, however, including better technical understanding of oil and gas reservoirs beneath NPR-1, the Department now proposes several new facilities believed to be necessary to maintain MER production through the 1990's and into the next century. These are described in the FSEIS (DOE 1993) and are summarized below. The Service completed a biological opinion in 1987 (File No. 1-1-80F-2R) that covers all of the on-going activities at NPR-1.

To maintain hydrocarbon production on NPR-1 at Maximum Efficient Rate, the Department proposes to conduct the following ongoing activities (DOE 1992) (those not pertaining to biological issues are omitted).

(1) Production at MER, estimated in the Long Range Plan to be approximately 99,000 bbl/day of oil in FY 1990, declining to approximately 72,000 bbl/day in FY 1995; 365 million ft/day of gas in FY 1990, increasing to 417 million ft/day in FY 1995; and 654,000 gal/day of natural gas liquid products in FY 1990, increasing to 768,000 gal/day in FY 1995;

(2) Drilling, redrilling or deepening approximately 382 existing wells (including 148 for the steamflood operation described below), performance of approximately 2,663 remedial jobs on existing wells, and abandonment of approximately 1,080 existing wells.

(3) Investigating, remediating, or otherwise managing numerous old and inactive waste sites.

(4) Activities to permit third parties to construct, operate, and maintain pipeline projects, geophysical surveys, and other projects on NPR-1 lands. Approximately 3-4 third-party projects are anticipated per year.

(5) A program to initiate revegetation on approximately 1,045 acres of previously disturbed lands no longer needed for production operations.

(6) Continued maintenance of the NPR-1 perimeter firebreak. This activity was addressed in prior biological opinions dated June 3, 1987 (Case No. 1-1-87-F-40), August 20, 1991 (Case No. 1-1-91-F-18), June 16, 1992 [Case No. 1-1-91-F-18(R)], and April 27, 1993 [Case No. 1-1-91-F-18(R2)].

In addition, the Department proposes to initiate the following <u>new</u> activities to maintain MER production on NPR-1 (DOE 1992).

(1) Construction and operation of a phased multi-year steamflood operation consisting of 148 wells on an approximately 500-acre area (referred to as the SOZ Steam Flood Project). This project represents an expansion of a 59-acre pilot steamflood project initiated in 1987 and addressed under a prior biological opinion (Case No. 1-1-85-F-22).

(2) Construction and operation of an additional waste water treatment facility.

(3) Construction and operation of a 5-acre butane isomerization facility.

(4) Construction and operation of a fourth gas compression and processing facility.

(5) Construction and operation of facilities to increase gas compression capacity for gas-lift and gas injection projects, and to increase waterflooding capacity.

To mitigate for adverse effects on federally listed species of ongoing and new MER production activities on NPR-1, DOE proposes to implement the following mitigation commitments as part of the proposed action. This program consists of the following components.

Mitigation Commitments

<u>Conservation Area</u>

Within three years of the date of this opinion, the Department shall place into protected status 7,075 acres of undisturbed endangered species habitat within, or adjacent to, NPR-1, and if appropriate NPR-2, preferably along the north side of NPR-1 adjacent to the Lokern Road area. This will be subject to agreement between the Service and the Department on a management agreement which would identify precise acreage amount, location, and management details

related to the conservation area. If this cannot be accomplished within 3 years, the Department agrees to reinitiate consultation if the Service is not satisfied with the progress that is being made. Such habitat shall be protected against major development activities in perpetuity through a management agreement or other appropriate document executed by and between the Director, NPRC and State Supervisor, FWS. The Department shall enter into written, legally binding agreement with the Service and other affected parties concerning the manner in which compensation lands shall be managed. This conservation area would satisfy any present or future requirements for compensating for the impacts described in the proposed action.

Prior to finalization of any land protection mechanism as required under this mitigation commitment, the Department shall submit for the Service's review the following information: (I) a description of lands selected for protection; (ii) the manner in which they would be protected; (iii) Department commitments with respect to how such lands would be managed, if necessary; and (iv) other information as deemed appropriate by the Department or Service. Finalization of the protection program shall not occur until written approval is obtained from the Service that the protection program is acceptable in all pertinent respects. The Service is available to assist the Department in selecting suitable NPR-1 lands for protection and for other assistance as necessary.

Wildlife Management Plan

This Plan was developed in 1987 to mitigate the effects of routine NPR-1 operation on endangered species and other wildlife; it requires or encourages the following: (I) conducting pre-activity surveys prior to surface disturbing activities; (ii) revegetation of disturbed areas; (iii) monitoring endangered species populations; (iv) controlling coyote populations as appropriate; (v) implementing operating guidelines; (vi) studying conservation and habitat restoration techniques; (vii) developing information and education programs for NPR-1 employees and contractors; and (viii) participating in endangered species recovery programs (O'Farrell and Scrivner 1987). Some activities conducted under the Wildlife Management Plan are discussed further below.

Endangered Species Research and Monitoring Program

In 1979 DOE initiated an endangered species monitoring program on NPR-1 and hired EG&G Energy Measurements, Inc. (EG&G) as its sole biological consultant. In part, EG&G was tasked with implementing reasonable and prudent alternative no. 1 in the Service's 1980 biological opinion--which required an evaluation of effects of oil field development on NPR-1, "basic research" on endangered species including collection of "baseline population and distributional" data, and development of methods to "increase carrying capacity" and "promote the conservation" of endangered species on NPR-1.

Since 1979 EASI has conducted extensive endangered species activities on behalf of the Department and has become an integral component of DOE's overall program on NPR-1 and NPR-2. From approximately 1979 to 1980, EASI conducted site-wide surveys on the Reserves to inventory endangered species populations (Thom Kato, EG&G, pers. comm.). From approximately 1980 to 1987, EASI gathered extensive data concerning kit fox distribution, abundance, mortality factors, and reproductive success within "developed" and "undeveloped" habitats on the Reserves (see Project Effects section). These data were reported in numerous topical reports prepared in 1986 and 1987 and in a biological assessment prepared in support of the 1987 formal consultation and biological opinion.

Operationally, EASI's role on the Reserves is currently divided into seven program "elements" (Thom Kato, EG&G, pers. comm.). These are (1) endangered

species monitoring, including monitoring of kit foxes, lagomorphs, small mammals, coyotes, and other federally listed species; (2) pre-activity surveys on NPR-1; (3) habitat reclamation and management (discussed below); (4) research and development (discussed below); (5) general program assistance, including section 7 consultation support; (6) assistance with third party projects on NPR-1 and NPR-2; and (7) endangered species support activities on NPR-2. An eighth program element previously included through approximately 1990--investigation of relationships between oil field materials and practices and wildlife--was placed as a task in the research and development element in Fiscal Year 1992, evidently because most tasks associated with this element either have been completed or deferred.

Under Element 4--research and development--EASI has conducted or proposed to conduct a variety of projects that are either independent of or indirectly related to other program tasks. Justification for these "research" studies derives in large part from language in the Service's prior biological opinions requiring or recommending, for example, development of methods to "increase carrying capacity" on NPR-1 (1980 opinion) and to conduct artificial kit fox den studies (1987 opinion). Projects conducted or ongoing under this element include, but are not limited to, a kit fox supplemental feeding study, a kit fox relocation project, a giant kangaroo rat habitat reclamation study, and a burn area re-seeding study. Projects proposed but not conducted to date include a kit fox artificial den study and a study of Bakersfield kit foxes associated with the relocation project (William Lehman, USFWS, pers. comm.).

NPRC has proposed an adjustment in the overall scope of its endangered species program from one that has been dedicated to gaining understanding (data collection, monitoring, research and studies) to one that for the most part is limited to reasonable avoidance, habitat reclamation, and habitat conservation, including the establishment of the on-site conservation area.

Monitoring would continue to be conducted in accordance with current scopes based on the following frequencies: Kit foxes would continue to be monitored annually through fiscal year 1996 (NPR-1, NPR-2, abundance, capture and tagging, prey and predators, i.e., lagomorphs, small mammals, coyotes and bobcats, diseases, sources and rates of mortality, and reproductive success). Absent a convincing scientific basis, after that kit fox abundance only would be monitored every 5 years. The abundance of all other protected species would be monitored annually through fiscal year 1999, and every 5 years thereafter.

NPRC proposes that no new data collection, research, or study activities would be initiated. Such activities currently in progress, however, would be completed, including a comprehensive effort that is in progress to integrate and document all data collected and all research/study information, analyses, and conclusions. The Service recognizes NPRC has conducted a great deal of valuable research of the sensitive species of Elk Hills. However, studies (particularly on the conservation area) should continue to gather information on endangered species management and range-wide recovery. Efforts can include habitat manipulations that will sustain and enhance the habitat quality on NPR-1; monitoring populations of listed and candidate species; beet leafhopper control and it's effect on blunt-nosed leopard lizards; etc. Ultimately, these studies should be designed to facilitate on-site endangered species conservation with an emphasis of range-wide recovery needs. The Department and the Service have agreed to address the issue of research/studies as part of the conservation area management agreement.

In late 1988, the DOE established an interagency committee to assist DOE and Chevron by providing additional perspectives on its endangered species programs on NPR-1 and NPR-2. Known informally as the Elk Hills Endangered Species Advisory Committee, this group is composed of representatives from DOE, Bechtel Petroleum Operations, Inc. (DOE's Unit Operator), EASI, Chevron,

the Service, California Department of Fish and Game, the California Energy Commission, the Bureau of Land Management, Enterprise Advisory Services, Inc., and the San Joaquin Valley Endangered Species Recovery Planning Program. The committee meets four times per year.

Habitat Reclamation and Compensation

Both prior biological opinions concerning MER production on NPR-1 discussed in detail the issue of habitat losses, resulting from MER production, and compensation for such losses. A reasonable and prudent measure in the 1980 opinion required DOE to "prepare a Master Plan for the restoration of disturbed habitat on NPR-1." The terms and conditions within the 1987 opinion required the Department to (1) complete an inventory of previously disturbed parcels at NPR-1 that could be rehabilitated to offset habitat loss associated with project activities, and (2) to develop a 10-year program to restore on-site disturbed acreage equivalent to that lost as a result of project activities.

Pursuant to these requirements, the Department in 1988 completed detailed disturbance mapping of NPR-1 based on current aerial photography, and in 1985 initiated a habitat reclamation program on NPR-1 and NPR-2. Through FY 1993, 899 acres of previously disturbed acres on NPR-1 had been replanted (EG&G 1995). While this represents all lands available for reclamation (i.e., lands that are abandoned and meet all reclamation criteria), the Department has estimated an additional 363 acres on NPR-1 will be available for abandonment and reclamation, through 1998 (DOE 1994). This would yield a total of 1,262 acres revegetated as a result of the Department's reclamation program through 1998. In addition, approximately 920 acres of disturbed lands on NPR-1 have revegetated naturally (DOE 1991).

The issue of how the Department's habitat reclamation program relates to its overall obligation to compensate for habitat losses on NPR-1 resulted in considerable discussion during the current consultation. Based on the requirement within the 1987 opinion to restore "equivalent on-site acreage" DOE questioned whether its habitat reclamation program alone was not sufficient to compensate for MER related disturbances, provided equivalent acreage was revegetated. However, for the following reasons the Service did not consider habitat reclamation alone to be adequate. First, the 1987 biological opinion states that equivalent on-site acreage should be restored "at a minimum.". Second, both prior opinions also mention other compensation methods, including zoning for no development, purchase of off-site habitats, and contribution of funds. Third, "equivalent" reclamation (at a 1:1 ratio) would not be consistent with San Joaquin Valley compensation policy as developed by the Service and California Department of Fish and Game through numerous prior projects--which typically requires a 3:1 compensation ratio for permanent habitat impacts and a 1.1:1 ratio for temporary impacts in saltbush scrub habitats. Finally, in previous projects, revegetation of disturbances resulting from a project typically is not credited to the compensation obligation for that project but is considered a separate mitigation measure.

On the other hand, the Service recognizes that DOE has in good faith expended considerable effort and expense on its habitat reclamation program based in part on the Service's recommendations and requirements. Because of this, the Service has worked with the DOE to develop a compensation program for NPR-1 that would utilize standard compensation policies, recognize the Department's reclamation efforts, and encourage continuation of such efforts.

Studies near completion demonstrate that in some cases reclamation projects are no more effective than natural revegetation for habitat restoration. In situations where natural revegetation is effective, NPRC would limit reclamation to only those activities needed to stabilize soils while natural revegetation is occurring. Procedures for reclamation would be developed in

collaboration with the Service and other professionals as appropriate. Otherwise, habitat reclamation and success monitoring would continue in a manner similar to current procedures. Existing disturbances would be reclaimed as they are identified as no longer being needed for oil field operations.

The resulting program is based on the following assumptions: (1) because MER development has primarily been considered a single integrated project under this and prior biological opinions, and not as a series of separate projects, the habitat compensation obligation for MER development should apply retro-actively to 1976 for the unfulfilled portion of habitat reclamation obligations stemming from the 1987 biological opinion; (2) that habitat disturbances resulting from MER development should be compensated at the same rate as other San Joaquin Valley habitat losses; (3) that habitat disturbances on NPR-1 that have recovered naturally should not count as credits toward DOE's compensation obligation, since they are fortuitous and not the result of its reclamation program; and (4) that all acres revegetated or planned for revegetation under the DOE's reclamation program should be credited toward its compensation obligation, even though many reclaimed areas were disturbed after MER development began. The latter assumption is also based on the fact that the Department's reclamation program is a relatively large-scale, systematic effort being applied to a wide variety of disturbances on NPR-1. We therefore regard it as a programmatic effort rather than merely a project effort.

Finally, to satisfy DOE's compensation obligation, the Service and Department have discussed conceptually the possibility of placing portions of NPR-1 into protected status for the primary purpose of endangered species management. The Service considers this a suitable strategy because significant areas of NPR-1 are relatively undisturbed (especially along its periphery); and because NPR-1 and undisturbed portions of NPR-2 are contiguous with other important native habitats, including the Buena Vista Valley and the Lokern Road area.

Based on the above discussion, the Department has agreed in principle to compensate for habitat losses associated with MER development on NPR-1 by placing into protected status a total of 7,075 acres of undisturbed lands on NPR-1 and NPR-2. This figure is based on estimated temporary disturbance of 318 acres and estimated permanent disturbance of 2,525 acres resulting from MER development, utilizing agreed-upon compensation ratios and minus all acres revegetated or planned for revegetation under DOE's reclamation program established pursuant to the 1987 biological opinion: i.e., 318 temporary acres X 1.1 = 350 acres; 2,525 permanent acres X 2 or 3 = 5,965 acres; 350 + 5,965 = 6,315 total compensation acres + 691 acres of temporary disturbance for third party projects (691 x 1.1 = 760); 6,315 + 760 = 7,075 (DOE 1995). The derivation of temporary versus permanent disturbances is explained in the Project Effects section below.

Plant Mitigation Commitments

To protect federally listed plants and plant species of concern on NPR-1, the Department also has agreed to the following measures.

(1) The Department will complete one comprehensive floristic survey of NPR-1 for all State and Federal endangered, threatened, candidate, and special concern species in the areas of NPR-1 where this kind of a survey has not already been completed. The Department agrees to complete the survey by the end of the fourth growing season, subject to adequate precipitation following permit issuance. Within 60 days of permit issuance, NPRC will provide a written scope of work for the survey to the Service for review, comment, and approval. The scope of the surveys will be developed informally in collaboration with Service personnel from the outset. The scope will address such things as priorities, precipitation criteria, reporting requirements, and schedules. Service comments and approval on

the scope are to be provided to NPRC within 60 days. Within 6 months following the completion of each year's survey, the Department will complete a topical report covering the results and findings for that year's survey, including mapping. Within 6 months following the completion of the last year's survey, the Department will complete a topical report covering the results and findings for the four year survey.

(2) With the exception of Hoover's woolly-star, the Department will initiate a separate section 7 consultation for any project that would disturb habitat known to have federally threatened or endangered plants.

(3) To minimize adverse effects of oil and gas production on Hoover's woolly-star, the Department will implement the following protective measures:

a. The Department will conduct preactivity surveys for Hoover's woolly-star for all projects and to make every reasonable effort to conduct them during the Hoover's woolly-star's growing season.

b. If Hoover's woolly-star is known or thought to be in a project area, every reasonable effort will be made to avoid them by relocating and/or reconfiguring the project.

c. If it becomes necessary to locate a project in an area where Hoover's woolly-star is known or thought to be present, every reasonable effort will be made to wait until after seed set before beginning ground disturbances. When disturbances occur after seed set, 2 to 4 inches of topsoil will be conserved and respread within one year, if possible, within appropriate Hoover's woolly-star habitat at a site that is being revegetated outside the conservation area. If it is not possible to meet the 1-year time frame, the topsoil shall be stockpiled and respread within appropriate habitat outside the conservation area as soon as possible.

d. It will not be necessary to protect Hoover's woolly-star that has become reestablished in previously disturbed areas.

(4) The Department will include Hoover's woolly-star habitat in the conservation area.

(5) The Department will use locally obtained native seed for revegetation to the extent commercially available at competitive prices.

(6) The Department will ensure that the habitat of the four oil neststraw (*Stylocline citroleum*) populations known to exist in Sections 10R, 12R, and 17S, is not developed.

Species Account/Environmental Baseline

San Joaquin Kit Fox. The endangered San Joaquin kit fox historically was distributed within an 8,700-square mile in central California from the vicinity of Tracy in the upper San Joaquin Valley south to the general vicinity of Bakersfield. Intensive agriculture, urbanization, and other land-modifying actions have eliminated extensive portions of habitat and are the most significant causes of this species' endangerment. The coyote and the introduced red fox compete for food resources with the smaller kit fox, and are suspected of preying upon kit foxes as well. Predation, competition, poisoning, and road kills contribute substantially to the vulnerability of this species. Kit foxes currently are limited to remaining grassland, saltbush, open woodland, and alkali sink valley floor habitats, and similar habitats located along bordering foothills and adjacent valleys and plains.

Although in the southern San Joaquin Valley, they appear to make extensive use of habitat fragments in an urbanizing environment.

Giant Kangaroo Rat. The giant kangaroo rat was distributed historically from southern Merced County, south through the San Joaquin Valley, to southwestern Kern County and northern Santa Barbara County. Preferred habitat is native annual grasslands with sparse vegetation, good drainage, fine loamy soils, and slope of less than 10 percent. Significant populations survive only in a few areas of remaining habitat, including the Pahoche Hills, Cuyama Valley, Carrizo and Elkhorn Plains and the Lokern area.

Kangaroo rats typically inhabit areas of open ground which tends to facilitate their mode of locomotion. Such areas include rangeland, wildlands, and farmlands that have not been recently cultivated or disced. Kangaroo rats can repopulate formerly cultivated areas from adjoining occupied habitat.

Blunt-Nosed Leopard Lizard. The blunt-nosed leopard lizard was distributed historically throughout the San Joaquin Valley and adjacent interior foothills and plains, extending from central Stanislaus County south to extreme northeastern Santa Barbara County. The blunt-nosed leopard lizard prefers open, sparsely vegetated areas of low relief and inhabits valley sink scrub, valley saltbush scrub, valley/plain grasslands, and foothills grasslands vegetational communities.

Adult lizards often seek safety in burrows, while immature lizards use rock piles, trash piles, and brush. The lizards use burrows constructed by mammals, such as kangaroo rats, for overwintering and aestivation. The habitat of the lizard has been significantly reduced, degraded, and fragmented by agricultural development, petroleum and mineral extraction, livestock grazing, pesticide application, and off-road vehicle use. Today its distribution is limited to scattered parcels of undeveloped land, with the greatest concentrations occurring on the west side of the valley floor and in the foothills of the Coast Range. The 1985 revised recovery plan (FWS 1985) identified habitat essential for the survival and recovery of the species, priority habitat areas, and areas that could be restored to habitat.

Tipton Kangaroo Rat. The Tipton kangaroo rat inhabits saltbush scrub and alkali sink scrub communities in the Tulare Lake Basin of the southern San Joaquin Valley. They currently inhabit approximately 4 percent of their historic range. Tipton kangaroo rats commonly dig burrows on elevated ground which is not subject to flooding. However, areas which are flooded in winter and spring are occasionally colonized during the dry season. The preferred location for Tipton kangaroo rat burrows typically involves alluvial fans and floodplains and includes fine, highly alkaline sands and, to a lesser degree, alkaline sandy loams. In addition, they generally burrow around the bases of woody shrubs. One of the smallest kangaroo rats, the subspecies is often found in areas also occupied by the larger Heermann's kangaroo rat.

Hoover's woolly-star. Surveys have shown that Hoover's woolly-star populations range from the upper Cuyama Valley near Ventucopa, Santa Barbara County, northward to the Panoche Hills in San Benito County, a distance of approximately 140 miles. Hoover's woolly-star occurs in 42 USGS 7 ½ - minute quadrangles within Kings, Kern, San Luis Obispo, Santa Barbara, San Benito, and Fresno counties. Hoover's woolly-star occurrences primarily are located within four areas. The four areas from largest to smallest are: (1) the Kettleman Hills area, (2) the Carrizo Plain-Elkhorn Plain-Temblor Range-Caliente Mountains-Cuyama Valley-Sierra Madre Mountains area, (3) the Lokern-Elk Hills-Buena Vista Hills-Coles Levee-Maricopa-Taft area, and (4) the Antelope Plain-Lost Hills-Semitropic area. Additional, more isolated populations occur throughout the region. An intra-agency draft recovery plan has been developed for Hoover's woolly-star.

Kern Mallow. Kern mallow was first described as *Eremalche kernesis* (Wolf 1938). The most recent treatments (Bates 1992, 1993) assign Kern mallow the name *Eremalche parryi* (Greene) Greene ssp. *parryi*. Bates' treatment of Kern mallow, which includes both white- and purple-flowered gynodioecious plants, has not widely been accepted by the scientific community. Due to the debate within the scientific community over the newest treatment, the Service intends to undertake a status review to solicit available scientific information on which to base a determination of the appropriate taxonomic circumscription of Kern mallow. In the interim, the Service shall continue to consider the listed entity to be *E. kernensis* C.B. Wolf, which was the circumscription used when Kern mallow was listed in 1990. The endangered Kern mallow is a small annual herb of the mallow family 2 to 4-inches in height primarily with white flowers (USFWS 1989). Kern mallow is restricted to the eastern base of the Temblor Range, occurring from the vicinity of McKittrick to near Buttonwillow within valley saltbush scrub in Kern County (Taylor and Davilla 1986). The species is threatened by oil and gas development, transmission line maintenance or expansion, agricultural conversion, overgrazing by livestock, exotic plant competition, and off-road vehicle use. An intra-agency draft recovery plan has been developed for Kern mallow.

San Joaquin wooly-threads. The endangered San Joaquin wooly-threads is a small annual herb of the sunflower family and is endemic to the San Joaquin Valley of California. Its white-wooly stems, only three inches long, often trail along the ground. Flowers are about 1/4-inch in diameter, lack ray flowers, and have a yellow center. San Joaquin wooly-threads once ranged throughout the floor of the San Joaquin Valley from western Fresno County and eastern Tulare County south to the foothills of the Tehachapi Mountains, reaching into San Benito County on the northwestern part of its range following the rain shadow of the South Coast Ranges (Taylor, 1989). Little is known of the habitat preferences of San Joaquin wooly-threads. It appears to favor non-alkaline soils of sandy or silty sand texture and an arid climatic regime (Taylor, 1989). Much of the habitat for San Joaquin wooly-threads has been eliminated by conversion of annual grassland sites to agriculture. An intra-agency draft recovery plan has been developed for San Joaquin wooly-threads.

Endangered Species Surveys/Status

In 1979, when the Department began its endangered species program on NPR-1, kit foxes were numerous and widely distributed within the Reserve. In 1984, kit fox dens were observed on all but two sections (DOE 1991). However, since 1979 the kit fox population on the NPR-1 "study area" has declined from a high of 144 animals in the winter of 1981-1982 to a low of just 12 animals in the winter of 1991-1992. In addition, kit foxes have disappeared from the central upland portions of NPR-1--where most oil development has occurred--and now appear to be confined to the flatter peripheries of NPR-1. This decline and the status of kit foxes on NPR-1 is discussed in detail in the Project Effects section. However, Elk Hills continues to be very important for the long-term survival and recovery of the San Joaquin kit fox.

Distribution of other federally listed species on NPR-1 typically is more restricted than that of kit foxes. From 1979 to 1987, a total of only 136 blunt-nosed leopard lizards were observed in only 28 of NPR-1's 74 sections (DOE 1991). Leopard lizards typically are found in washes and areas of low relief around the periphery of the Reserve, especially in the Buena Vista Valley along the NPR-1/NPR-2 border; however, leopard lizards also have been observed in six sections in the NPR-1 central uplands. Recorded leopard lizard densities on NPR-1 vary from 0.16 to 0.24 individuals per acre (DOE 1991).

Giant kangaroo rat burrow systems have been observed in 30 sections of NPR-1 (DOE 1991). Like the leopard lizard, the majority of these burrow systems

occur in the Buena Vista Valley, though a few burrows also have been observed in the central uplands. In recent surveys, however, many of these burrow systems have been found to be inactive, possibly because of drought conditions from 1987 to 1991. Giant kangaroo rat burrows on NPR-1 were observed at elevations ranging from 316 to 1,510 feet.

The California Aqueduct is cited in Williams (1985) as the approximate line between the ranges of the Tipton kangaroo rat and the short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*). Consequently, Tipton kangaroo rat distribution on NPR-1 is confined to those small portions of the Reserve east of the aqueduct. During a three-night trapping census conducted in 1988, six to 12 Tipton kangaroo rats were captured per night in this area (DOE 1991).

Initial field surveys for the Hoover's wooly-star and other federally listed plants were conducted on NPR-1 in spring 1988 (EG&G 1988, DOE 1991). A total of 28 Hoover's wooly-star populations were observed, primarily restricted to alluvial fans along the lower flanks of the Reserve in Sections 4B, 10B, 12G, 7R, 8R, 10R, 12R, 13R, 32R, 17S, 18S, 20S, 21S, 22S, 23S, and 26S (DOE 1991). Further surveys were conducted in 1991 and additional wooly-star populations were observed in Sections 3B, 12B, 13B, 1G, 10G, 25S, 27S, 30S, 31S, and 14Z (EG&G unpublished data). Hoover's wooly-star populations on NPR-1 tend to occur in areas where other vegetation is sparse such as washes and formerly disturbed sites (e.g., the NPR-1 firebreak and abandoned roadways). Four populations were found at or above 1,000 feet in elevation (EG&G 1993).

The Kern mallow, San Joaquin wooly-threads, and California jewelflower (*Caulanthus californicus*) were not observed during these surveys. However, apparently suitable habitat for Kern mallow was observed in the northwestern portion of NPR-1 (Sections 12Z, 13Z, and 14Z), and the species likely exists here in low numbers or may become established within the foreseeable future (DOE 1991). Potential habitat for San Joaquin wooly-threads also was observed along the northern flanks of NPR-1, but these habitats may be suboptimal because of the dense cover of red brome present (DOE 1991). Based on these data the Service concludes that the Kern mallow and San Joaquin wooly-threads may be present within NPR-1 and may be affected by proposed project activities within the remaining life of the NPR-1 oil field. Suitable habitat for the California jewelflower probably does not exist on NPR-1 (DOE 1991).

Effects of the Proposed Action on Listed Species

Adverse effects of continued MER production on NPR-1 on the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Kern mallow, San Joaquin wooly-threads, and Hoover's woolly-star may result from numerous sources. During construction activities, individual animals may be directly injured or killed by vehicle strikes resulting from construction related traffic, through inadvertent crushing or entombment in collapsed dens or burrows, or through entrapment in construction related holes or trenches. Also during construction, individual mallow, wooly-threads, or woolly-star populations may be crushed or damaged by vehicle traffic or destroyed by grading, pipeline trenching, and related disturbances. Seedbanks of these plants also may be buried or otherwise destroyed. Other forms of death or injury to federally listed species may result from wildfires inadvertently ignited during welding operations, contact with oil spills, sumps, and inundation of animals during release of hydrostatic pipeline test water.

Individual kit foxes, leopard lizards, kangaroo rats, and plant populations also may be subject to harm and mortality during routine day-to-day operations on NPR-1. Factors contributing to such harm and mortality include routine vehicle traffic, routine grading associated with well drilling and access road construction, oil spills, contamination by commonly used oil field chemicals, habitat degradation (discussed below), and other routine operations.

In addition, individual kit foxes, leopard lizards, and kangaroo rats may be subject to harassment during NPR-1 construction and other activities resulting from increased levels of human disturbance, destruction or excavation of dens and burrows, entrapment in open pipes and construction related trenches, and other factors. Some animals may escape direct injury during such activities but become displaced into adjacent areas. These animals may be vulnerable to increased predation, exposure, and stress through disorientation and loss of shelter.

To date, effects discussed above have been substantially minimized by the Department's endangered species mitigation program. A key component of this program is the practice of conducting preactivity surveys prior to all surface disturbing activities. Preactivity surveys are conducted according to "Operational guidelines for conducting endangered species preactivity surveys on Naval Petroleum Reserve #1, Kern County, California" (Kato and O'Farrell, 1987). Based on available data, the Service concludes that DOE has done a good job of implementing its preactivity survey program (EG&G 1992). In 1980, 74 percent of all NPR-1 projects were conducted without preactivity surveys, while in 1984 and 1985 all projects conducted on NPR-1 were preceded by surveys (Kato 1986). Pre-construction surveys continue to be implemented on NPR-1 on a regular basis (Thom Kato, EG&G, pers. comm.). However, some problems exist in ensuring that recommendations resulting from such surveys actually are implemented. For example, in Fiscal Year 1991 recommendations were not implemented in 22 of 175 projects (12.6%) for which preactivity surveys were conducted, and recommendations were not followed in 3 of 90 surveys (3.3%) in Fiscal Year 1992. The instances noted above where the recommendations were not followed did not result in take of endangered species.

Since the December 1987 Biological Opinion, the number of deaths that occurred as a result of DOE/NPRC activities included 2 kit foxes and 2 blunt-nosed leopard lizards. Twenty-four giant kangaroo rat burrows were disked in 1988 during firebreak maintenance but the actual number of individuals killed was not determined. From a historical perspective, a total of 49 San Joaquin kit foxes, 7 blunt-nosed leopard lizards, and 72 giant kangaroo rats have been reported killed or injured as a result of the factors discussed above since 1980. (EG&G unpublished data). Of these, 11 San Joaquin kit foxes, 2 blunt-nosed leopard lizards, and 6 giant kangaroo rats have been killed or injured as a result of the Departments's endangered species research program. No Tipton kangaroo rats are known to have been killed or injured during MER activities on NPR-1.

Based on radio-collar data, 291 kit foxes were recovered dead on NPR-1 from 1980 to 1988. Of these, cause of death for 29.9 percent was classified as predation (primarily by coyotes), 24.7 percent as probable predation, 10.0 percent as vehicle strikes, and 3.1 percent as other causes (DOE 1991). Cause of death for 32.3 percent of kit foxes recovered could not be determined. Excluding these foxes, 80.7 percent of foxes for which cause of death could be determined were killed by predation, 14.7 percent by vehicle strikes, and 4.6 percent by other causes (DOE 1991). Mortality sources other than predation and vehicles included disease, shooting, drowning, and burying.

Following is a detailed discussion of the effects of past and proposed future MER activities on NPR-1 on the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, federally listed plants, and their habitats (USFWS 1987).

San Joaquin Kit Fox

DOE/NPRC has studied the San Joaquin kit fox population on NPR-1 intensively since 1980 on a 28,480-acre area encompassing the southern half of the Reserve and 2,880 acres in adjacent Buena Vista Valley known as the NPR-1 study area.

The NPR-1 study area contains 16,640 acres defined as "developed" habitat and 11,840 acres defined as "undeveloped" habitat; a square mile containing more than 15 percent of developed land (oil wells, roads, etc.) is defined as developed, and a square mile containing 15 percent or less of developed land is defined as undeveloped (DOE 1991). The areas (developed or undeveloped) are largely contiguous; the range of percent developed in the areas considered was 0.5% to 46.3%; and some sections were divided into half-sections when the developed and undeveloped areas were delineated. Studies conducted by EASI on NPR-1 have included monitoring of kit fox population size, reproductive success, diet, mortality factors, movement patterns, and den characteristics. In part, their purpose has been to determine effects of MER related oil development on the resident kit fox population.

Between 1981 and 1991, EASI has estimated the San Joaquin kit fox population on the NPR-1 study area and on NPR-2 (beginning in 1983) twice annually based on intensive trapping sessions and capture-recapture data (once annually since Fiscal Year 1992). In 1988, trapping sessions were extended to include the entire civil boundaries of NPR-1 in an effort to detect differences in kit fox abundance or distribution between the study area and the Reserve as a whole.

During the period since detailed studies began (1980), the minimum known kit fox population within the NPR-1 study area declined from a high of 165 foxes in the winter of 1981-1982 to 44 foxes in the winter of 1985-1986 (DOE 1991). Similarly, the minimum known population size declined from a high of 167 foxes in the summer of 1982 to 55 foxes in summer 1985 (DOE 1991). The population appeared to stabilize at 40 to 50 kit foxes through approximately 1990, but recent evidence suggests the population has again declined. In winter 1991 the minimum population size was as low as 12 in the NPR-1 study area, but has increased to 40 in 1993 (EG&G unpublished data).

This San Joaquin kit fox population decline on NPR-1 was discussed at length in the Service's 1987 biological opinion and remains a subject of concern. It has been discussed in the biological assessment (DOE 1991), DSEIS (DOE 1992), numerous Elk Hills Endangered Species Advisory Committee meetings, as well as other documents and forums. However, the exact cause of the decline has proven difficult to determine.

Several factors have been considered in attempting to explain this decline, including: (1) the effects of MER development; (2) the endangered species research program; (3) effects of an extended drought in California; and (4) other natural or human-caused factors. In addition, this decline may reflect a general decline in the species due to rangewide habitat degradation.

MER Development. As required under the Service's 1980 biological opinion, the Department attempted to determine the effects of MER development on kit foxes through studies conducted by EASI from 1980 through 1986. Based on these studies, EASI and DOE concluded that the NPR-1 kit fox decline has occurred at similar rates in developed and undeveloped habitats (DOE 1991). This conclusion in turn suggests that MER development has not affected the NPR-1 kit fox population in a significant manner.

However, several factors suggest that these conclusions may not be accurate. First, the kit fox population on NPR-2--where little oil development occurred compared to NPR-1 during the same time period--has declined significantly less than on NPR-1. The NPR-2 kit fox population numbered 177 animals in the summer of 1983 and 113 in the summer of 1989 (EG&G unpublished data). Based on winter data, the NPR-2 kit fox population appears even more stable compared to NPR-1 (119 foxes in the winter of 1983-1984 and 131 in the winter of 1988-1989) (DOE unpublished data). Recent kit fox trapping data presented in the draft FY93 annual progress report shows that kit fox abundance differed between NPR-1 and NPR-2, but that they exhibited similar trends. In addition,

the 1993 minimum population size has increased on NPR-2 to 108 foxes, just as on NPR-1.

Second, circumstantial evidence suggests that the kit fox decline on NPR-1 has been greater in the central upland portions of the Reserve, where most oil development has occurred, than in the flatter lands along its periphery, which are relatively undeveloped. This change in distribution is demonstrated by the fact that few foxes have been captured in the central uplands in recent years, where they were relatively numerous in the early 1980's. By far most kit foxes currently are captured in the flatter undeveloped periphery of the Reserve (Thom Kato, EG&G, pers. comm.). The Department has concluded that kit foxes are presently found on their preferred habitat on NPR-1.

Several factors with respect to MER development can probably be eliminated as causing the kit fox decline on NPR-1. First, it is unlikely that den loss has contributed significantly to the decline. Between 1980 and 1986, only 5 known kit fox dens were destroyed inadvertently as a result of the MER production and another 20 were intentionally excavated to avoid burial of resident foxes (DOE 1991). However, these losses appear to be relatively insignificant since during the same period approximately 946 dens were known to be utilized by kit foxes (Berry et al. 1987).

Contamination of kit foxes by heavy metals commonly associated with oil fields also appears to be minimal. Kit fox hair samples collected from kit foxes on NPR-1 developed lands, NPR-1 undeveloped lands, NPR-2, Camp Roberts, and the Elkhorn Plain were analyzed by Oak Ridge National Laboratory in Oak Ridge, Tennessee (Suter et. al. 1992). Results indicated that kit foxes on NPR-1 exhibited little evidence of contamination by the elements studied, including arsenic, barium, vanadium, chromate, or uranium. Although a few foxes showed high tissue concentrations of some elements, most levels were associated with background soil concentrations or were highest in undeveloped reference sites. Heavy metal concentrations evidently were not great enough to account for the kit fox decline on NPR-1.

The Endangered Species Research Program. The intensive kit fox research and monitoring program conducted on NPR-1 by EASI has occasionally been cited as a possible contributor to the NPR-1 kit fox decline (e.g., O'Neil and Greer 1988). Throughout the life of the program, approximately two thousand kit foxes have been captured and 486 foxes have been radio collared (Thom Kato, EG&G, pers. comm.). All foxes captured, whether collared or not, have been equipped with individually numbered ear tags. Research factors possibly contributing to the kit fox decline include lowering of kit fox survivorship as a result of wearing radio collars, spread of disease through trapping and handling, and loss of kit foxes to research accidents.

At the Service's request, DOE/NPRC considerably expanded their studies of the effects of EASI's radio-collar program on kit foxes in 1992. Utilizing EASI data from 1980 to 1992, DOE/NPRC evaluated effects of radio collars on numerous parameters, including collar to body weight ratio, collar design (heavy or light), survival period, and recapture interval, again comparing radio collared kit foxes to kit foxes with ear tags only. With one exception, no differences in survivorship were observed between radio-collared and ear-tagged foxes. Based on these results, and with reference to the large data set and thoroughness of EASI's study, the Service concludes that EASI's kit fox radio collar program has not significantly contributed to the kit fox decline on NPR-1.

However, DOE/NPRC found that kit fox pups radio collared prior to the month of July tended to survive for shorter periods than pups collared after July (EG&G unpublished data). This result probably has not significantly affected kit fox status on NPR-1 but may have important implications in how kit fox radio collar programs are managed on NPR-1 and elsewhere.

Effects of the Drought. By the early 1990's, endangered species populations throughout the San Joaquin Valley were exhibiting declines likely associated with California's five-year drought that lasted from 1987 to 1992. For example, surveys conducted on NPR-1 in 1991 found that most previously active giant kangaroo rat precincts were no longer occupied (EG&G, unpublished data). Similar giant kangaroo rat declines were observed in the Carrizo Plain (Dan Williams pers. comm.), and leopard lizards reportedly did not reproduce in the Carrizo Plain and elsewhere in 1991 (Dave Germano pers. comm.). Similarly, little kit fox reproduction was observed on NPR-1 in 1991 (EG&G, unpublished data). This harsh five-year drought has often been cited as a primary or contributing factor in the kit fox decline on NPR-1. The principal result of the drought thought to affect kit foxes was reduction in availability of prey species (typically, small mammals and lagomorphs).

Since 1983, EASI has conducted a bi-annual census of lagomorphs on NPR-1 and NPR-2, and, like the kit fox, lagomorphs have declined significantly on both Reserves (DOE 1991). On NPR-1, lagomorphs also were censused during road counts from 1980 to 1983 and declined annually over this period. Similarly, the California Department of Fish and Game (CDFG) has conducted two annual spotlighting routes near NPR-1 (the "Taft" and "McKittrick" routes) in which both kit foxes and lagomorphs have been censused since approximately 1970 (CDFG unpublished data). Results of CDFG data also indicate significantly declining lagomorph numbers along these routes, together with a decline in kit fox numbers that appears to strongly "mimic" the pattern of lagomorph decline. These data suggest that a decline in prey availability caused by the drought may be a primary contributor to the kit fox decline on NPR-1.

However, based on other available data this conclusion cannot be considered certain. For example, the lagomorph and kit fox decline on NPR-1 began prior to 1987, when the five-year drought began; while on NPR-2, where the kit fox decline has been less pronounced, lagomorph densities did not begin to decline until 1987, when the drought began (DOE 1991). Furthermore, in an analysis of EG&G data (kit fox numbers versus lagomorph numbers) on NPR-1 and NPR-2 conducted in 1991, the General Accounting Office (GAO) found that between 1984 and 1989 the estimated number of lagomorphs per kit fox was higher on NPR-1 than on NPR-2 (GAO unpublished data). This suggests that prey availability alone can not account for the perceived differences between kit fox numbers on NPR-1 and NPR-2, and that some other factor or factors may have contributed to apparently differential kit fox declines on the two Reserves.

CDFG data suggest another pattern with respect to fluctuating kit fox numbers. According to the graph of these data (DOE 1991), in 1970 kit fox and lagomorph numbers appear to have been declining from earlier highs in the late 1960's. Their numbers then appear to have remained relatively low from approximately 1972 to 1979, when they began to incline sharply to highs in the early 1980's that were unequaled within the study period. The early 1980's is precisely when EASI began its systematic counts of kit foxes and lagomorphs on NPR-1 and NPR-2.

This suggests that EASI initiated its kit fox census on NPR-1 and NPR-2 when lagomorph numbers were at an unusual high, resulting from natural cyclic fluctuations or to some other factor such as rainfall. This in turn suggests that (1) kit fox numbers were unusually high in 1979 or 1980, when EASI census activities began (likely due to high lagomorph numbers), (2) that this high represented a cyclic fluctuation rather than average kit fox carrying capacity on NPR-1, and (3) that the initiation of intensive MER activities on NPR-1 and the observed kit fox decline on the Reserve was coincidental, not causally related (Harris et al 1987).

Other Natural Factors Other factors possibly contributing to the NPR-1 kit fox decline include coyote predation and disease. Since 1980, coyotes have been responsible for most known kit fox mortalities on NPR-1 (80.7 percent of

all dead foxes for which a cause of death could be determined) (DOE 1991). However, based on other studies this appears to be the normal interaction between kit foxes and the larger, more aggressive coyote (e.g., Linda Spiegel, CEC, pers. comm.); and EASI data indicate that coyote numbers on NPR-1 declined contemporaneously with kit fox numbers. Though coyote predation may have exacerbated kit fox problems originally caused by other factors, no data we reviewed suggest that kit fox-coyote interactions can account for the kit fox decline on NPR-1. The significance of coyote predation in kit fox populations is published in articles such as O'Farrell (1984, 1987), and Standley et al. (1992).

In 1981, 1982, and 1984, the kit fox population on NPR-1 was studied for the presence of disease by analyzing kit fox blood serum for the presence of 10 infectious pathogens (DOE 1991). Despite the occurrence of antibodies for canine parvovirus, tularemia, canine distemper, and canine hepatitus in kit fox blood samples, little clinical evidence of disease has been noted in the NPR-1 kit fox population (DOE 1991). Disease can therefore be largely ruled out in explaining the observed kit fox decline on NPR-1.

Summary The above discussion illustrates that the relationship between kit foxes, oil development, and other environmental factors on NPR-1 is complex. In short, it is difficult to ascribe the San Joaquin kit fox decline on NPR-1 conclusively to any single factor.

Nevertheless, several observations seem important. First, lagomorph and kit fox numbers appear to have declined jointly-(if differentially)-throughout the general area, not just on NPR-1. Second, although the disappearance of kit foxes from the central upland portions of NPR-1 has been pronounced and contemporaneous with intensive oil developments-suggesting a direct relationship-CDFG data suggest that kit fox presence in the central uplands in the early 1980's may have been the result of unusually optimal conditions at that time. If this is true, then kit foxes may not normally occupy this portion of NPR-1 because of natural factors (e.g. relatively steep terrain), and this area may have been the first to be abandoned when environmental conditions deteriorated--possibly, at least in part, because of the drought. On the other hand, oil development in the central uplands may have contributed to the adverse conditions-(already marginal because of natural factors)-that eventually caused kit foxes to abandon the area. In this respect, the Service considers EASI data suggesting that kit fox declines have been equivalent in developed and undeveloped habitats on NPR-1 to be inconclusive.

Third, the fact that kit fox declines on NPR-2 have been less severe than fox declines on NPR-1 may be significant and is difficult to explain. Several differences between the two Reserves that may account for this fact have been cited--(e.g., intensive oil development on NPR-1 and overall gentler topography on NPR-2), but here again results are inconclusive.

Based on existing data, the only factors that probably can be ruled out as causing or significantly contributing to the NPR-1 kit fox decline is coyote predation, disease, oil field chemicals, and the endangered species research program. Conversely, it seems likely that the decline may have resulted from a combination of the other effects discussed-(e.g., the drought, natural cyclic fluctuations, oil field developments, and naturally marginal conditions in the central uplands of the Reserve). Continued monitoring of the kit fox population on NPR-1 in the immediate future, especially in light of the end of the drought in the winter of 1992-1993, will be critically important in better understanding the respective roles of the factors discussed above in the NPR-1 kit fox decline.

Based on the above discussion, the Service concludes as follows with respect to the San Joaquin kit fox: (1) that MER oil production probably is not solely responsible for the kit fox decline on NPR-1 but likely has been a

contributing factor; (2) that intensive oil developments in the NPR-1 central uplands likely has contributed to the disappearance of the kit fox from this portion of the Reserve; (3) that proposed new developments in the central uplands, such as the larger facilities as described in the DSEIS (DOE 1992), SEIS (DOE 1993), will contribute to continuing habitat losses and adverse effects in this area and may inhibit effective future use of this area by kit foxes; and (4) that the latter effect is not likely to jeopardize the continued existence of the species because the central uplands probably represents, on average, marginal kit fox habitat except in optimal conditions, and provided that DOE implement the mitigation commitments described on pages 4 to 7 above.

Giant and Tipton Kangaroo Rats

Specific effects to giant kangaroo rats potentially resulting from continuing MER production on NPR-1 include: (1) Destruction of giant kangaroo rat burrow systems during construction of proposed facilities in Townships G, R, and S and by third-party pipelines; (2) removal of food sources (grasses and seeds) during construction activities; (3) alteration of soil conditions-e.g., soil compaction-making it more difficult for kangaroo rats to construct burrows; (4) accidental oil spills or wastewater discharge; (5) disturbance; and (6) accidental death or injury during EASI's trapping and research activities (DOE 1991). In 1986, for example, 12 kangaroo rats (species not identified) were killed when a DOE lessee discharged wastewater into a natural drainage adjacent to NPR-1. Furthermore, O'Farrell et al. (1987) reported that 73 percent of all giant kangaroo burrow systems on NPR-1 occurred at least 150 feet away from well pads, and numerous well pads may be constructed in known giant kangaroo rat habitats in Sections 6-7G, 14R, 20R, 25R, 28R, 26-27S, and 36S during continuing MER production.

However, construction of the larger facilities currently proposed-(e.g., the fourth gas plant, butane facility, and cogeneration plant)-is not expected to affect known giant kangaroo rat populations, and pre-construction surveys and flexibility in well pad location should minimize impacts to giant kangaroo rats elsewhere (DOE 1991). Furthermore, the majority of these wells would be constructed in the central upland portions of NPR-1 where giant kangaroo rats are relatively uncommon. Third-party pipelines-expected to disturb a total of 101 acres-may directly affect some giant kangaroo rat habitat in the Buena Vista Valley and other peripheral areas on the Reserve.

The Tipton kangaroo rat, which is present only in Section 23S east of the California Aqueduct, should not be affected by any planned DOE activities on NPR-1 because no development is planned in that area.

Blunt-nosed Leopard Lizard

Specific effects of continuing NPR-1 activities on blunt-nosed leopard lizards are expected to be similar to those cited above for giant kangaroo rats. In addition, leopard lizards are vulnerable to entrapment in well cellars, and, because they inhabit washes and are vulnerable to accidental wastewater discharges and oil spills. Both such forms of leopard lizard mortality have been documented either on or adjacent to NPR-1 in the 1980's (DOE 1991). In 1992, an aestivating leopard lizard was inadvertently unearthed during gravel mining on NPR-1 but this lizard was unharmed and was returned to its habitat (EG&G unpublished data). Other forms of potential leopard lizard effects on NPR-1 include vehicle strikes and destruction of small mammal burrows during construction activities and third-party projects such as seismic surveys and pipelines.

However, most construction of relatively large new facilities will occur in the central upland portions of the Reserve where little leopard lizard habitat exists, and pre-construction surveys and flexibility in well location should

minimize leopard lizard effects during DOE and third-party projects elsewhere on the Reserve.

Hoover's Woolly-star and Other Federally Listed Plants

The overall effects of the programmatic on listed, proposed, candidates, or sensitive plants cannot fully be assessed at this time because inventory information is incomplete and not always properly timed. Although some intensive surveys have been conducted, they have not always been floristic. Potential effects of proposed project activities on Hoover's woolly-star include (1) destruction of plants and plant habitats during grading, trenching and other construction activities, (2) crushing of individual plants and plant populations during off-road vehicle use and seismic surveys, (3) inundation of plant populations resulting from oil spills or hydrostatic water releases, (4) destruction of plant populations resulting from man-caused fires, and (5) dust from vehicular traffic that can reduce plant productivity. No known populations of Kern mallow or San Joaquin wooly-threads currently exist on NPR-1. However, similar adverse effects to these species might occur as a result of MER activities should they later be found or become established on NPR-1.

Adverse effects to federally listed plants would be minimized because (1) most proposed new activities would occur in the NPR-1 central uplands where Kern mallow and San Joaquin wooly-threads populations are not likely to exist, (2) NPRC agrees to initiate a separate section 7 consultation for any project that would disturb habitat known to have federally threatened or endangered plants other than Hoover's woolly-star, (3) populations of Hoover's woolly-star would be avoided to the maximum extent practicable, as described on pages 8 and 9 above, and (4) where plant populations are not avoidable, DOE would implement other mitigation measures such as stockpiling of topsoil.

Habitat Disturbance

As of June 1988, an estimated 6,467 acres of native habitat originally existing on NPR-1 have been disturbed either permanently or temporarily as a result of oil development activities since the 1920's (DOE 1993). Of these, an estimated 3,227 acres have been disturbed since the inception of MER production in 1976 (DOE 1993).

The Department estimates that habitat disturbance on NPR-1 resulting from proposed new facilities between 1989 and 2025 will total 878 acres (DOE 1991), which includes 5 acres that were disturbed for a water well project covered by a separate consultation (File No. 1-1-92-F-39). This will result from proposed work on 382 wells (579 acres), gas operations expansion (15 acres), and construction of the cogeneration facility (3 acres), the butane isomerization facility (5 acres), steam generators for the SOZ Steam Flood Project (210 acres), gas compression facilities (10 acres), gas injection facilities (4 acres), and pipeline replacement and maintenance activities (50 acres) (DOE 1993). Of this, 750 acres would be affected by 1998.

Adding past MER disturbances to anticipated future disturbances yields total estimated habitat disturbance on NPR-1 resulting from DOE activities through the life of MER production (1976-2025), or 4,105 acres (3,227 + 878 = 4,105). In addition, non-Federal third party pipeline projects are expected to disturb 691 acres through the year 2025 (DOE 1991). Because the Department has indicated its willingness to consider these as DOE disturbance for the purpose of this consultation (Jim Killen, DOE, pers. comm.), total disturbance resulting from DOE and related activities during MER production is 4,796 acres.

In addition, 547 acres within the NPR-1 civil boundaries have been disturbed in the past by activities not constructed or undertaken by the Department.

These include 133 acres disturbed by the California Aqueduct, 45 acres occupied by the town of Taft, and 369 acres of agricultural lands not owned by DOE (EG&G unpublished data). An estimated 79 acres have been disturbed since 1988 as a result of third party projects on NPR-1 (DOE 1991). However, these disturbances are either the result of non-DOE projects or are addressed and mitigated under separate biological opinions. Finally, third party seismic surveys are expected to result in minor temporary disturbances of 3,390 acres through 2025 (DOE 1991).

Estimated temporary disturbance on NPR-1 resulting from past MER development totals 432 acres, while estimated permanent disturbance totals 2,795 acres. Estimated temporary disturbance resulting from proposed new activities totals 50 acres, and estimated permanent disturbance totals 828 acres. Temporary disturbance throughout the life of MER development (1976-2025) totals 482 acres and permanent disturbance totals 3,623 acres (DOE 1995).

Cumulative Effects

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative to the proposed action.

Our agency is aware of other projects currently under review by State, county, and local authorities where biological surveys have documented the occurrence of the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Hoover's woolly-star, Kern mallow, and San Joaquin wooly-threads. These projects include urban, mineral, and energy development, and flood control and reservoir construction.

However, we do not anticipate that the project under evaluation in this biological opinion, considered together with other non-Federal actions, would appreciably reduce the likelihood of survival and recovery of the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Hoover's woolly-star, Kern mallow, or San Joaquin wooly-threads.

Conclusion

After reviewing the current status of the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Kern mallow, San Joaquin wooly-threads and the Hoover's woolly-star; the environmental baseline for the action area; the effects of the action and the cumulative effects; it is the Service's biological opinion that the proposed continuation of the oil development program on NPR-1 at Maximum Efficient Rate, as implemented, is not likely to jeopardize the continued existence of these species. No critical habitat has been designated for these species, therefore, none will be affected. This conclusion is based on (1) continuing implementation by DOE of its mitigation commitments, and (2) the fact that most proposed future MER-related disturbances would occur in the central upland portions of NPR-1 where few populations of threatened and endangered species currently exist.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the Endangered Species Act prohibit any taking (i.e., to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct) of listed fish and wildlife species without special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly

disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not a intended as part of the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary and must be implemented by the Department so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Department has a continuing duty to regulate the activity covered by this incidental take statement. If the Department (1) fails to require an applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Sections 7(b)(4) and 7(o)(2) of the Act do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for removal or reduction to possession of endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

San Joaquin kit foxes, blunt-nosed leopard lizards, giant kangaroo rats, and Tipton kangaroo rats may be taken incidentally during continued MER production and proposed construction of new facilities on NPR-1. Project actions that may result in the mortality, harm, or harassment of these species have been previously discussed in this biological opinion. Mitigation measures proposed by the Department will substantially reduce but not eliminate the potential for incidental taking of these species during proposed NPR-1 activities.

Amount of Extent of Take

Based on information provided in the project biological assessment (DOE 1991), information on past incidental takings on NPR-1 provided by EASI, information in our files, and through prior consultations, the Service anticipates that the following numbers of kit foxes, leopard lizards, and kangaroo rats may be subject to harm or mortality during proposed NPR-1 project activities through the year 2025:

1. Ninety (90) San Joaquin kit foxes (3/year for 30 years) in the form of direct mortality or injury through accidental death during project activities.

2. Two hundred and ten (210) blunt-nosed leopard lizards (7/year for 30 years) in the form of direct mortality or injury through accidental death during project activities.

3. Nine hundred (900) giant kangaroo rats (30/year for 30 years) in the form of direct mortality or injury through accidental death during project activities.

4. Thirty (30) Tipton kangaroo rats (1/year for 30 years) in the form of direct mortality or injury through accidental death during project activities.

The number of animals subject to incidental take must not exceed the annual amounts stated above, and the total for 30 years is cumulative only.

The number of San Joaquin kit foxes, blunt-nosed leopard lizards, giant kangaroo rats and Tipton kangaroo rats subject to harassment from noise, vibrations, and capture or excavation of dens and burrows cannot be estimated because the number of individuals of these species within potential project areas is unknown. Therefore, the Service anticipates harassment of all individuals of these federally listed species inhabiting areas where project activities would occur provided that such harassment: (1) Is the result of bona fide project activities; (2) is inadvertent or for the express purpose of removing individual animals from construction areas to safe locations; and 3) that all terms and conditions specified below are fully implemented.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species discussed.

Reasonable and Prudent Measures

The Service states that the following reasonable and prudent measures are necessary and appropriate to minimize the potential for incidental take of the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, and Tipton kangaroo rat authorized by this biological opinion.

1. The potential for harm or mortality to federally listed wildlife species and their habitats resulting from project related activities shall be minimized.

2. The potential for inadvertent entrapment of federally listed wildlife species during construction activities shall be minimized.

3. Compliance with the reasonable and prudent measures, terms and conditions, reporting requirements, and reinitiation requirements contained in this biological opinion shall be ensured.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Department must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

The terms and conditions specify measures considered necessary by the Service or modify mitigation commitments proposed by the Department. Unless otherwise indicated, all terms and conditions described shall be implemented by the Department at each project site. Where terms and conditions vary from or contradict mitigation commitments as proposed in this or any previous document, specifications in these terms and conditions shall apply.

1. The potential for harm or mortality to federally listed wildlife shall be minimized by implementing the following procedures:

   (a) The Department shall continue to conduct pre-activity surveys prior to all surface disturbing activities on NPR-1. Any change in preactivity surveys would have to be approved by the Service, and may involve reinitiation of consultation.

   (b) Biological monitors (see attachment 1), shall be present, or readily available, on NPR-1 construction sites during all critical construction activities occurring within or adjacent to sensitive endangered species habitat as identified during pre-activity surveys. Examples of activities for which such monitors may be

present include surveys or flagging necessary to determine and delineate specific construction areas, pipeline alignments, and location of access routes and storage areas; grading and trenching activities; checking of pipes, pipeline trench segments, and similar structures for entrapped wildlife; backfilling pipeline trench segments; den and burrow excavations; and other activities as determined by monitoring biologists to be necessary.

(c) The areas disturbed by construction related activities and routine day-to-day operation on NPR-1 shall be minimized to the maximum extent practicable. All NPRC and Contractor vehicles shall be confined to existing roads or to project areas which have received a preactivity survey.

(d) All spills of oil, liquids contaminated by oil, hazardous materials within NPR-1 shall be cleaned up in a manner consistent with the NPR-1 Spill Prevention, Control and Countermeasure Plan.

(e) Speed limits in all construction areas shall not exceed 25 mph.

(f) A litter control program shall be implemented during project activities. This program shall include daily collection of trash, especially that which is food-related, disposal in covered receptacles, and regular removal from project sites.

(g) Construction activities (but not drilling, operations, maintenance, or any other activities) between dusk and dawn shall be minimized.

(h) Personnel performing pre-activity surveys, wildlife handling, kit fox den excavations, and monitoring activities are to be qualified to perform these duties as described by Attachment 1. One supervisory biologist as a training officer who will be given responsibility over all trainees, with full authority to deny or grant trainees the ability to perform permitted activities. This will provide some level of consistency regarding qualifications and employee certification.

2. The potential for inadvertent entrapment of federally listed wildlife species during construction activities shall be minimized by implementing the following procedures:

(a) The Department shall make every reasonable effort to avoid damage or destruction of San Joaquin kit fox dens, giant and Tipton kangaroo rat burrows, and burrows potentially utilized by blunt-nosed leopard lizards during proposed MER activities on NPR-1. Such avoidance measures may include minor re-location of project facilities and minimization of construction impacts to the least possible area.

(b) Known San Joaquin kit fox dens shall not be damaged or destroyed by project related actions unless written or verbal concurrence is obtained from the Service's Sacramento Field Office prior to such effects. If concurrence cannot reasonably be obtained in a timely manner (e.g., on weekends), destruction of known kit fox dens may proceed only if qualified personnel determine that the den cannot reasonably be avoided and if the Service is verbally notified as soon as possible after the fact. Any known kit fox den that must be destroyed shall first be monitored for three consecutive nights by qualified personnel to ensure that it is not occupied by kit foxes, and then shall be excavated by or under the direct supervision of qualified personnel and backfilled to preclude later use by kit foxes. Destruction of all known kit fox dens shall be documented in the annual report.

Potential San Joaquin kit fox dens may be excavated without prior notification to the Service, provided that qualified personnel have determined that the den is not a known kit fox den. Alternately, excavation of potential kit fox dens need not be conducted prior to construction activities, provided that no evidence of kit fox use of such dens is observed after three consecutive nights of monitoring, and that construction operations over such dens occur no more than 24 hours after such dens are last determined to be unoccupied. In the event the Service modifies the procedures for monitoring dens prior to excavation, NPRC shall adopt the revised procedures, so as to be in compliance with this term and condition.

(c) San Joaquin kit foxes, blunt-nosed leopard lizards, and giant and Tipton kangaroo rats may from time to time be captured and relocated from construction sites, provided (i) that burrows of these animals cannot reasonably be avoided during construction activities; (ii) that associated conditions and actions deemed appropriate by the Service are satisfied; (iii) that verbal or written approval from the Sacramento Field Office is obtained prior to any such capture and removal; and (iv) that any person or persons conducting capture and relocation activities possess an appropriate scientific collecting permit issued by the Service or are otherwise qualified to conduct such activities, as determined by the Service in writing.

(d) At the end of each day during all major NPR-1 construction projects, all open pipeline trench segments and other steep-walled holes or trenches greater than two feet deep shall either be covered with plywood or similar materials, or shall be equipped with escape ramps constructed of wooden planks, earth fill, or similar materials and spaced no further than one-quarter mile apart. Projects to which this term and condition applies include the same as those described in term and condition 3(a).

(3) If entrapped wildlife is observed, said wildlife shall only be removed by qualified personnel (see Attachment 1).

3. Compliance with the reasonable and prudent measures, terms and conditions, reporting requirements, and reinitiation requirements contained in this biological opinion shall be ensured by:

(a) Prior to the sale of NPR-1, the Department shall initiate and complete a subsequent section 7 consultation as to this Federal action; and the reasonable and prudent measures and terms and conditions shall be adhered to by the subsequent owner until a section 10(a)(1)(B) permit and a CDFG 2081 permit are issued for their actions. In addition, as part of the subsequent section 7 consultation, the Department shall enter into a Conservation Agreement with the Service if the conservation area has not been established.

(b) Within 90 calendar days following the end of each fiscal year, the Department shall submit to the Service's Sacramento Field Office a brief annual report detailing the following information: (i) A summary of all major construction activities undertaken the previous year; (ii) dates that such construction occurred and the number of habitat acres permanently or temporarily disturbed; (iii) pertinent information concerning the Department's success in meeting project mitigation measures; (iv) an explanation of failure to meet such measures, if any; (v) known project effects on federally listed species, including an estimate of the number of kit fox dens and giant kangaroo rat burrows destroyed, including a general estimate of other small mammal burrows impacted, if any; (vi) known

occurrences of incidental take of listed species, if any; (vii) habitat reclamation efforts undertaken that year, if any; (viii) results of ongoing monitoring of habitats reclaimed in previous year; (ix) an estimate of habitat acres reclaimed to date; and (x) other pertinent information. The term "major construction activity" in this term and condition shall apply to the proposed gas plant, cogeneration plant, butane isomerization facility, all underground pipelines, and any other facility resulting in permanent disturbance of more than 3 acres at a time, or temporary disturbance of more than 5 acres at a time.

(c) If requested, upon completion of any proposed construction project, or at any reasonable time deemed appropriate by the Service, the Department or its contractors shall accompany Service personnel on site inspection tours of construction sites or other locations, as requested, to review project impacts to endangered species and their habitats.

(d) Unless otherwise authorized by the Service in writing, all terms and conditions within this biological opinion shall apply to all third party projects permitted by the Department on NPR-1.

Reviewing Requirement

The reasonable and prudent measures, with implementing terms and conditions, are designed to minimize incidental take that might otherwise result from project activities. If, during proposed project actions, the amount or extent of incidental take of the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, or Tipton kangaroo rat is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. The Department must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Reporting Requirement

The Service is to be notified in writing within three working days of the accidental death or injury of a San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat or Tipton kangaroo rat or of the finding of any dead or injured kit fox, leopard lizard, or kangaroo rat, during project related actions. Notification must include the date, time and location of the incident or of the finding of a dead or injured animal, and any other pertinent information. The Service contact for this information is the Assistant Field Supervisor for Endangered Species at (916) 979-2725. To determine disposition of dead or injured San Joaquin kit foxes, blunt-nosed leopard lizards, or giant kangaroo rats, the California Department of Fish and Game, Region 4 Office, Fresno should be contacted (209/222-3761).

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species and the ecosystems upon which they depend. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. Therefore, the Service recommends the following additional actions to protect federally listed species and their habitats during proposed continuing MER activities at NPR-1:

(1) The Department should consider placing into conservation status all lands outside of the primary production and conservation areas for the benefit of listed species. These lands could be subject to oil development activities, however, the quality of the habitat should be maintained.

(2) The Department should consider, in the event of the sale of NPR-1, selling only the sub-surface mineral rights. The surface ownership should be retained by the Federal government for the long-term survival and recovery of the listed species that occupy NPR-1.

(3) The Department should direct EASI to continue monitoring of kit fox and lagomorph population trends and rainfall patterns on NPR-1 and NPR-2. This information and information obtained from CDFG survey routes, should be utilized to further clarify the relative importance of factors potentially affecting kit fox distribution and abundance on NPR-1. In accordance with the concluding paragraph below, the Department should reinitiate consultation concerning MER activities on NPR-1 should any such new information suggest that MER production is resulting in effects to San Joaquin kit foxes not considered in this opinion, or that the conclusions in this opinion with respect to effects of MER production on kit foxes is incorrect or inadequate.

(4) The Department should direct EASI to increase monitoring of population trends on NPR-1 of other federally listed species-(i.e., the blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, Kern mallow, Hoover's woolly-star, and San Joaquin wooly-threads). The Department should reinitiate consultation concerning MER activities on NPR-1 should any new information suggest that MER production is resulting in effects on these species not considered in this opinion or that the conclusions in this opinion with respect to effects of MER production on these species is incorrect or inadequate.

(5) The Department should contribute funds to be utilized for research projects on federally listed San Joaquin Valley species conducted either on NPR-1 but by researchers other than EASI, or off NPR-1 in adjacent, nearby, or other San Joaquin Valley locations. The rationale for this recommendation is as follows.

First, NPR-1 is a highly lucrative oil field, generating average net revenues of approximately $750 million per year. Second, NPR-1 occupies a key location in the configuration of remaining San Joaquin Valley habitats in Kern County (near or adjacent to the Lokern Road area, Buena Vista Valley, and others) and DOE activities on NPR-1 have resulted in temporary or permanent disturbance to over 6,000 acres of endangered species habitat within this area--by any measure a significant effect. Third, over 3,500 acres of habitat disturbance on NPR-1 resulted from Federal activities conducted prior to the onset of MER development and no mitigation for the effect has been required under this or previous biological opinions. Fourth, in the Service's view, restricting DOE research funds non-competitively to a single group (EASI) does not result in the greatest benefit to affected endangered species. Finally, as a Federal agency, the Department has significant responsibilities under section 7(a)(1) of the Act to utilize its authorities in carrying out endangered species programs.

Based on these considerations, the Service recommends that DOE contribute a sum of approximately $100,000 per year through the life of the NPR-1 oil field, or until federally listed species affected by DOE activities are delisted, whichever comes first, to a suitable interest-bearing account to be administered by the Service for research and management of such species.

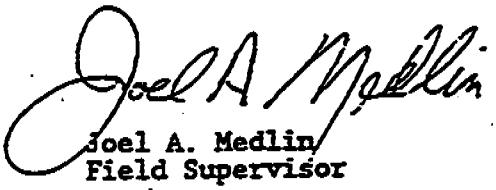
In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on proposed continuing MER production on NPR-1. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect federally listed species in a manner or to an extent not considered in this opinion; (3) the project is substantially modified in a manner that causes an effect to listed species that was not considered in this opinion; and/or (4) a new species is listed or critical habitat is determined that may be affected by the action.

We appreciate the cooperation of the Department, Chevron, and EASI throughout this consultation process. Please contact Jody Brown or Peter Cross of my staff at (916) 979-2728 if you have questions or information concerning this biological opinion with respect to federally listed wildlife species, and Kirsten Tarp at (916) 979-2120 if you have questions or information with respect to federally listed plants.

Sincerely,



Joel A. Medlin
Field Supervisor

Attachment

cc: ARD-ES, Portland, OR
Ms. Sandra Morey, CDFG Sacramento, CA
Regional Manager, CDFG, Fresno, CA
Mr. Jim Killen, U.S. Department of Energy, Tupman, CA
Mr. Brian Cypher, EASI Energy Advisory Services, Inc., Tupman, CA
Ms. Linda Spiegel, California Energy Commission, Sacramento, CA
Dr. Daniel F. Williams, SJVESRPP, Fresno, CA

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ATTACHMENT 1

DEFINITION OF QUALIFIED PERSONNEL
(FOR KIT FOX DEN EXCAVATION/REMOVAL OF ENTRAPPED WILDLIFE, PREACTIVITY SURVEYS AND MONITORING ACTIVITIES ONLY)

Kit Fox Den Excavation, Removal of Entrapped Wildlife, Preactivity Surveys

Personnel are to have either a 4-year degree in biology, or a related field, from an accredited college or university, plus 30 days of full time on-the-job training at NPRC performing preactivity surveys with another qualified person; or 2 years of field, or field related, experience working in an endangered species program on a full time basis, plus 90 days of full time on-the-job training at NPRC performing preactivity surveys with another qualified person. Training is to be carried out under the supervision of and be certified by a NPRC supervising biologist. The supervising biologist is to have a 4-year degree in biology, or a related field, from an accredited college or university, plus a combination of advanced education and field experience qualifying that person to work in the NPRC endangered species program both as a biologist and as a supervisor.

Training is to include:

* Identifying protected and candidate species known to occur on or adjacent to NPRC;

* Life history of protected and candidate species know to occur on or adjacent to NPRC;

* Topical Report 110282-2178 "Operational Guidelines for Conducting Preactivity Surveys on Naval Petroleum Reserve No. 1" and its supplements; the current NPR-1 site wide Biological Assessments and Biological Opinions for NPR-1 and NPR-2; FWS's Standard Recommendations for Protection of protected species occurring on or adjacent to NPRC; and sections 9 and 10 of the Endangered Species Act.

* The video titles "Protecting Endangered Species on NPR-1".

Demonstrating the ability to successfully conduct preactivity surveys is to be the basis for certification by the supervising biologist. Included in this is the knowledge to know when to ask for assistance from the supervising biologist.

Monitoring

For the purposes of monitoring activities occurring within or adjacent to endangered species habitat, monitors are considered to qualified upon:

1) Successfully completing an 8 hour training course. Training is to be carried out under the supervision of and be certified by a NPRC supervising biologist. The supervising biologist is to have a 4-year degree in biology, or a related field, from an accredited college or university, plus a combination of advanced education and field experience qualifying that person to work in the NPRC endangered species program both as a biologist and as a supervisor.

Training is to include:

* Identifying protected and candidate species known to occur on or adjacent of NPRC;

* Life history of protected and candidate species known to occur on or adjacent to NPRC;

* Topical Report 110282-2178 "Operational Guidelines for Conducting Preactivity Surveys on Naval Petroleum Reserve No. 1" and its supplements; the current NPR-1 site wide Biological Assessments and Biological Opinions for NPR-1 and NPR-2; FWS's Standard Recommendations for Protection of protected species occurring on or adjacent to NPRC; and sections 9 and 10 of the Endangered Species Act.

* The video titled "Protecting Endangered Species on NPR-1.

2) Completing the following reviews with preactivity survey personnel and the lead person in charge of the project:

* Construction project boundaries;

* Areas demarcated to avoid disturbing endangered species or their habitat;

* Specific measures identified during the preactivity survey to avoid impacts to endangered species;

* Project scope and schedule;

* Designated points of contact and phone numbers.

Demonstrating the ability to successfully conduct monitoring is to be the basis for certification by the supervising biologist. Included in this is the knowledge to know when to ask for assistance from the person who conducted the preactivity survey, or from the supervising biologist.