DOE/EIS-0070 U.S. Department of Energy August 1980

Assistant Secretary Environment
Office of Environmental Compliance
and Overview



# Draft Environmental Impact Statement

## Mining, Construction and Operation for a Full Size Module at the Anvil Points Oil Shale Facility, Rifle, Garfield County, Colorado

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**Environmental**

Cover Sheet
Draft Environmental Impact Statement
Mining, Construction and Operation for a Full-Size Module at
the Anvil Points Oil Shale Facility

(a) Lead Agency: U. S. Department of Energy

(b) Proposed Action: The approval to mine 11 million tons of oil shale from the Naval Oil Shale Reserves (NOSR) at Anvil Points, Colorado, to construct an experimental full-size shale retort module on a 365-acre lease tract having a 4700 bbl/day production capacity, and to consider extension, modification or new leasing of the facility.

(c) For Further Information Contact: (1) Larry W. Harrington, U.S. Department of Energy, Laramie Energy Technology Center, P. O. Box 3395, University Station, Laramie, WY 82071, phone 307-721-2251, FTS 328-4251; (2) Dr. Robert J. Stern, Acting Director, MEPA Affairs Division, Office of the Assistant Secretary for Environment, Room 4G-064, Forrestal Building; or (3) Mr. Stephen H. Greenleigh, Esq., Assistant General Counsel for Environment, Room 6D-033, Forrestal Building, Washington, D.C. 20585, phone 202-252-6947.

For copies of the EIS contact: Larry W. Harrington at the address noted above.

(d) Designation: Draft EIS

(e) Abstract: The statement assesses impacts associated with mining up to 11 million tons of oil shale and subsequent construction and operation of a full-size oil shale module at the Anvil Points Oil Shale Facility in Garfield County, Colorado. Modelling results predict that the facility will comply with all Federal ambient air quality standards. Land disturbance during the 18-month construction period is expected to cause 600 to 80,000 tons of sediment loading in the Colorado River, depending upon the use of runoff control techniques. Retort process water will be deposited in the Balzac Gulch retorted shale disposal site. The project will consume 122 acre-ft/yr of water, 64 acres of surface land, and add from 233 to 1,378 people to the area during different phases of construction and operation.

(f) Alternatives to the proposed action include no action, alternative locations for the retort and the disposal site.

(g) The Department of Energy has determined that not enough information is currently available to assess fully the impacts of the proposed disposal of spent shale and raw shale fines. Therefore, a supplemental EIS is planned to address the environmental impacts of alternative methods of disposing of spent shale and raw shale fines. The supplemental EIS will be based on more detailed design information, which will be available during Phase I and II. Construction will not commence on any aspect of the disposal operation until a final supplement has been circulated and a Record of Decision published.

(h) Comments on this draft EIS should be addressed to Larry W. Harrington at the address noted above. The comment period ends 45 days after appearance in the Federal Register.

PREFACE

Proposed Action. Development Engineering, Inc., (DEI), a subsidiary of Paraho Development Corporation, has requested approval from the Department of Energy (DOE) to mine 11 million tons of oil shale from Naval Oil Shale Reserve (NOSR) 3, to extend the existing lease, and to construct and operate a full-size (4,700 bbl/day) retort on a 365-acre lease tract at the Anvil Points Oil Shale Facility, Colorado. The retort module would be developed by DEI and would use the Paraho direct-mode process technology. Operating the module and its supporting facilities would require mining and crushing the oil shale, transporting the raw shale to the retort, retorting, transporting the shale oil to storage tanks, disposing fines and spent shale, and transporting the crude shale oil from the site. Presently, the existing Anvil Points semiworks and pilot plants are operating independently on a part-time basis; the semiworks plant would supplement the full-size module as necessary.

The Anvil Points operation will have three phases: Phase I is an 8-month program to plan the facility; Phase II is an 18-month period to develop the mine, detail the design plans and construct the module; and Phase III is an 18-month module operation period which may be extended, depending on start-up and operating performance. DEI currently is working on preliminary plans for Phase I. Construction and finalized detailed design plans will not start until completion of the NEPA (National Environmental Policy Act) process. However, a supplemental EIS will be prepared to assess the potential impacts of spent shale disposal and the disposal of raw shale fines after more design information is available. DEI expects to maintain its 44-month production schedule; however, Phase III would not be completed before the existing DEI facility lease expires in July 1982.

The proposed action could contribute to the Congressionally mandated oil shale development program by demonstrating the reliability, efficiency, and feasibility of oil shale surface retorting in a commercial size retort, thus obtaining technical information which may aid in developing the oil shale retorting industry. An expanded development program for the Paraho process will provide physical scale-up and cost data for evaluating commercial scale process economics. In addition, environmental data will provide an opportunity to minimize potential adverse impacts of full-size operations. The proposed Anvil Points module will be an experimental, not a commercial facility. A commercial oil shale facility would contain 10 or more modules the size of the proposed full-size module.

Lease Authorization and Approval. The objective of the proposed action is to continue to "encourage the use of the (Anvil Points Oil Shale) facility . . . in research, development test, evaluation, and demonstration work," consistent with 10 U.S.C. 7438(b), as ordered by Congress. Development Engineering, Inc. (DEI), the lessee of the facility, has proposed to build a full-sized oil shale retort for testing of economic, environmental, and process parameters. In order to conduct such a test, additional oil shale must be mined. "The Secretary of the Interior (now the Secretary of Energy) may, after consultation by the Secretary of the Navy with the Committees on Armed Services of the Senate and House of Representative . . . authorize the mining and removal, of any oil shale or products therefrom from lands in the naval oil shale reserves that may be needed for such experimentation." 10 U.S.C. 7438(b).

On July 27, 1974, Development Engineering, Inc., proposed to construct a full-size Paraho retort at Anvil Points. Under the plan, a maximum of an additional 11 million tons of oil shale would be mined from the Naval Oil Shale Reserves. In a letter dated October 30, 1974, the Acting Secretary of the Navy for Naval Petroleum and Oil Shale Reserves, Mr. Jack L. Bowers, forwarded the DEI proposal to the Chairmen of the Senate and House Armed Services Committees. In a letter dated December 6, 1974, Congressman Hebert, the Chairman of the House Armed Services Committee, stated that the Committee had no objection to the mining of an additional 11 million tons of oil shale. In a similar letter dated October 24, 1974, Senator Stennis stated that the Senate Armed Service Committee had no objections to the mining of an additional 11 million tons of oil shale.

In May 1975, the Secretary of the Interior completed an Environmental Impact Assessment on the proposed action, authorization to mine 11 million tons of oil shale. On November 4, 1975, the Energy Research and Development Administration's Assistant Administrator for Fossil Energy notified Development Engineering, Inc., that authorization of the proposal and modification of the existing lease would require preparation of an Environmental Impact Statement before final action could be taken with respect to the authorization.

In 1972, the Anvil Points Oil Shale Facility was leased to DEI. Prior to leasing the site, the Interior Department issued a Final Environmental Statement (FES). The FES was used in preparation of the lease's environmental stipulations, and they apply specifically to operation of the on site pilot plant and semiworks reactor. Since the Lease Agreement was predicated upon the 1972 FES, it was ERDA's determination that additional authorization of the proposed construction and mining would be required, and the authorization would be reflected in an addendum to the lease.

Site and Process History. The oil shale property which contains the present Paraho project site at Anvil Points, Colorado, was purchased by the government as early as the 1920's for possible development. Actual oil shale development efforts were not conducted at the site until the Bureau of Mines Shale Research Facility was established under the Synthetic Liquid Act of 1944. The plant and underground room-and-pillar mine resulting from the Bureau's pioneering technology development efforts were operated by them during the period from 1944 through 1956. Authority to lease the facility was given to the Secretary of the Interior in 1962, and from 1964 through 1969 the facility was leased to the Colorado School of Mines Research Foundation for purposes of improving retorting technology. During that period, Mobil Oil Company acted as project manager for a consortium of six petroleum companies (Mobil, Humble, Pan American, Sinclair, Continental, and Phillips) at the site. This group operated the Anvil Points mine until 1966. The facility was essentially unoccupied until 1972.

The development of oil shale retorts, not unlike other technologies, has been largely a sequential effort wherein innovations are originated to solve identified problems in contemporary processes. The first "modern" oil shale retort was developed by the Nevada-Texas-Utah Co. in the 1920's. NTU retort technology was first used by the Bureau of Mines at Anvil Points Research Center. Although the retort successfully recovered oil from shale through a direct combustion process, it utilized a batch-type operation which required that the retort vessel be loaded before burning and dumped after completion of firing. The Bureau of Mines gas combustion retort was developed in 1951 at Anvil Points to overcome this problem, reaching a 150 ton/day pilot plant capacity at the conclusion of the Synthetic Liquid Fuels Program in 1955.

Between 1964 and 1966, Mobil Oil and its associates improved the process attaining a capacity of 350 tons/day at yields in excess of 85 percent of Fischer assay. However, difficulties were encountered with small shale sizes, high rates of gas and shale throughput, and bridging due to rich shales. The Paraho/DEI gas combustion retort was designed to overcome such limitations.

The DEI kiln was invented by John B. Jones (U.S. Patent No. 3,736,247), and initially used for calcining limestone where it has attained a capacity of 700 tons/day in a 10.5 ft diameter design. In May 1972, DEI leased the federal facilities at Anvil Points and launched a project to apply the DEI kiln to oil shale retorting. A consortium of 17 companies,* known as the Paraho Oil Shale Project, was formed and activities at Anvil Points were initiated in 1973. Some of the facilities originally developed by the Bureau of Mines were utilized, including the underground mine, crushing plant, retort structure, various storage tanks, shale disposal area, and associated laboratories, maintenance shops, and water supplies. The project was scheduled to run until August 1976 under funding to be supplied by its industrial participants.

Two retorts, a pilot plant retort and a larger semiworks reactor, were constructed and operated under the program. The pilot plant retort is 60 ft in height with a 4.5 ft outside diameter; the semiworks reactor is 75 ft high and has a 10.5 ft outside diameter. The retorts were designed so that they could be operated in any one of three modes: direct heated, whereby heat is sup-

* The seventeen Paraho participants were Atlantic Richfield, Cartr Oil (Exxon), Chevron Research (Standard of California), Cleveland-Cliffs Iron Company, Gulf Oil, Kerr-McGee, Marathon Oil, Arthur G. McKee, Mobile Research, Phillips Petroleum, Shell Development, Sohio Petroleum, Southern California Edison, Standard Oil Company (Indiana), Sun Oil, Texaco, and the Webb-Gary-Chambers-McLoraine Group.

plied by the combustion of carbon in the spent shale (similar to the Gas Combustion process); indirect-heated, in which heat is supplied by recycled gases heated externally (similar to the Petrosix process); and a combination of these two modes. As part of the Paraho operations, approximately 10,000 bbl of raw shale oil were produced in 1975 for use in a Navy refining program. The shale oil was refined at the Gary Western Company Refinery in Fruita west of Grand Junction, Colorado, to obtain NATO gasoline, JP-4 jet fuel, JP-5 jet fuel and heavy fuel oil. The fuels were subsequentally tested in a variety of Navy and other military vehicles and in the boilers of ore freighters on the Great Lakes.

In 1976, the lease on the Anvil Points facility was extended to 1982 by ERDA (lessor of the site at that time) and a government sponsored program to provide 100,000 bbl of shale oil for subsequent refining and testing was initiated. This effort was completed in early 1978. (The Department of Energy became the overseer of the Anvil Points facility lease and DEI, lessee, in October 1977, when ERDA became part of DOE).

Having completed the production phases, the semiworks plant was shut down. Since that time, several runs of foreign oil shale have been made in the pilot plant.

<u>DOE Oil Shale RD&D Program</u>. The Department of Energy (DOE) has established a research, development and demonstration (RD&D) program for encouraging the development of the country's oil shale resources with the concurrent production of its associated minerals. DOE's primary oil shale goal is to foster the development of a commercial oil shale industry. In concert with this

goal, the objectives of the Oil Shale Program are to assist in the development of this industry through RD&D efforts, financial incentives, and the mitigation of institutional barriers. RD&D aspects of the program are specifically directed to:

1. Provide technical, economic, and environmental information to the private sector that will enhance its shale oil industry potential.

2. Optimize oil shale processes or develop new concepts which ensure the most efficient and cost effective utilization of the nation's oil shale resource.

3. Obtain environmental data and develop environmental protection systems to ensure that the oil shale resource is developed in the most environmentally acceptable manner.

The DOE strategy to accomplish this end is comprised of two major activity elements: (1) research and development, and (2) commercial development and demonstration support. Through the existence of these parallel activities, the DOE Oil Shale RD&D Program focuses near term research and development (R&D) on supporting industrial development while maintaining an adequate level of more advanced R&D attuned to future needs.

Program activities are directed at key technical and environmental needs representing significant barriers to commercial oil shale development. These involve the following:

1. Mining and second generation surface processing techniques.

2. True in situ methods that require no mining in preparation for in place combustion and subsequent shale oil recovery.

3. Modified in situ methods which create a rubbled retort with enhanced permeability by mining within the oil shale formation prior to in place combustion and oil recovery.

4. Advanced processing technology with potential for reducing the environmental impacts and improving the energy efficiency of commercial plants.

5. Resource assessment targeted at both eastern and western oil shales.

6. Environmental studies related to the processes being developed.

7. Supporting oil shale and shale oil processing research that is not tied to any specific technology but rather to development problems in general.

The technology developments that will result from achieving the program's objectives are made available to the oil shale industrial community.

The DOE surface retort development strategy is largely dependent upon financial incentives which are believed to be the most expeditious and cost effective means of motivating the private sector to construct and operate initial demonstration scale oil shale processing facilities. In addition to these financial incentives, the DOE is pursuing a surface module demonstration plant program as defined in PL 95-238. The objective of this program is to stimulate oil shale industry development by demonstrating the engineering, economic, and environmental feasibility of a surface retorting process at a unit scale considered necessary to prove commercial feasibility. The program is divided into two phases:

1. Phase I includes the procurement of technical designs, cost estimates, and environmental data for site specific construction and operation of one or more of the modern oil shale surface retorting processes that have previously shown feasibility at pilot scale. These designs will be for modular equipment configurations at a size that could be replicated in commercial practice.

2. Phase II, if needed due to problems implementing incentive approaches, will include the actual construction and operation of a retort process selected subsequent to Phase I, leading to either commercial expansion or abandonment. Operating data, operating costs, and environmental information will be collected and evaluated to determine performance and acceptability.

In May 1979, DOE issued a Program Opportunity Notice (PON) inviting prospective contractors to submit proposals to design and potentially construct a commercial scale oil shale surface retort module. (This has no direct relationship with the subject action although both actions address the same technology). Phase I contract talks were initiated in December 1979 with all three firms that responded to the PON. These firms were: Paraho Development Corporation, Grand Junction, Colorado; Superior Oil Company, Englewood, Colorado; and TOSCO Research, Inc., of Denver. Following negotiations, DOE entered into Agreements with Paraho and Superior. Two other firms, Rio Blanco Oil Shale Corporation and Occidental Oil Shale, Inc., have signed letters of intent to apply for Phase II grants, based on plans and designs developed with private funding.

Phase I contracts will be an 18 month program to prepare for possible future construction and operation of the demonstration facility. The facility would be one module of a full-size commercial oil shale plant and could eventually cost about $200 million to build and operate. At full production, it should produce roughly 10,000 bbl per day of shale oil, although both the production levels and exact costs vary among proposers. The initial phase, which will include design of the module as well as plans for its construction and operation and the preparation of an appropriate EIS, will be financed by $15 million allotted by Congress in 1979.

DOE's decision to begin construction of a cost shared demonstration plant (Phase II) will be based primarily on the success of various financial incentives now pending before Congress. These incentives include price and purchase guarantees which would be offered by the Administration's proposed Energy Security Corporation, and a $3/bbl shale oil tax credit. If these incentives provide the stimulus needed for private industry to move into commercial shale oil production on its own, a cost shared demonstration facility may not be necessary. However, if the proposed incentives are not successful in achieving the desired stimulus to industry, Phase II of the program would ensure that updated designs of a commercial module are available, and that the federal government could move forward jointly with industry to demonstrate the commercial feasibility of surface oil shale processing with little, if any loss of time.

Other DOE sponsored research and development supporting surface retorting is focused on mining and environmental needs, with long term R&D directed to improving surface retorting processes. The costs of mining and surface retorting are high, especially capital costs. Although technology exists that may be scaled up to commercial production through the PON module demonstration program, the need for basic concept improvement still exists. An increased governmental effort in this area is required to advance surface retorting and, thereby, achieve the significant positive scale economies that appear to be possible. A base technology effort devoted to understanding and improving surface retorting is embodied in the DOE's Oil Shale RD&D Program. Through this planned rational approach toward understanding the basic technology, the DOE is preparing for the development of new retort concepts and designs.

Naval Oil Shale Reserve Development Policy. In January 1980, the DOE announced its intent to assess the impact of proposed policy options to develop the 55,000 acre Naval Oil Shale Reserves (NOSR) near Rifle, Colorado. Commercial scale production is foreseen ranging from one 50,000 bbl/day facility to several facilities producing collectively up to 200,000 bbls/day which is the maximum potential from the NOSR 1 and 3 oil shale resources. At this maximum production rate, the recoverable reserves of high grade oil shale from NOSR 1 and 3 would be exhausted in approximately 25 years. NOSR shale oil development policy options include: (a) leasing large parcels to industry;

(b) joint government/industry ventures; (c) government-owned-contractor-operated (GOCO) ventures; (d) quasi-utility ventures.

NOSR 1 and 3 were withdrawn for the Navy by Executive Order in 1916 and 1924 as potential reserves of military fuels. In 1962, PL 87-796 gave the Secretary of the Navy the same authority to develop the NOSRs as he had for the Naval Petroleum Reserves. In 1977, PL95-91 transferred the jurisdiction over the Naval Petroleum and Oil Shale Reserves from Navy to the Department of Energy.

As a result of the Arab Oil Embargo of 1973-1974, a multi-year pre-development plan for NOSR 1 and 3 was prepared by the Navy and submitted to Congress. Approval of this plan was received in 1977. The objective of the plan was to assess the oil shale and water resources of NOSR 1 and 3; develop environmental baseline data; and determine the most suitable development scenarios for the NOSR 1 and 3 resources. In late 1978, the plan was divided by DOE into two phases. The first is a continuation of efforts to develop environmental baseline data, and resource and technology assessment, to be completed in late 1981. The second phase will involve site characterization for hypothetical commercial scale facilities including an environmental impact analysis. The second phase could be emphasized beginning in 1981 should the government's efforts to encourage private oil shale development fall short of national objectives.

The funds to develop the NOSRs under the several policy options to be considered--lease, industry partnership, government ownership, etc.--have not yet been authorized by Congress. DOE is preparing an environmental impact statement to analyze the impact of such a program if authorized by Congress.

Relationship Between the Proposed Action and Current DOE Oil Shale Development Programs. The DOE Oil Shale Program has been structured to provide the technical, economic, and environmental information base necessary to support commercial oil shale development. In view of the comprehensive nature of the program, neither approval nor disapproval of the proposed action will appreciably affect the schedule of planned program activities or impact the overall program. Thus, approval of the proposed action may be given independent of any NEPA related activity concerning the Oil Shale RD&D Program, in concert with the intent of 40 CFR 1506.1(c).

The proposed demonstration project involves an experimental scaleup of existing technology, defined to investigate options for the future development of oil shale, not to foreclose them. As such, the project is not considered a key element of the Oil Shale Program which already contains efforts similar in nature. To place the proposed action into such a key position would be to jeopardize unnecessarily the orderly development process embodied in the program.

The Paraho retort has had a long developmental cycle. Beginning in 1973, Paraho processes have gone from a conceptual stage through several levels of pilot retorts, each of which have had measurable success. The proposed action is yet another stage. These stages have been, and remain, independent of the schedule followed by the DOE Oil Shale Program which was initiated well after the first Paraho retort had produced its initial output for the Navy. The two programs, DOE's and Paraho's, are following different schedules leading to different ends; DOE's program is based upon the technology development and results of pioneering efforts such as that completed by Paraho heretofore.

The government's commitment of funds in support of the proposed action will be confined to administrative purposes only--the monitoring of the Anvil Points lease and use of existing government equipment and facilities. The DOE does not propose to fund the project beyond this level. Oil Shale RD&D funds are committed to supporting a continuous development effort embodied within the Oil Shale RD&D Program plan which does not include the proposed action. Government support monies beyond this possible source are limited. Each energy program, oil shale being one, is confined to a specific budget authorized and approved at the Congressional level.

The mining and processing of 11 million tons of oil shale, averaging approximately 25 gallons per ton, will yield as much as 5.9 million bbl of shale oil. Extracting this amount of shale by underground room-and-pillar methods with a 70 percent in place resource recovery will commit 15.7 million tons of oil shale to the proposed action. This amount of shale is only a fraction of one percent of the 11.4 billion tons of shale on NOSR 1 and 3, and approximately one percent of the 1.2 billion tons of reserves in the Anvil Points lease. It should be noted, however, that the present lease allows DEI to mine up to 400,000 tons of oil shale through 1982. Thus far, they have only mined approximately 220,000 tons. Acceptance or rejection of the proposed action, therefore, will not appreciably affect the Oil Shale Program by prohibiting access to minable oil shale deposits.

<u>Conclusion</u>. The Anvil Points Oil Shale Facility has been made available to industry to encourage the development of surface retorting technology. Recently, the government has offered to share the cost of building modules with industry, and it is considering other incentives such as tax credits and price

purchase guarantees. If Development Engineering, Inc., should proceed with its plans at Anvil Points, the economics, process, and environmental aspects of a full-size Paraho module will be demonstrated. However, the DOE financial incentive program and cost sharing program, not the proposed action, are seen as the incentive required to stimulate the commercial industry. Approval of the proposed DEI program, therefore, must be made on its merits alone.

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# 1. INTRODUCTION AND EXECUTIVE SUMMARY

In compliance with the National Environmental Policy Act (NEPA), Council on Environmental Quality Regulations, 40 CFR 1500, and Department of Energy NEPA Guidelines 45 FR 20694, March 1980; this draft Environmental Impact Statement was prepared for the proposed Paraho modular oil shale project at the Anvil Points Oil Shale Facility near Rifle, Colorado (Development Engineering, Inc. lessee at Anvil Points is a subsidiary of Paraho Development Corporation). This document evaluates environmental, social, and economic impacts that could occur as a result of the construction and operation of this proposed facility. The purpose of this EIS is to evaluate a request from Development Engineering, Inc. (DEI) to mine 11 million tons of oil shale from the Naval Oil Shale Reserves (NOSR) at Anvil Points, Colorado, to construct an experimental full-size-oil shale retort module on a 365 acre lease tract having a 4700 bbl/day production capacity, and to consider extension, modification or new leasing of the facility.

In 1972, the Anvil Points Oil Shale Facility was leased to DEI. The current lease expires in 1982. Two retorts, a pilot plant retort and a larger semi-works reactor, have been constructed and operated. The pilot plant retort is 60 feet in height and 4.5 feet outside diameter; and the semiworks reactor is 75 feet high and 10.5 feet outside diameter. Prior to leasing the site, the Interior Department issued a Final Environmental Statement (FES). The FES was used in preparation of the lease's environmental stipulations, and they apply specifically to operation of the pilot plant and semiworks reactor. Since the Lease Agreement was predicated upon the 1972 FES, it was ERDA's determination that additional authorization of the proposed construction and mining would be required, and the authorization would be reflected in an addendum to the lease after the new EIS is approved. Since the lease expires in 1982, a new lease may now be required, or the existing lease may be modified or extended.

On July 27, 1974, Development Engineering, Inc., proposed to construct a full-size Paraho retort at Anvil Points. Under the plan, a maximum of an additional 11,000,000 tons of oil shale would be mined from the Naval Oil Shale Reserves. In a letter dated October 30, 1974, the Acting Secretary of the Navy for Naval Petroleum and Oil Shale Reserves, Mr. Jack L. Bowers, forwarded the DEI proposal to the Chairmen of the Senate and House Armed Services Committees. In a letter dated December 6, 1974, Congressman Hebert, the Chairman of the House Armed Services Committee, stated that the Committee had no objection to the mining of an additional 11,000,000 tons of oil shale. In a similar letter dated October 24, 1974, Senator Stennis stated that the Senate Armed Service Committee had no objections to the mining of an additonal 11,000,000 tons of oil shale.

In May, 1975, the Secretary of the Interior completed an Environmental Impact Assessment on the proposed action, authorization to mine 11 million tons of oil shale. On November 4, 1975, the Energy Research and Development Administration's Assistant Administrator for Fossil Energy notified Development Engineering, Inc., that authorization of the proposal and modification of the existing lease would require preparation of an Environmental Impact Statement before final action could be taken with respect to the authorization. Authorization to proceed may require modification to the existing lease or a new lease for the facility.

## 1.1 ENVIRONMENTAL IMPACTS AND CONCERNS RELATED TO THE PROPOSED ACTION

To date, the environmental impacts and concerns related to this proposed project include the following:

Air Quality Impacts: Modeling results predict that the facility will comply with all Federal ambient air quality standards. Gas clean-up and fugitive dust control are the primary mitigating measures to protect air quality.

Water Quality Impacts: Surface and groundwater contamination from sediment runoff and retort process waste water is the major potential water quality impact associated with the facility. Land disturbance during the 18 month construction period is expected to cause 600 to 80,000 tons of sediment loading into the Colorado River, unless controlled. Additional sediment loading could occur during the operation phase, due to permanent topographic changes resulting from construction. This sediment loading is less than six percent of the total loading that occurs naturally from the drainage area in the vicinity of Anvil Points. Moreover, at least half of the loading will be prevented by using conventional runoff control techniques. Retort process waste water will be deposited in the Balzac Gulch retorted shale disposal site, where an impervious dike and lining constructed of compacted spent shale will prevent any significant surface and groundwater contamination. The Balzac Gulch disposal site may be classified as a no discharge system under Environmental Protection Agency approved Colorado discharge regulations, and, therefore, would be exempt from Federal and State water permit requirements under the Clean Water Act. However, if spent oil shale is classified as a hazardous waste, the proposed facility would be subject to permit requirements under the Resource Conservation and Recovery Act. The onsite water requirements (122 acre-ft/yr or 39,753,700 gallons maximum) are much less than the project's present water rights (723 acre-ft/year or 2,287,346,795 gallons). Also, the facility will re-use water to the maximum extent possible.

Land Use Impacts: The proposed project will use a maximum of 64 acres of surface land for the retort and support facilities, the retorted shale disposal site (30 acres in Balzac Gulch), underground conveying systems and access roads. The total underground mine area is expected to be about 53 acres, but it may be as large as 138 acres.

Socioeconomic Impacts: An influx of Paraho workers and their families, ranging from 223 to 1328 people at any one time, could cause a shortage of housing and school facilities in the nearby town of Rifle. These shortages would be mitigated by building new housing and by adding more classroom space to the Rifle and Silt elementary schools, and Rifle Senior High School. Any increased population should not burden other public services.

Ecological Impacts: Constructing and operating the proposed facility will disturb about 64 acres of sparse vegetation. Revegetation measures will be used to the maximum extent practicable, however, uncertainties exist over the success of revegetation efforts. Physical effects, such as land disturbance and noise, will displace some terrestrial wildlife. The site area does not carry any significant aquatic wildlife. The proposed action is not expected to disturb the critical habitat of any endangered or threatened species.

Occupational Health and Safety Impacts: "A commercial oil shale retorting facility using modern industrial hygiene practices will not expose workers to a carcinogenic risks that are not presently acceptable in modern energy industries" (Carcinogenic Testing of Oil Shale Materials, R. Merril Coomes, 12th Oil Shale Symposium Proceedings, Colorado School of Mines, 1979). To date research has indicated "that crude shale oil and shale oil coke have carcinogenic potential equivalent to, or less than, common petroleum refinery products and intermediates, and, that refining shale oil by hydrotreating significantly reduces the carcinogenics potency. In tests where animals have been exposed to massive amounts of raw oil shale and TOSCO #II processed shale by skin contact, ingestion, and inhalation, for their lifetime, 24 hours per day, did not develop cancer or demonstrate any signs of acute or chronic toxicities, (Id.)."

Despite the implementation of mitigating measures, the construction and operation of the proposed facility will have the following unavoidable adverse impacts:

- Approximately 64 acres of land surface, its vegetation and wildlife will be disturbed during the life of the project. Areas impacted would be the plant site and support facilities, the retorted shale disposal site, and the transport areas (access roads and conveying systems). Filling up to 30 acres of Balzac Gulch with spent shale, to a depth of 400 feet will change the topography permanently.
- Atmospheric emissions of particulates, fugitive dust, sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons, may degrade local air quality during construction and operation of the facility.

Less significant unavoidable impacts are elevated noise levels accompanying construction and operation, and increased demands on regional schools and public service facilities.

## 1.2 IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed action will result in a commitment of the following resources:

- 0.92 percent (11 million tons) of the 1.2 billion tons of estimated oil shale reserves on DEI lease tract will be mined and processed, yielding 5.9 million barrels of shale oil. Up to 300,000 barrels of shale oil equivalent will be unrecovered in fines unless plans are made for later use. However, the in-place raw shale to be mined in the proposed project is only a fraction of one percent of the 11.4 billion tons of 25 gallon per ton shale on the Naval Reserves.

- A maximum of 122 acre-ft/year or 39,753,700 gallons of water (183 acre-ft or 59,630,550 gallons over 1.5 years of operation) will be consumed on-site. It is expected that 90 percent of this water will be obtained from the Colorado River. DEI also has a large incentive to re-use process waters for dust control and cooling. The existing NOSR 1 reservoir on the plateau also will be used. All water consumed will be surface water.

## 1.3 ALTERNATIVES

Several programmatic and site alternatives were considered. DOE's programmatic option to the proposed action is:

- disapprove scale-up of the Anvil Points facility, while continuing to allow adequate mining for the semiworks plant operation.

The alternative locations for the retort area:

- in the mine or on the mine bench
- a location near the existing facility
- on top of the mesa near the mine

The alternative locations for the disposal site are:

- in the mine
- near the existing disposal area

For the purposes of this particular action other site alternatives, such as locating the proposed action off the NOSRs on federal or private lands, were not considered due to DEI's lease commitments to the NOSRs.

The preferred alternative involves locating the retort facility on the hog-back, and the spent shale disposal area in the Balzac Gulch. This is the most technically feasible alternative and would present the least potential for adverse envionmental impacts.

# 2. DESCRIPTION OF THE PROPOSED ACTION

## 2.1 OVERVIEW OF THE PROPOSED ACTION

The purpose of this EIS is to evaluate a request from DEI, lessee of the Anvil Points Oil Shale Facility, for approval to mine 11 million tons of oil shale and to consider extension of the lease to the Anvil Points Oil Shale Facility. The proposed action includes the construction and operation of a full-size-module-oil-shale-retort facility (4,700 bbl/day) on the leased premises. In 1972 the Anvil Points Oil Shale Facility was leased to DEI. In 1962 Congress passed legislation that allows leasing "to encourage the use of the facility in research, development, test, evaluation, and demonstration work," (10 U.S.C. 7438 (b)). It was hoped by Congress that "a successful lease would relieve the Government of expenditures for custody and maintenance." (U.S. Code Congressional and Administrative News, p. 315, 1962). The full-size module facility would be developed by Development Engineering, Inc. (DEI), a subsidiary of Paraho Development Corporation, and would use the Paraho direct-mode process technology. Operating the module and its supporting facilities would require mining and crushing the oil shale, transporting the raw shale to the retort, retorting, transporting the shale oil to storage tanks, disposing fines and spent shale, and transporting the crude shale oil from the site. Presently, the existing Anvil Points semiworks and pilot plants are operating independently on a part-time basis; the semiworks plant would supplement the full-size module as necessary.

The proposed action could contribute to a national oil shale development program by demonstrating the reliability, efficiency and feasibility of oil shale retorting on a commercial size retort and obtaining technical information which may aid in developing the oil shale retorting industry. An expanded development program for the Paraho process will provide physical scale-up data, and cost data for evaluating commercial-scale process economics. In addition, the module will provide an opportunity to observe impacts of full-size operations. Environmental data also could be used by the U.S. Environmental Protection Agency (EPA) as background information for setting Clean Air Act, New Source Performance Standards for the oil shale industry. However, the proposed Anvil Points module will be an experimental, not a commercial facility. A commercial oil shale facility would have 10 or more modules the size of the proposed full-size module.

The Anvil Points operation will have three phases: Phase I is an eight-month program to plan the facility; Phase II is an 18-month period to develop the mine, detail the design plans and construct the module; and Phase III is an 18-month module operation period which may be extended, depending on start-up and operating performance.

DEI currently is working on preliminary plans for Phase I. Construction and detailed design will not start until the final EIS is approved. Upon receipt of detailed plans for the shale disposal area, a supplemental EIS will be prepared. Upon approval, DEI expects to maintain its 44-month production schedule; however, Phase III would not be completed before the present lease expires in July 1982.

## 2.2 DESCRIPTION OF THE PARAHO PROCESS AND PROPOSED FACILITIES

### 2.2.1. General Description of the Process

The Paraho direct-mode process incorporates a shale and gas distribution system within a vertical kiln retort. The Paraho semiworks retort is capable of using either internal or external heating to achieve the required retorting temperature; however, the proposed facility will utilize only direct-mode retorting. A description of indirect-mode retorting is found in Section 3.4.3.1.

The direct-mode retort is a refractory-lined vessel consisting of four processing zones: 1) preheating and oil mist formation; 2) retorting; 3) combustion; and 4) cooling (see Figure 3-1). Raw shale, ranging in size from 1.0 to 3.5 inches, is delivered to a feed bin at the top of the vessel, and rotating chutes distribute the shale into the first zone of the retort. At the same time, a grate mechanism removes spent shale from the bottom of the retort to ensure a continuous flow of shale through the vessel.

Air mixed with recycled gas is injected into the cooling zone and rises as it becomes heated by the cooling shale. An air and gas mixture also is introduced at two points in the combustion zone and mixes with the hot, rising recycled gas. The raw shale, descending into the retorting zone, is heated to retorting temperature by the combustion of gases and carbonaceous material of the spent shale in the combustion shale below.

The heat produced in the retort decomposes kerogen, the organic portion of the shale, and an oil mist is formed. This oil mist, together with gas and water vapor, is moved from the top of the retort, to the electrostatic precipitators. In the electrostatic precipitators, the oil mist is separated from the gas stream as a liquid and transferred to storage tanks, where it is kept in a fluid state by steam coils and insulation.

After leaving the electrostatic precipitators, a portion of the off-gas is returned to the retort to cool the retorted shale and distribute heat in the retorting zone. In the module program, the remaining gas will be used, (after ammonia and sulfur are removed), in one of three ways: 1) burned in a gas turbine to provide power for the gas and recycle blowers, and other module power requirements; 2) burned in a boiler to produce steam; or 3) flared in a thermal oxidizer.

Final crude oil product will be owned by the Federal government. Oil will be moved by truck from the facility to two possible locations: a railroad siding (two miles from Anvil Points) or an upgrading station at Grand Junction (60 miles from Anvil Points). It is estimated that during peak production, 40 truck loads of shale oil will leave Anvil Points per day.

### 2.2.2 Facilities and Operations

The Anvil Points Oil Shale Facility, which DEI leases, includes portions of NOSRs 1 and 3. The lease tract is in Garfield County, eight miles southwest of Rifle, Colorado. Existing facilities are situated on 365 acres at Anvil Points. Project facilities will be built on the lease tract near the existing facilities. Access to the site is gained by U.S. Highway 6. Figure 2-1 shows the site in relation to the tri-state region.

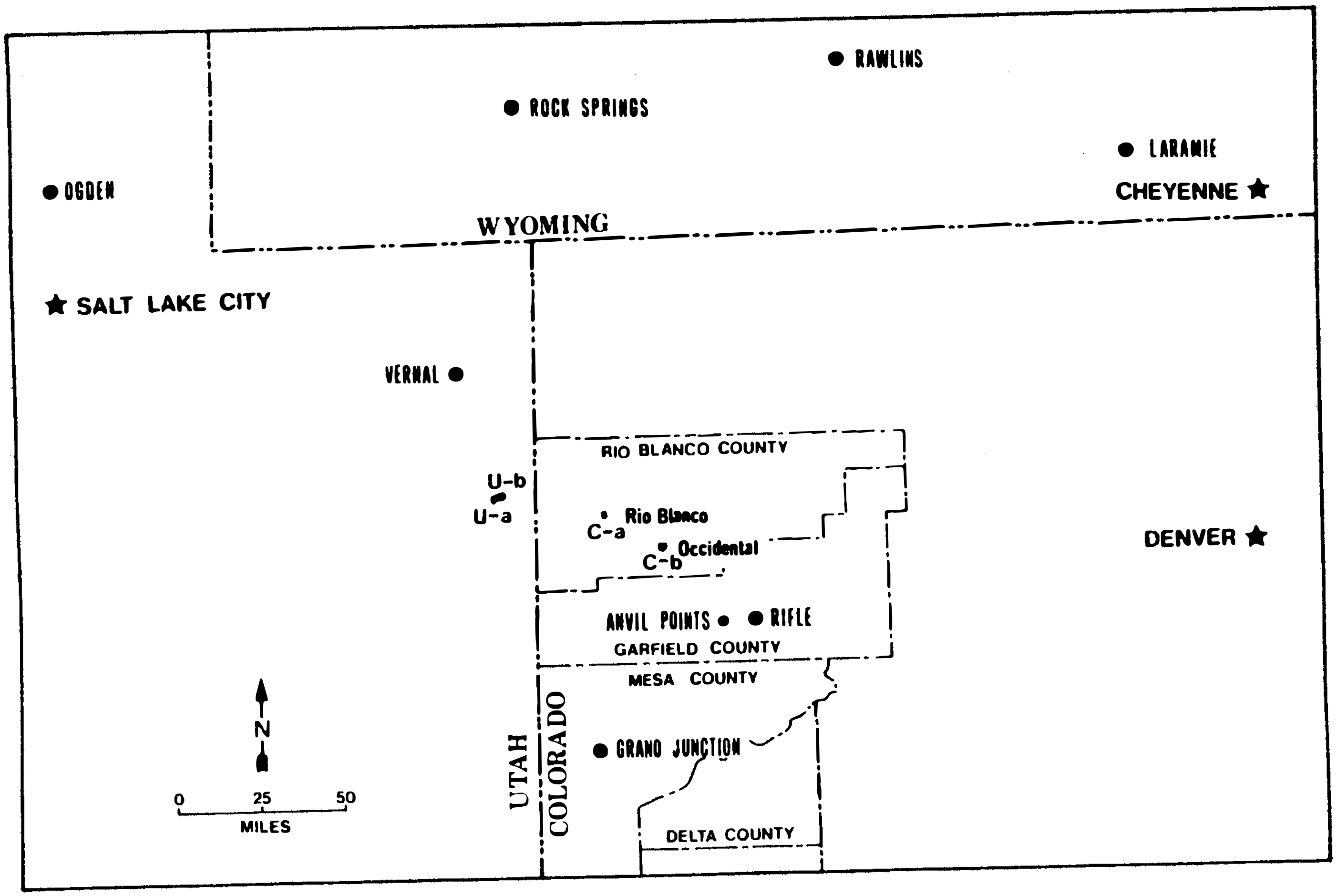
Figure 2-2 is a schematic diagram of the proposed full-size module and support facilities. The current underground mining activities will be extended eastward to produce the proposed amounts of oil shale. Between 4,500 and 8,400 tons/day of raw shale will be mined. Primary shale crushing occurs in the mine; shale is then conveyed to secondary crushing and screening areas located near the retort. Crushing and screening produces a 1.0 to 3.5 inch sized feed. Fines from the crushing and screening plant are transported to an area designated for raw shale near the proposed facility. The retort is expected to process 4,320 to 7,560 tons/day of crushed shale yielding 2,440 to 4,280 bbl/day* of unrefined shale oil and 31 to 45 x $10^6$ SCF/day of approximately 100 Btu/SCF gas (DEI, 1978). The oil is piped to existing storage tanks to be transported off-site for upgrading. Product gas is either recycled for use in the retort, used for generating electricity and/or steam, or flared in the thermal oxidizer unit. The Btu value of the gas will determine its use.

#### 2.2.2.1 Mining

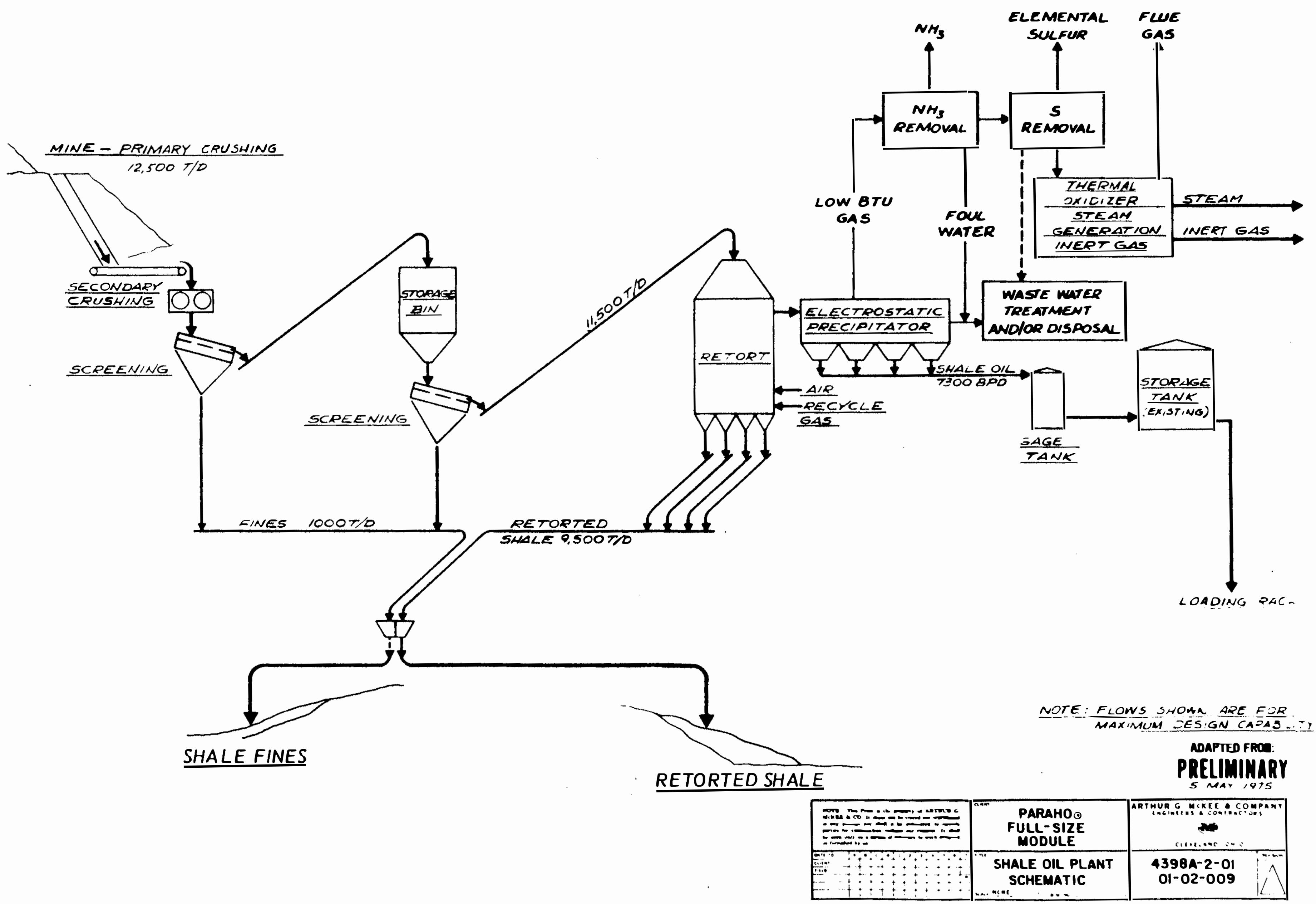
An eastern extension of the present mining activity in the Mahogany Zone is planned to produce the retort feed required to meet design capacity. The underground mining area will be around 53 acres, but may be as large as 138 acres. Ore will be stockpiled in the mine during low retort periods and will

* The figures on daily shale oil production were derived from daily shale throughput estimates, assuming 25 gal shale oil/ton of shale and a 95 percent Fischer Assay. On a foot-by-foot basis, the proposed mined horizon varies from 10 gallons per ton (GPT) to nearly 80 GPT. A blended sample should range from 24 to 30 GPT. Therefore, 25 GPT will be the standard measure for purposes of this document.

**FIGURE 2–1**
**REGIONAL MAP**



# FIGURE 2-2
# SHALE OIL PLANT SCHEMATIC



be used as needed. A conventional room-and-pillar mining system will be utilized with a 40 ft upper level and a 30 ft lower bench.

Room-and-pillar mining includes the following steps:

- Drill, load, and blast the upper level
- Bar down dangerous overhead rock
- Muck the blasted oil shale
- Scale remaining loosened shale from overhead and sides of ribs and pillars
- Install roof bolts
- Install lighting system and water system for drilling and dust control

Upper levels will be drilled with a drill jumbo which is capable of drilling 4.5 inch holes 30 feet deep. Bench drilling will use a vertical drill capable of drilling 4.5 inch holes 30 feet deep in a single path.

The blasting agent, primarily an ammonium nitrate and fuel oil mixture, will be placed in the holes pneumatically. The blasted shale will be loaded into dump trucks by front-end loaders and transported to the primary crusher in the mine. Roof bolts will be installed using an aerial platform machine. The normal pattern will be six and eight foot bolts on five foot centers. A tooth-type mechanical scaler will remove loose rock from the roof and ribs.

A ventilation system similar to that used in coal mines will be installed. An exhaust system will eliminate the need for large air doors. Water for dust control will come from an existing pond above the cliffs, supplemented by water from the Colorado River and recycled process waste water.

2.2.2.2 Primary Crushing and Ore Handling

The primary crusher will be located in the mine. Shale less than 12 inches in size, will be produced by a single- or double-toothed roll crusher. A 30,000 ton crushed shale surge pile will be maintained in the mine. After crushing, the shale will be fed into an ore pass which will deliver the shale to a conveyor adit at approximately the retort elevation. A conveyor belt will deliver the shale to the secondary crusher.

2.2.2.3 Secondary Crushing and Screening

The secondary crushing and screening area includes three stations: a secondary crushing station, a primary screening station, and a secondary screening station. The shale will be crushed and screened to the required size (from 1.0 to 3.5 in. maximum) for optimum results in the oil separation process.

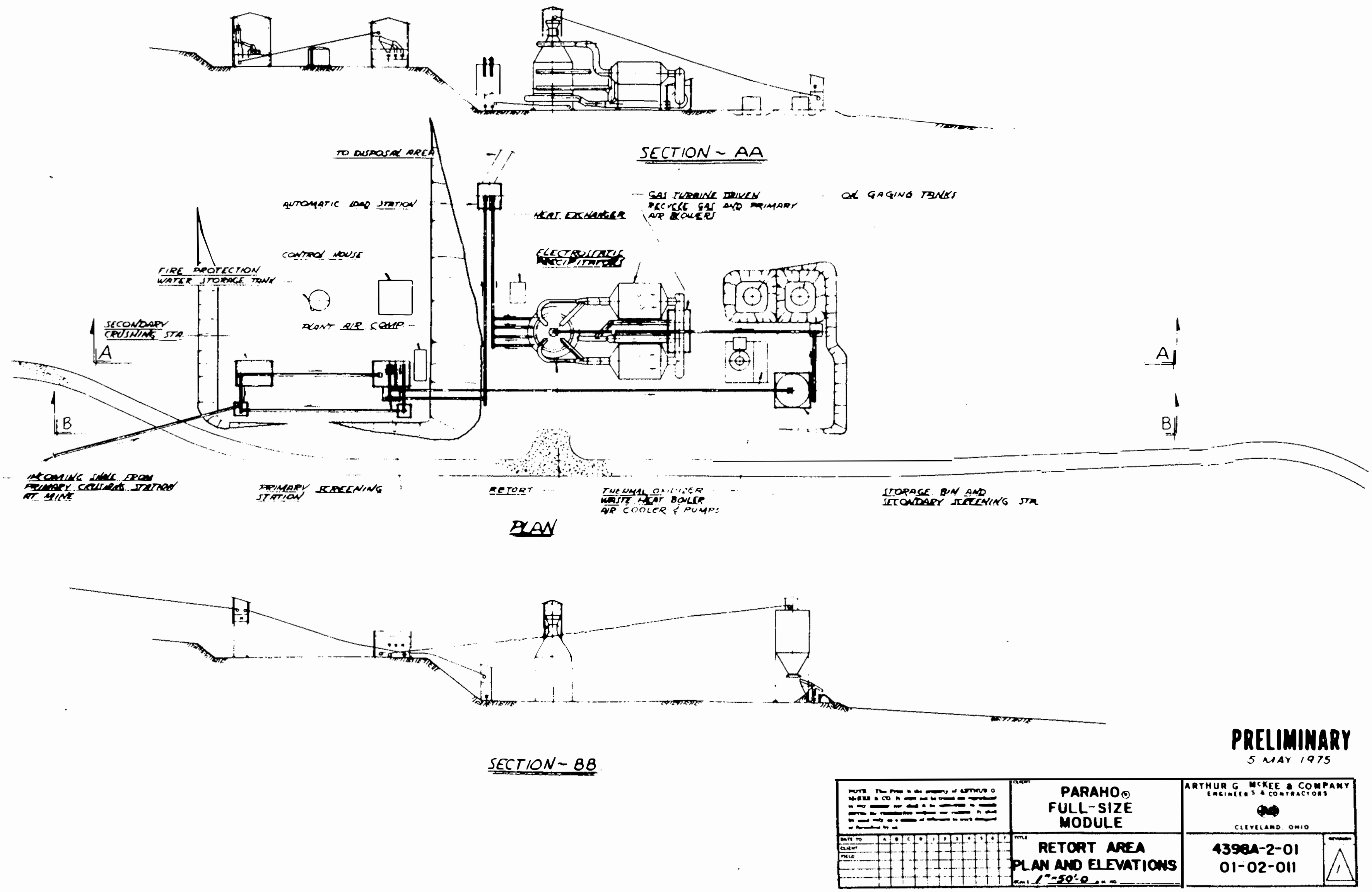
Dust collection hoods will be provided at the crushing station and all screening stations. Hoods also will be installed at all conveyor loading and discharge points and at the receiving bin of the retort. These hoods are connected to an induced draft baghouse which will clean the air and discharge it to the atmosphere. Baghouses will be equipped to handle loads of 12,500 tons of shale per day.

2.2.2.4 Retorting

A preliminary plot plan for the retort area is shown in Figure 2-3. The plan provides for a possible carbon dioxide removal system which would increase the heating value of the product gas. The proposed retort will be on top of the

## FIGURE 2–3

## RETORT AREA PLAN AND ELEVATION



hogback just south of the weather station along the existing mine road at an elevation of about 7,000 feet. The retort will be on a cleared and leveled site so that all solid materials can be fed to and taken away from the retort with a conventional conveying system. Conveyor distances and changes in elevation will be minimized by terracing the individual operating areas and taking advantage of the hogback terrain.

The retort vessel is a full-size module approximately 100 feet in overall height with a 42 foot outside diameter. A steel shell encloses a refractory lining for the entire charge depth of the vessel. The feed bin distributes shale through a number of chutes which uniformly spread the shale across the charging area. To seal the bin, an inert gas is introduced through a rotary seal near the bin and piped into the feed chutes just above the discharge level, at a pressure slightly higher than the retort gases. The inert gas seeks exit upward through the shale loading chutes and creates a pressure difference which effectively prevents the escape of combustive retort gases.

The upper and the middle gas distribution systems, located in the combustion zone, are similar. Each system consists of two manifolds serving a number of water cooled gas entry distributors.

Hydraulically operated reciprocating grate bars remove the retorted shale from the bed through a battery of rotary seals. Rubber belt conveyors collect the retorted shale discharge from the rotary valves. Dust collector systems will be provided for both the entry and discharge ends of the retort.

Major items of equipment required to complete the retort installation are the recycle gas blower, air blower, inert gas compressor, and the electrostatic precipitators (ESP's). The largest driver for the complex will be a gas turbine for air and recycle gas blower; all other prime movers will be electric motors.

The recycle gas blower has a capacity of 196,000 SCFM, and the air blower has design specifications of 41,000 SCFM of air delivered. The inert gas compressor will supply sealing gas for both shale feed and retorted shale withdrawal. The design capacity of this compressor is 6,200 SCFM.

The Paraho retort vessel will produce oil as a suspended mist in a gas stream. After retorting, the oil mist and gas will be channeled to ESP's for separation. The oil collected from the precipitators will be pumped through heated and insulated lines to one of two 4,000 barrel gauge tanks. All tanks will be insulated, and steam coils will keep the crude shale oil in a fluid state.

#### 2.2.2.5 Disposal of Fines and Spent Shale

Retorted shale will be discharged from the bottom of the retort to cross conveyors, moved to a belt conveyor, and transported to a holding bin. Discharge temperature of the retorted shale is estimated to be about 200°F; water will be used to cool the shale before it reaches the disposal area. The direct-mode process will combust carbonaceous materials in the oil shale, thus minimizing the release of volatile organic compounds from spent shale. A dust collection system will be provided at the discharge points. Retorted shale will be trucked to the disposal area where a truck or scraper will compact the retorted shale into a stable, impervious, and erosion-resistant land mass. The proposed spent shale disposal site, the Balzac Gulch, is a dry canyon immediately west of the proposed retort site. The disposal area will be less than 30 acres, assuming 11 million tons of shale are retorted and the pile is 400 feet deep.

A retention dam of compacted spent shale will be constructed downgradient of the disposal pile to prevent any runoff or leachate from reaching surface waters. Design of the retention dam and imprevious liner were based on tests on the physical and chemical properties of Paraho processed oil shale. Test results indicated that the processed shale can be compacted to a density of 110 lb/cu ft., representing 100 percent compaction based on the ASTM* D-1557 modified compaction test.** This compaction level produced a relatively impervious material having an infiltration rate of one foot or less per year. In addition, the material exhibited compressive strenghs of up to 200 lb/sq in. Adding lime or cement (3% by weight) increased the compressive strength to as high as 300 lb/sq in (Paraho, 1975). These findings form the basis of DEI's plans to use processed oil shale for construction of containment structures.

Detail plans for the design of the retention dam will be made during Phase II of the proposed action. It is expected that the design work will be in consort with planned additional field studies concerning the structural uses

* American Standard Testing Methods.

** This level of compaction was obtained by placing the spent shale in eight inch loose layers and compacting with seven passes of a Ray Go 400-A smooth-drum vibratory roller.

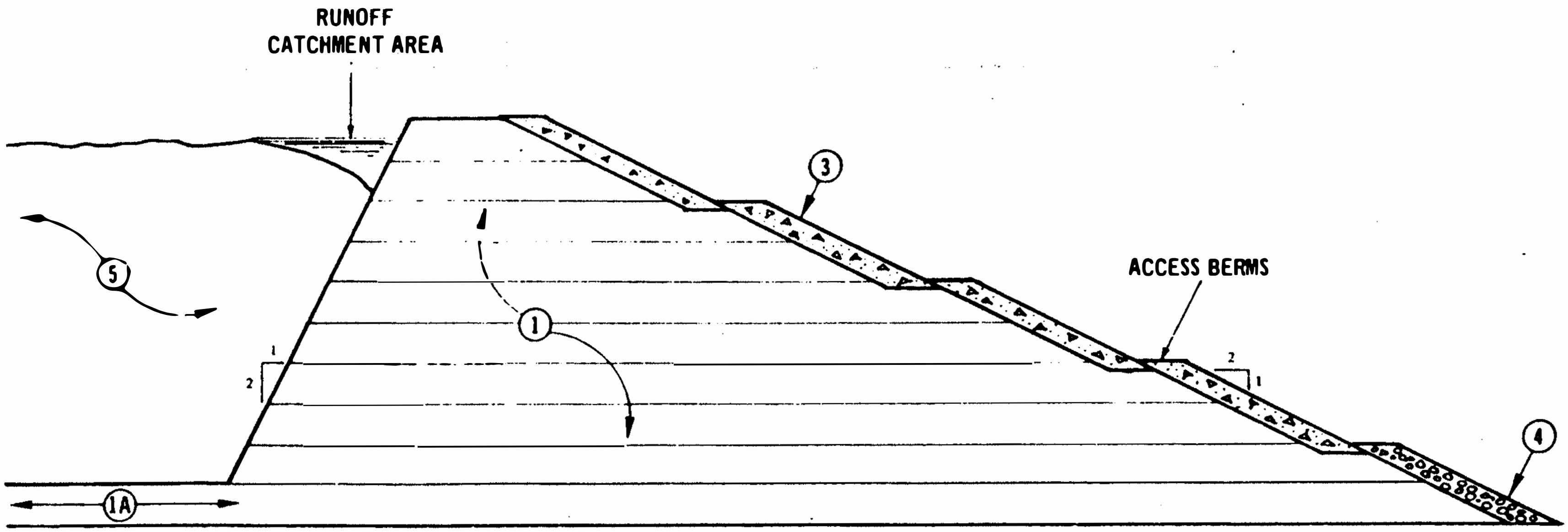
of processed oil shale (Madsen, 1979). Design plans for the retention dam are shown in Figure 2-4 and a schematic drawing of a cross-valley fill is shown in Figure 5-2 (p5-35). The structure shown is a homogenous processed shale fill dam. A compacted core dam structure with a relatively less compacted filler, and an impervious processed shale exterior also are being considered.

As can be seen from Figure 2-4, the face slopes are expected to be two feet in rise for each foot in horizontal distance (run) on the face being backfilled with processed shale, and one foot in rise for every two feet in run on the downstream face. Overall height and volume of material will be determined during the detailed design phase. The initial deposition for the site will be to establish a dike in the Gulch at an approximate elevation of 6,200 feet; approximately 2,500 feet N26°W of the SW corner of Section 18, R94W, T6S.

The retention dam will not impound large quantities of surface water. Surface runoff in Balzac Gulch is low, and water flows only for short periods of time after summer showers (Jones, 1979). Diversion canals are planned to collect and route surface runoff around the disposal site, thereby preventing contact with the spent shale and subsequent contamination. Whenever possible, this water will be used for revegetation efforts and dust control. The diversion canals will serve mainly as emergency bypasses in the event of a severe rainstorm. Since they will carry only uncontaminated water, it will not be necessary for diversion canals to meet the rigorous standards that would be required if they were carrying contaminated runoff. Construction specifications will be determined during the detailed design phase.

## FIGURE 2-4

## PROPOSED RETENTION DAM DESIGN




A. HOMOGENIOUS DAM--RETORTED SHALE MOISTENED AND COMPACTED

MATERIALS: 1 & 1A. Highly Compacted and Moistened Dam and Lining

3. Highly Compacted Cement Treated Retorted Shale
4. Cobbles and Rock from Strippings
5. Retorted Shale Deposit, Placed in Layers, Traffic Compaction

SOURCE: Sohio Natural Resources Company

A culvert installed beneath the disposal pile will channel any run-off under the disposal area. To comply with the lease, the culvert will serve as a catch-basin to trap runoff or leachate which could cause downstream contamination. However, due to the impervious nature of the disposal area liner, the culvert is not expected to carry significant amounts of contaminated water. The culvert discharge area will be determined in the detailed design phase. An access road must be constructed on the west side of the ridge from the retort to the disposal site.

Plans for vegetating the spent shale disposal pile are not finalized. The results of small scale field studies indicate that vegetation can be established successfully on spent shale using methods discussed in Section 4.4.1. Plans for the amount of topsoil cover, species of vegetation, amount of filler and amount of liner will be finalized during the design phase.

Spent shale fines rejected from retort screening areas will constitute 5% of the total shale crushed. Based on an 11 million ton throughput, 550,000 tons of fines will be produced.

The fines can be used on roads and in the mine. It is customary to use the fines to level and smooth the mine floor in order to protect tires. However, this use cannot accommodate 550,000 tons of fines.

Other uses for raw shale fines include resurfacing and repairing the roads in the plant and to the mine; topping material over a properly prepared retorted shale pile to improve appearance and to promote vegetation; and possible use as a capillary action breaker below the surface of a retorted shale pile. The final option has not been given detailed study. All of the above options will be evaluated during Phase I of the Anvil Points module program.

The fines can be permanently disposed of so that they cannot be retrieved for future use. This would require identification of a distinct area where the fines could be stored, protected from the wind and water erosion, and piled in a way that would prevent spontaneous combustion. Since detailed engineering is necessary to match the raw shale fines' characteristics with the terrain and other parameters which promote spontaneous combustion, a specific area cannot be identified at this time for storage of the fines. However, it may be possible to construct a dam and storage area in the canyon to the north of the proposed disposal area in Balzac Gulch.

Potential alternatives to handling raw shale fines and spent shale have been presented. However, a final choice cannot be made until detail engineering of the disposal area takes place. Because of this situation, DOE will publish a supplement to this EIS when more detailed design information is available. The supplement will identify alternatives and include a discussion of their relative environmental impacts. If the lease is extended to DEI or if new leasing takes place, mining and construction of a module will not be allowed until the supplemental EIS is approved and the lease is modified to require construction and monitoring in accordance with the EIS.

#### 2.2.2.6 Utilities

Utilities needed for construction and operation of the module include water, electricity, steam, process air, and sewage facilities. These needs will be satisfied in the following ways:

- Water will be supplied by the Colorado River through the existing water treatment system. A booster pump will provide water at the module plant site for fire protection, sanitation, boiler feed water, dust control, cooling, and other uses. Recycled process water will require minimal use of utilities.

- Electrical power will be supplied to the retort site through a new Public Service line near the highway. The existing power line to the mine can be upgraded to supply the increased mine power requirements.

- The steam required for utility and heating needs will be provided by a boiler associated with the product gas combustion. Auxiliary fuel will be used when the retort is not operating.

- Process air for the crusher and retort is required for cleaning dust collector bag filters, instrumentation, and pneumatic tools. Process air will be obtained in a manner appropriate to each use.

- Sewage from the crusher and retort areas will be disposed in four to five packaged disposal plants purchased by DEI. Process waste sludges and sludges from sewage treatment will be roughly 140 lbs/day, or 0.001 percent of the total solids handled. These sludges will be disposed within the retorted shale disposal area in specially prepared locations.

- Existing utilities will be refurbished and used as much as possible.

## 2.3 SCHEDULE

Construction startup is subject to approval of the action proposed in this Environmental Impact Statement and all required permits. (See Apendix C). The project will have three phases, requiring 44 months for completion, with a possible extension beyond this time to continue operation.

Currently, DEI is engaged in the preliminary work of Phase I. Thus, when project development begins, parts of Phase I necessary for acquisition of permits will be completed. A brief summary of the three phases is presented below:

Phase I: Engineering and Planning

- Eight months in duration

- Will entail selecting a site, developing cost estimates, developing alternatives for product dispositions, and collected and evaluating environmental data.

Phase II: Detailed Design, Procurement and Construction of Module and Support Facilities

- 18 months in duration

- Will require expansion of mining area and associated facilities; design, procurement, and construction of retort and supporting facilities; and refurbishing the existing facilities to be used for the proposed project.

Phase III: Startup and Operation of Module

- 18 months in duration, with extension likely, based on need for more development

- Will include plant startup and investigation of economic, technical, and environmental parameters, and demonstration of operability

- First six months will be required to attain sustained operating capacities. Remaining 12 months will involve testing at maximum possible capacities over sustained periods.

# REFERENCES

## SECTION 2


Development Engineering, Inc. September 1978. "Air Emission Source Construction and Operating Permit Applications." Submitted to EPA and Colorado Department of Health.

Jones, J. B. President, Development Engineering, Inc. Personal communication on March 28, 1979.

Madsen, Rees C. Sohio Natural Resources Company. Personal communication on March 21, 1979.

Paraho Development Corporation. December 1, 1975. "Retorted Shale Management - Parahoe Oil Shale Demonstration". Volume 6. Final report. Prepared by Woodward Clyde Consultant.

# 3. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

The proposed action, the mining of 11 million tons of oil shale from a 365 acre lease tract at Anvil Points, Colorado, will result in the construction of a full-size module retort facility, auxiliary transport areas, and a disposal site for the retorted shale. The proposal to locate the retort on a hogback near the existing mine was made after considering various technical, economic and environmental issues. The proposal to dispose of the retorted shale in the Balzac Gulch also was made after consideration of similar issues. A discussion of possible alternative sites for retort and disposal site locations is included in this section. In addition, methods of retorting (indirect- or direct-mode) also are discussed. Although other technologies are available for retorting oil shale (e.g. Tosco II), DEI is committed by both their lease and economic considerations to implementing processes developed by their company.

While general information regarding environmental impacts and characteristics of these alternatives can be discussed, it is important to remember that design specifications, base line data and monitoring have not been developed for alternative sites.

DOE's alternatives to approving the proposed action also are discussed. Programmatic alternatives could result in DEI either using oil shale from their lease tract, or obtaining oil shale off-site, should DOE not approve the proposed action. The possibility of locating the proposed action off the NOSR lease tract is not a practical alternative, due to considerations in DEI's lease and the limited availability of off-site lands.

## 3.1 OVERVIEW OF THE PROPOSED ACTION

DEI has been conducting oil shale retorting since 1972, when they leased what was formerly a Bureau of Mines pilot retort facility at Anvil Points, Colorado. In 1974, after conducting research on a pilot plant retort and a semi-works reactor, DEI released plans for construction of a full-size module retort. The full-size module, for which the mining of eleven million tons of shale would be used, will test economic, environmental, and process parameters.

The proposed action would result in the following:

- The present mine would be extended eastward, using current underground room-and-pillar mining technique. A new mine opening would be required, as would a new ventilation adit, crushing area, and expansion of the portal bench.
- Construction of a conveyor and raise to move oil shale from the mine to the proposed retort site on the hogback
- Retort and auxiliary facility construction on the hogback
- Construction of an oil pipeline from the retort to the existing storage tank area
- Extension of an access road from the bottom of the hogback to the disposal site in Balzac Gulch
- Preparation of the Balzac Gulch retort shale disposal site and a storage and/or disposal site for fines.

## 3.2 DESCRIPTION OF TECHNOLOGY

The Paraho direct-mode retort uses an air and gas mixture to combust feed sized oil shale in a four zoned retort (see Figure 3-1). Combusted shale is pyrolyzed into an oil mist which is transferred to electrostatic precipitators for oil/gas separation. Shale oil is then transferred to two 4,000 barrel gauging tanks, and finally, by way of a pipeline, to storage tanks at the existing tank farm. Gas from the ESP will be cleaned of $NH_3$ and $H_2S$, A portion of the gas will be recycled for use in the retort, and for power requirements. Remaining gases will be burned in a boiler to produce steam, or flared in a thermal oxidizer.

Retorted shale will be trucked one quarter mile to the Balzac Gulch disposal area where it will be compacted, and used to line the disposal site and to construct the retention dam. A stream diversion dam will be located above the retention dam. This area will be filled with loose spent shale and covered with vegetation when the project is completed.

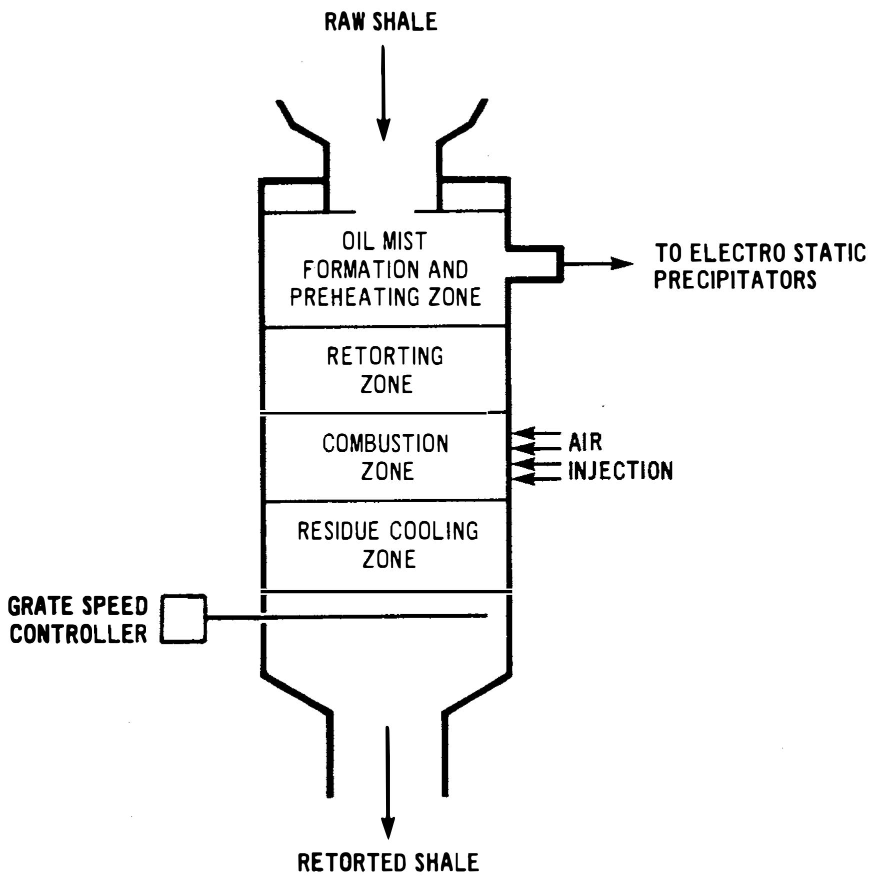
## 3.3 DISCUSSION OF THE PROPOSED ACTION

This section will include an overview of the major impacts of the proposed action as well as a description of the existing environment of the proposed action and alternatives. A detailed discussion of the existing environment is found in section 4; environmental impacts are detailed in section 5.

### 3.3.1 Air Quality

The major pollutants associated with the proposed action will be fugitive dust and particulates (during mine, facility, and road construction, and mine and transport operations), particulates (from facility operation), and $NO_x$ and $SO_2$ emissions associated with the combustion of shale. Modeling results and projections made from semiworks and pilot operations show the facility to be within limits of Federal Ambient Air Quality Standards (NAAQS) (see section 5.2.2).

**FIGURE 3-1**
**SCHEMATIC OF DIRECT-MODE RETORT**



Major mitigating measures to reduce fugitive dust emissions will include baghouse covers on transfer points, coverings on all conveyors, and road wetting. In addition, wet spraying techniques will be used on all roads and in the shale disposal area. Particulates from facility stack emissions will be subject to Federal emissions standards and will be reduced 50% by ESP's and $NO_x$ and $SO_2$ controls. $NO_x$ will be controlled by 90% with an ammonia water wash system; $SO_2$ will be controlled by a Stretford removal system with a 99% reduction efficiency (see section 5.2.1.3).

### 3.3.2 Water Quality and Use

As much as 122 acre feet per year or 39,753,700 gallons of water per year will be required for operation of the proposed retort facility, mine, and disposal site. This water will be surface water supplied by the Colorado River and supplemented by the Glover Park Reservoir, as needed. In addition, water supplies in the area will provide DEI with an incentive to re-use process water to the maximum extent possible.

The retorted shale disposal site will use a significant amount of the total water supply (approximately 16.9 mgy). Also, significant will be the use of onsite water for sanitation and other requirements of plant employees. Secondary off-site water use associated with increased growth in the area will be approximately 300 afy or 97,755,000 mgy. Retort sanitation water will be treated in one of four or five packaged disposal plants DEI is planning to install. In addition, increased offsite water will be handled by Rifle's new sewage and water treatment facilities (to be operational in late 1980).

The Paraho facility will operate as a no-discharge system, consequently water used to cool the spent shale in the Balzac Gulch will be retained in runoff ponds or captured in a culvert and drainage basin in the bottom of the pile and re-used or evaporated rather than returning to the Colorado River. DEI will re-use process waste water to the greatest extent possible.

Sediment loading into the Colorado river could reach 600 to 80,000 tons during the 18 month construction period. This will be mitigated substantially (50%) by using conventional runoff control techniques.

### 3.3.3 Solid Waste

The major solid waste problem associated with the proposed action will be the disposal of 4 million tons of spent shale into the Balzac Gulch. In addition, fines from the screening areas will be set aside in a special area and either used or disposed according to State and Federal regulations. Estimated production of fines from the modular project will be 200,000 tons. (See p.2-16).

Sewage from the crusher and the retort facility will be disposed of in a packaged disposal plant. Process waste sludges and sewage treatment sludges will amount to approximately 140 lbs/day, or about 0.001 percent of the total solid waste generated. These sludges will be disposed of in a location within the spent shale disposal area. This area will be designed to meet State standards, as well as any new standards which may be required under RCRA.

### 3.3.4 Land Use

The proposed action will require approximately 64 acres of land surface. In addition, mine expansion will commit between 53 and 138 acres underground. This area is primarily rural and the most significant land use change, other than facility construction, will be the influx of new workers creating the need for new housing, schools and services.

The major land use impact of the proposed action will be the change in topography caused by construction of a spent shale disposal site on 30 acres in the Blazac Gulch. This will be mitigated by revegetating the disposal area after the project is completed. However, the success and long term effects of revegetation on spent shale is uncertain.

Other land use requirements include product pipeline and conveyor areas, road expansion, retorting plant requirements and mine expansion requirements (a new mine portal bench to provide access and ventilation). Following termination of the project, DEI will restore all impacted project areas to levels determined necessary by State reclamation officials.

### 3.3.5 Ecology

Ecological disturbances can be classified as vegetation impacts and wildlife impacts. Conversations with the State and Federal wildlife services have pointed out that, although the Bald Eagle and Peregrine Falcon have been seen in the area, Anvil Points is not a critical habitat to any State or Federal Endangered Species. However, this would have to be confirmed by a site study.

There also is no significant aquatic life in either the Anvil Points facility area or any areas draining into the proposed site location. The gentler and moister climate on top of the mesa near the existing mine has been termed an "excellent" grouse habitat by the State Division of Wildlife. (See p.4-25 and 4-26).

The most significant vegetation disturbance will be the filling of 30 acres in the Balzac Gulch disposal site. However, this area is relatively dry and sparsely vegetated, thereby reducing the impacts. After the project is completed, Balzac Gulch will be revegetated as will all facility areas. Disturbance from oil pipeline and conveyor construction will be mitigated by re-seeding as soon as possible.

### 3.3.6 Socioeconomics

Construction of the retort facility, expansion of the mine, and development of the Balzac Gulch disposal site will create a need for an estimated 450 workers. About 300 workers will be needed during the operation phase. Depending on the amount of labor needed for other oil shale projects in the area, this could mean an additional 333-1328 people entering the Rifle area during the construction phase, and 223-885 people during the operation phase.

This influx will have mixed effects on the town of Rifle and its surrounding areas. The current vacancy rate for housing in Rifle is around 5%, which cannot absorb a projected 10-59% population increase. Additionally, there will be an impact on the school system in the Rifle/Silt/New Castle school district, parts of which are overcrowded already. This problem could be mitigated somewhat by using Oil Shale Trust Fund grants to build additional classrooms, by relying on mobile classrooms, and by busing children to nearby schools.

A 10-59% population increase also will burden sewage and water treatment facilities. New treatment plants for the town of Rifle, which are scheduled to be operational by late 1980 will accommodate the increase. Clagett Memorial Hospital is not expected to experience a strain from worker influx, however, outpatient and laboratory facilities may need to be expanded. Police and fire-fighting forces will handle additional population increases adequately; however, expansion of the existing jail facilities may be needed.

### 3.3.7 Occupational Health and Safety

The major health problem associated with processing oil shale is the presence of polycyclic aromatic hydrocarbon (PAH) compounds. One PAH compound, benzo(a)-pyrene, is a known carcinogen and found in oil shale at levels of around 3 ppm. This level is not significantly higher than levels found in crude petroleum oil. Additional carcinogenic and mutagenic compuonds have been tentatively identified with shale oils. Spent shale contains considerably lower levels of carcinogens.

Paraho workers may be exposed to PAH compounds through inhalation and dermal contact. Dermal contact can be mitigated by a high degree of automation, and proper worksuits. In addition, inhalation dangers can be offset by the proper use of respirators.

## 3.4 DISCUSSION OF ALTERNATIVES TO THE PROPOSED ACTION

### 3.4.1 Programmatic Alternatives

This section will address DOE's alternatives to approving the mining of 11 million tons of oil shale from the existing mine and the construction of the retort.

#### 3.4.1.1 No Action Alternative

A DOE option relating to the proposed action is to deny approval for the 11 million ton mining scale-up. Environmental impacts associated with the present operations would continue, but potential impacts of the proposed action would be eliminated. Delay also would cause the loss of valuable environmental and technical data relating to the development of oil shale as alternative sources of energy.

Socioeconomic impacts associated with the population increases of new workers would be eliminated, but 17 jobs from the semiworks operation would remain.

### 3.4.2 Site Alternatives

Two major developments of the proposed action are construction of a retort facility and development of a spent shale disposal area.

Alternative on-site retort facility locations considered were: top of the mesa; in the mine or mine bench, and near the existing facility. Figure 3-2 shows the approximate locations of these sites. Disposal alternatives include: in the mine, and on or near the existing disposal site.

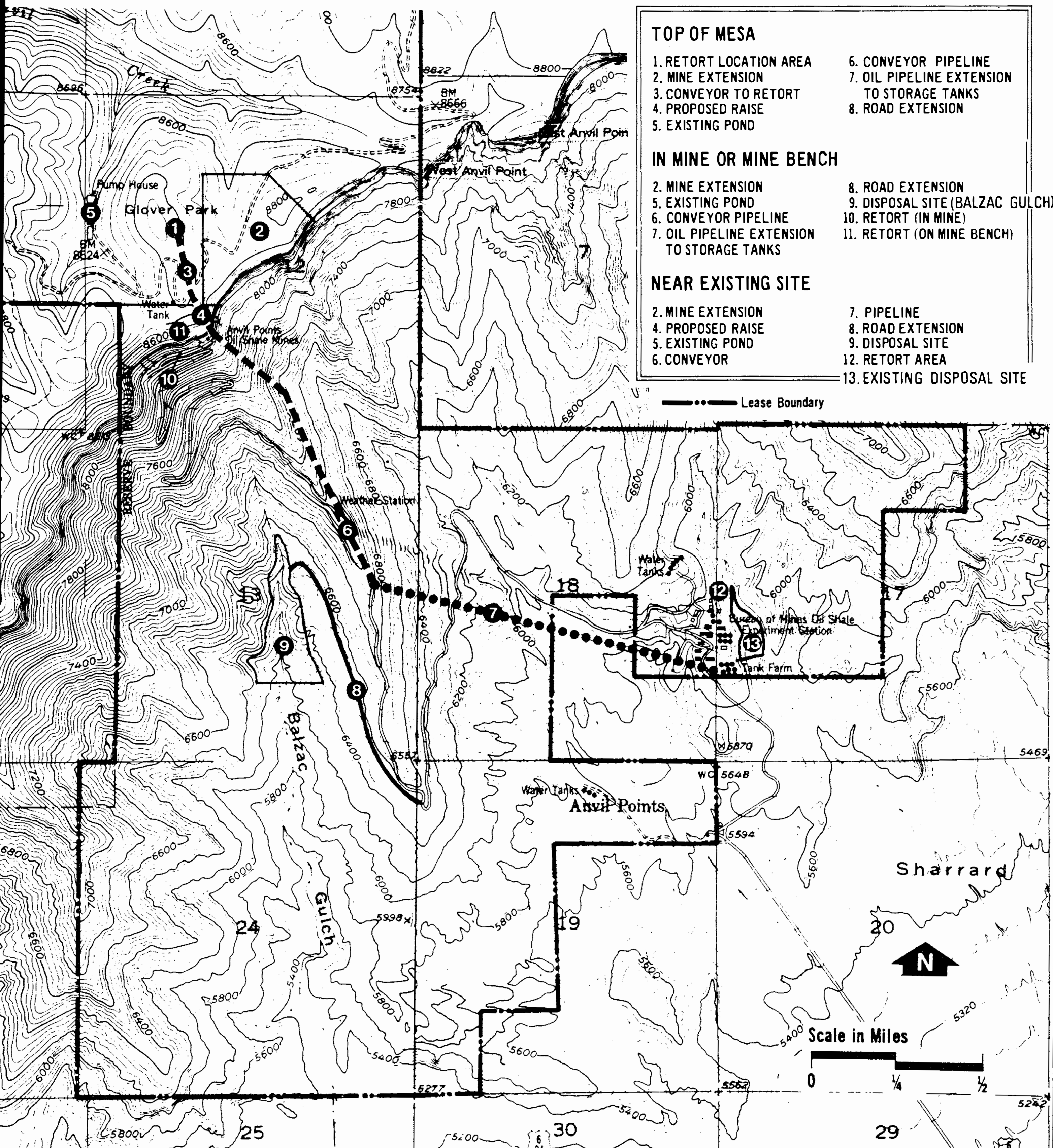
### 3.4.2.1 Top of the Mesa

The top of the mesa is a large, relatively flat area, possibly suitable for a retort site. Although a specific location on the mesa was not pinpointed, the area was considered primarily because of its proximity to the mine. This location would reduce shale transportation costs and allow the possibility of locating the disposal area in a canyon near the retort. The availability of adequate roads on the mesa and the proximity to the Glover Park Reservoir, also would reduce transportation costs.

The main disadvantage of locating the retort on the top of the mesa would be increased environmental disturbance. Due to an increased amount of rainfall, the top of the mesa has considerably greater vegetation and wildlife (both variety and numbers). The weather patterns also present less favorable retort operating conditions.

Advantages of locating the disposal site in the canyon on the mesa may be reduced by the increased possibility of shale leaching and vegetation disturbance. Atmospheric conditions pose both difficulties and advantages. The relatively flat, open terrain would greatly aid in dispersing retort emissions. This may be offset somewhat by the fact that the retort is not the only source of air pollution. The higher elevation also would pose difficulties in adapting atmospheric pressure to the levels necessary for commercial production.

# FIGURE 3–2
# SITE ALTERNATIVES CONSIDERED



Contruction time poses another disadvantage in this site location. A tunnel around the mine extension to provide access for vehicles and personnel from the administration area to the top of the mesa would require 1½ years for construction. The alternative to the tunnel would be to drive over 30 miles through Rifle, Colorado. In addition, a new shaft would be required for lifting shale to the surface. Existing utilities would need extensive refurbishing.

An oil pipeline would be required if the existing storage area is used for shale oil. A direct-line pipeline would cause greater environmental and technical problems, because of rock slides which occur frequently on the steep slopes at the top of the mesa. Proposed road extensions to Balzac Gulch and conveyor lines to the retort would not be necessary if the facility is built on top of the mesa.

#### 3.4.2.2 In Mine or on Mine Bench

Building a facility in the mine would require additional controls and studies relating to the subsidence, transportation and process technology problems potentially involved. A major potential occupational health and safety risk could evolve from carrying out combustion within a combustive environment. Additionally, there would be a problem with space requriements; room size, roof supports, and storage areas must be increased. An extra ventilation system would be required, as well as additional controls for the uncertain health effects caused by increased pollutant levels resulting from lowered dispersion potential. There must also be a fail proof means of escape from the mine in case of fire. Finally, locating the retort facility in the mine would eliminate the possibility of using the mine as a disposal site.

Locating the facility in the mine bench would require excavating part of the cliff face to enlarge the mine bench. Both locations (in mine and on bench) would require substantial improvements and expansion of existing and proposed roads. Expansion of the existing mine switch-back road would cause considerable disturbance to area vegetation and wildlife. A retort in the mine site also would be less adaptable to existing utilities and the back up use of existing plant facilitites.

Advantages over the proposed action would be a decreased need for raw shale transportation, minimal surface disturbance from construction of the facility itself, and a controlled atmosphere for retorting (pressures and elevations similar to those needed for commercial facilitites).

#### 3.4.2.3 Near the Existing Site

The present semiworks and pilot retorts are located at the Bureau of Mines Oil Shale Experiment Station, (See Figure 3-2) close to Anvil Points. Because the area is developed already, building the new retort near the existing semiworks facility would involve the shortest construction time, and would facilitate back-up use of existing facilities, utilities, and disposal site. Product disposition would be facilitated since a new oil pipeline would not be required. However, substantial road construction would be required to carry shale greater distances from the mine. Additional road construction also would be required if spent shale were to be disposed of in Balzac Gulch. Fugitive dust, vehicle emissions, and erosion potential would increase as a result of transporting greater loads longer distances. There also is the possibility of greater air pollutant levels, since emission dispersion is reduced by the lower elevations.

3.4.2.4 Disposal Site Alternatives

Alternative spent shale disposal sites to Balzac Gulch are 1) the existing disposal area in the canyon to the east of the existing retorting area and 2) in the mine. A disposal site in the canyon on top of the mesa could be considered if the retort is located on top of the mesa (see figure 3-2).

The existing disposal area does not have the capacity to hold 11 million tons of spent shale. If a dam were to be built at the bottom end of the existing spent-shale disposal area, its top would have to be at the 5,800 ft elevation to avoid covering the existing plant (the plant would be on the edge of the dam). If a dam were to be built with its top at the 5,800 ft elevation, approximately 400,000 to 800,000 additional tons of spent shale could be added to the existing area.

However, a dam could be placed upstream (north) from the existing spent shale disposal area with the top of the 6,100 ft or 6,150 ft elevation. This may allow for disposal of spent shale in the same canyon as the existing facility.

However, use of the existing shale disposal area, or the area further up the canyon, would require transport of spent shale in trucks over 2-1/2 miles of winding road. Fugitive emissions, fuel consumption, and hazardous roads make this alternative unattractive.

Disposal of spent shale in the existing spent shale disposal area may not be possible since it will require extensive rebuilding. The pile, which is nearly 40 years old, needs to be rebuilt to provide a more stable condition for long term management. The pile is also unavailable for further disposal until high temperatures caused by combustion of raw shale, which is mixed with the spent shale in areas, have been lowered. Work is ongoing to cool hot areas and to rebuild problem areas. The existing disposal area has provided useful information on how a spent shale disposal pile should be managed in the future.

Disposal of spent shale in the mine would cause storage problems, as well as problems associated with the compacting required to prevent leaching. Mine disposal also would require a significant amount of water for cooling, since hot, spent shale cannot be placed in an area where it would combust raw shale. Most significantly, the mine would be closed off from future use for R&D if filled with spent shale. The intent of making Anvil Points available by Congress was to encourage R&D on mining and retorting.

Advantages of mine disposal include: less erosion from building roads and structures in the Balzac Gulch (somewhat overshadowed by requirements for more road construction and vehicle traffic between the retort and mine); elimination of environmental impacts on Balzac Gulch; and mitigating the potential for subsidence by filling empty areas of the mine.

#### 3.4.2.5 Environmental Impacts of Site Alternatives

The severity of impacts for each site alternative is directly related to the existing quality of the environment impacted. Thus, a more densely vegetated area, such as the top of the mesa, would experience more environmental damage than an area with no vegetation (i.e., the mine). Vegetation on the hogback is somewhat sparse; the existing site also is sparsely vegetated and has been disturbed already. The same is true for the disposal sites.

Another factor to consider in assessing environmental impacts is the amount of land disturbed for support facilitites (i.e., roads, pipelines, conveyors, and utilities). Total distances that spent shale and the end product oil travel will impact the environment. Retort site and disposal site proximity also influence environmental impact. For example, the greatest disruption would occur if the retort were located in the mine, and the disposal site were located near the existing facility, because both spent shale and shale oil would have to be transported further than they would for other alternatives.

Technical, as well as environmental, considerations often are the limiting factor. Choosing the mine as a retort site not only poses problems with air pollutant dispersion, but technical unknowns also are present (see Section 3.4.2.2). The benefits in terms of reducing subsidence, and effects of having heavy vehicles within a mine also are technical unknowns.

Other limiting factors are: space considerations (both the mine and the existing site have limited space for retort and disposal site); construction time; and adaptability to atmospheric pressure necessary for retorting. Table 3-1 compares these considerations to the proposed action.

### 3.4.3 Process Alternatives

DEI is committed by their lease to demonstrate the reliability, efficiency, and operability of processes which they have designed and developed. Under the lease DEI was committed to build and operate at least one surface retort. Since it was the intent of Congress to encourage industry to conduct research at Anvil Points at no expense to the Government, DOE is not in a position to direct DEI's retorting methods.

### 3.4.3.1 Description of Process

An indirect-mode retort is similar in design to direct-mode retort (see Section 3.2.7). The major difference between direct- and indirect-mode processes is the mechanism by which heat is transferred to effect retorting. The retort is illustrated in Figure 3-1. In the direct-mode, air and gas are injected directly into the shale, thus causing combustion of carbonaceous material. The indirect-mode injects inert gas into the retort; consequently, no combustion occurs. This gas can be separated and recycled in an external furnace.

### 3.4.3.2 Summary of Environmental Impacts

Indirect-mode gases have a much higher heating value (900 Btu/scf) than direct-mode gases (100 Btu/scf). Concentrations of $H_2S$ and $NH_3$ also are significantly higher from indirect-mode gases. Higher carbonaceous residue on indirect-mode retorted shale causes higher concentrations of polycyclic organic matter (POM). In addition, indirect-mode shale may have a higher soluble salt content and greater leaching potential than direct-mode spent shale, since the temperature at which retorting is effected (and at which carbonate materials decompose and insoluable calcium silicates form) is lower than the temperatures required for direct-mode retorting. Cementation properties (and ability to create water-impervious liners) are also reduced in carbonaceous indirect-mode spent shale.

The major disadvantage of indirect-mode retoring is the requirement of 40% more water, primarily used for cooling and revegetating the disposal site. Because the area's water supply is limited, indirect-mode retorting may be prohibitive.

## 3.5 SUMMARY, ENVIRONMENTAL TRADEOFFS

Environmental disturbance is one of many considerations in determining a site location. Some site alternatives (the mine) present little or no surface impact, while others (top of the mesa) present significant impacts. The proposed hogback location is in a relatively sparse area and would pose minimal environmental impacts. Balzac Gulch, although relatively vegetated, does not present the problems inherent in the other two disposal site alternatives; namely lack of available space and unliklihood that a retort would be located on the mesa.

Another important consideration in weighing environmental impacts is technical feasibility. Disposing of spent shale in the mine appears to be environmentally attractive; however, the potential hazards of mixing raw and spent shale, leaching shale, and limited space may restrict its use. The health effects and new controls necessary for locating a retort in a closed environment also are unknown.

TABLE 3-1

SUMMARY OF ENVIRONMENTAL IMPACTS

| Impact Area / Alternatives Relative to Proposal Action | Transportation | Terrestrial Environment | Atmospheric Conditions | Technology |
|---|---|---|---|---|
| **Retort Site Locations** | | | | |
| Top of Mesa | Decrease - mine to retort. Decrease - pond to retort. Increase - retort to Balzac Gulch. | Increased disturbance due to more favorable environment. Increased disturbance from additional road construction. | Atmospheric pressure different from commercial requirements. Greater ability for air pollutant dispersion | Same as proposed action. |
| In Mine or Bench | Decreased - to retort. Increased use of heavy equipment to mine. Increased disturbance to disposal site. | Decreased disturbance from construction of the retort. Excavation of cliff face for mine bench location increases disturbances. | Similar pressure to commercial requirements. Atmosphere controlled for retorting. Additional ventilation needed for air pollutant dispersion from mine. | Impact on subsidence, retorting in a closed environment and necessary controls not yet assessed. |
| Near Existing Site | Increased handling of shale. Decreased handling of shale oil. | Disturbance from increased handling. Least site disturbances, since facility already developed. | Less dispersion potential from lower elevation. | Minimal need for new technology assessments or studies. |
| Proposed Action (Hogback) | Location central to mine and disposal site. Decreased amount of heavy materials handling relative to other sites. | Construction will disrupt small area of sparse vegetation; conveyor and pipeline areas disrupted from construction. | Higher elevation alleviates dispersion problems. | Technology already assessed. |
| **Disposal Site Locations** | | | | |
| In Mine | Increased transportation from existing site. Decreased transportation from hogback for top of mesa site. | Increase in water requirements. Greatly decreased impact relative to Balzac Gulch. Areas transporting heavier loads will suffer increased subsidence problems. Minimizes potential for subsidence of land above mine. | Higher particulate levels since dispersion area is enclosed. | Requirements for cooling, impact on leaching and required amount of compactibility not yet known. Not yet determined whether area is available for crushing and storage. |
| Near Existing Site | Greatly decreased transportation if retort location near existing facility. Increased transportation from hogback mesa and mine sites. | No need for new road to Balzac Gulch. Problem of space - area is not large enough. | New disposal site might exacerbate conditions posed by fire in old site. Same fugitive dust levels as proposed action. | New design for fill in a flat area (rather than a canyon) needed. |
| Proposed Action (Balzac Gulch) | New road required; greater transporting distances than mine location; less than existing site. | 30 acres of sparsely vegetated land disturbed. Ability to reclaim land being studied, presently uncertain. | Fugitive dust emissions from construction of roads and unloading of materials. | Technology presently available based on DEI studies. |

TABLE 3-1 (Cont'd)

SUMMARY OF ENVIRONMENTAL IMPACTS

| Impact Area / Alternatives Relative to Proposal Action | Construction Time | Ability to Use Existing Facilities and Utilities | Additional Construction | Other Considerations |
|---|---|---|---|---|
| Retort Site Locations | | | | |
| Top of Mesa | Increased construction time for building tunnel, new shaft. | Decreased accessibility to existing facilities and utilities except water from pond. | Pipeline construction more extensive, unless straight, downhill slope is used.<br>Utilities. | -- |
| In Mine or Bench | Increased construction time especially if cliff face must be excavated. | Decreased ability to use existing facilities and utilities except water from pond. | o Cliff face<br>o Utilities<br>o Ventilation controls<br>o Pipeline | Occupational Health and Safety implications - working with a combusti process in combustible environment. |
| Near Existing Site | Shortest of all alternatives. | Greatest use of existing utilities and backup from existing site. | -- | Problem in finding an are large enough for scale-size. |
| Proposed Action (Hogback) | Greater contruction time than existing site, less than mine and mesa sites. | Use of existing facilities feasible.<br>Water system must be extended. | Pipeline to existing storage tanks. | -- |
| Disposal Site Locations | | | | |
| In Mine | Increased contruction time since feasibility studies required and sufficient site area must be cleared. | -- | Road from existing site or top of mesa must be upgraded or constructed. | Storage and crushing are must be found. |
| Near Existing Site | Greater; since area of sufficient size must be found and cleared. | Excellent, providing retort location is near existing site. | -- | -- |
| Proposed Action (Balzac Gulch) | Least contruction time. | New road must be constructed to disposal site. | -- | -- |

The most significant environmental impact of locating the retort near the existing facility would be increased road construction, and consequently, subsidence, from shale handling. This may be offset somewhat by the availability of existing utilities and back-up facilitites, and by removing the need for a product pipeline. The major problem with locating the retort near the existing site is the lack of adequate space. This factor also would rule out the possibility of placing the disposal site near the facility, since there would be little room for both sites.

The hogback location presents advantages as well as disadvantages. There is adequate space. Product disposition will pose some problems related to the other alternatives (a pipeline and conveyors would need to be built); however, this will be mitigated by reseeding the area and burying conveyors. In addition, plans developed for feasibility studies (an ore pass and mine adit) will be utilized, cutting even more time off the total construction time.

The proposed Balzac Gulch disposal site will cause greater land disturbances than other alternatives. However, consideration of other impacts indicate that Balzac Gulch will present the least overall impact. The gulch is the largest available disposal site, and it can be utilized without excessive clearing. There are no major surface water sources in the gulch; consequently, runoff and leaching are unlikely. Finally, the use of Balzac Gulch will have the least impact on worker health and safety since vehicle traffic would be much lower than for the existing disposal site alternative.

# 4. DESCRIPTION OF THE EXISTING ENVIRONMENT

## 4.1 PHYSIOGRAPHY, GEOLOGY, AND LOCATION OF EXISTING AND PLANNED SITE AND FACILITIES

### 4.1.1 Description of Site and Facilities

The lease tract for the existing oil shale facility and proposed modular project lies in Garfield County Colorado, eight miles west of Rifle, 34 miles west of Glenwood Springs, and 55 miles northeast of Grand Junction. The lease tract lies on both NOSR 1 and 3; Anvil Points is near the Roan Cliffs boundary between the two reserves (see Figure 4-1).

The Anvil Points facility is the site of the existing Paraho development projects and support facilities as well as the proposed action and alternatives (see figure 4-2). The site is 1.5 miles north of the Colorado River. The entire area includes a large hogback, a smaller ridge, and three adjacent canyons all oriented roughly in a north-south direction. The site terrain is rugged and dry, receiving only about 11 inches of precipitation a year (NOAA, 1970). Junipers and other mountain shrubs and grasses cover the cliffs west of the hogback and the ridge. The canyons are more sparsely vegetated. The cliff face east of the hogback, facing a more southward direction, is virtually barren.

Existing facilities on the site are the mine, pilot and semiworks retorts and their support facilities, a retorted shale disposal site, some dwellings for the operational personnel, revegetation study plots, and about seven miles of road. Beginning at an elevation of about 5,300 feet, a 1.5 mile paved road climbs a gentle incline from the highway past the housing area and revegetation study plots to the existing retort site. The present pilot and semi-works retorts, crushing area, equipment, storage tanks, and operation and administrative buidlings are on a small ridge at an elevation of 6,000 feet. Currently, retorted shale and fines are deposited and compacted in a small canyon immediately east of the retort site. A small stream originating at the top of the mesa to the east of Anvil Points, sometimes flows through that canyon before being directed around the existing retorted shale pile.

Proposed facilities for the site are an extension of the present mine, a new mine opening and ventilation adit, a modular retort and operational support facilities, a retorted shale disposal site and access road, an oil pipeline from the retort to the existing tank farm, and some new dwellings. A convoluted 5.5 mile gravel road connects the present retort site with the mine. The road crosses a small canyon between the ridge and the higher hogback to the west, and a small stream which originates at the top of the mesa between East and West Anvil Points, and flows through the canyon. At the southern end of the hogback, the road climbs from an elevation of about 6,600 feet to the proposed retort site at 7,000 feet. The hogback drops off quickly to the west, to an elevation of approximately 6,000 feet at the floor of the large Balzac Gulch. The drainage channel through the gulch, shown in Figure 4-2, usually is dry.

The terrain declines sharply below the proposed retort site; a switch-back road ascends to the mine opening. There are four mine openings in the face of the cliff at an elevation of 8,200 feet, approximately 900 feet below the mesa

**FIGURE 4–1**
**LOCATION OF NAVAL OIL SHALE RESERVES 1 AND 3**

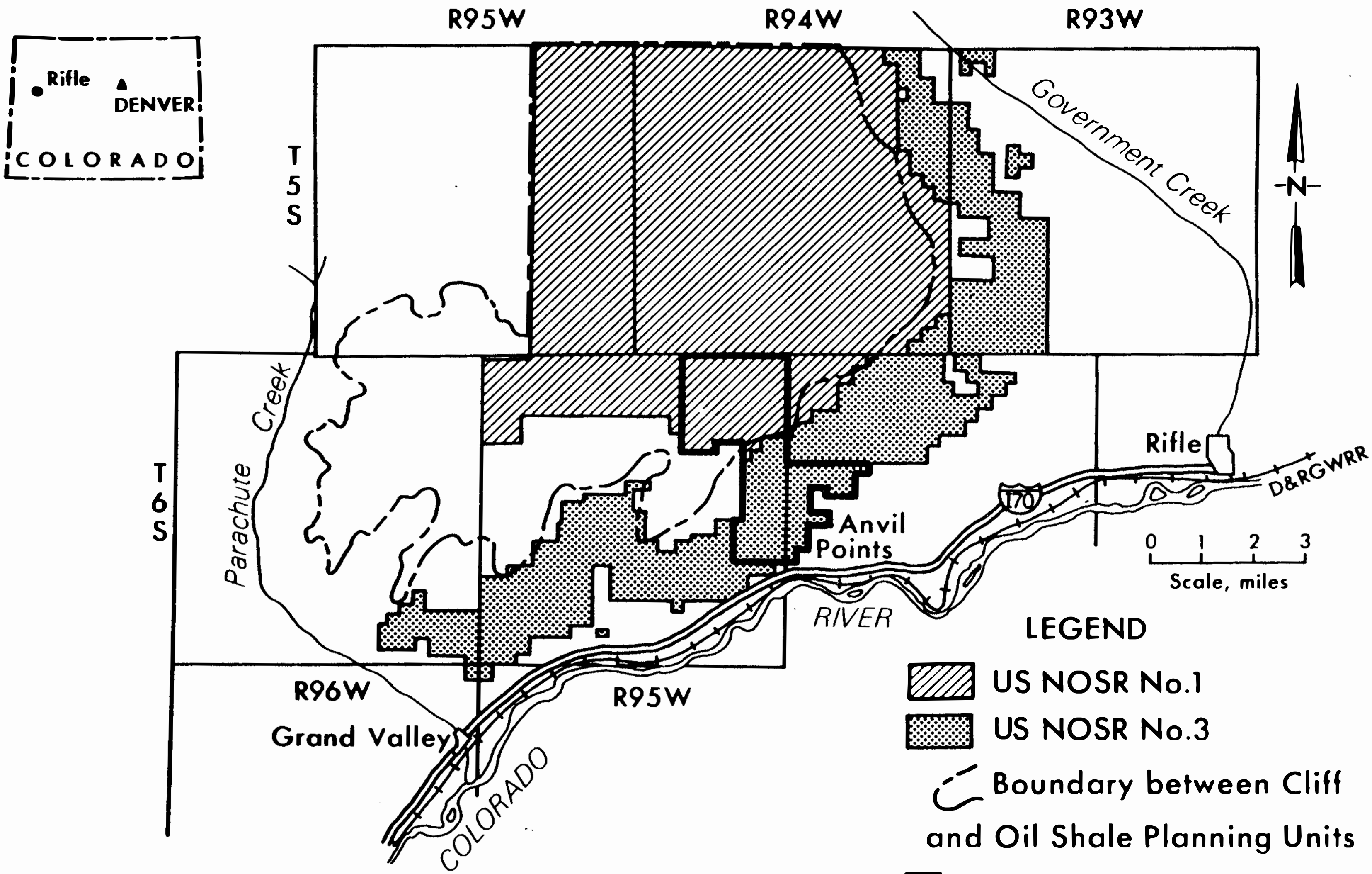
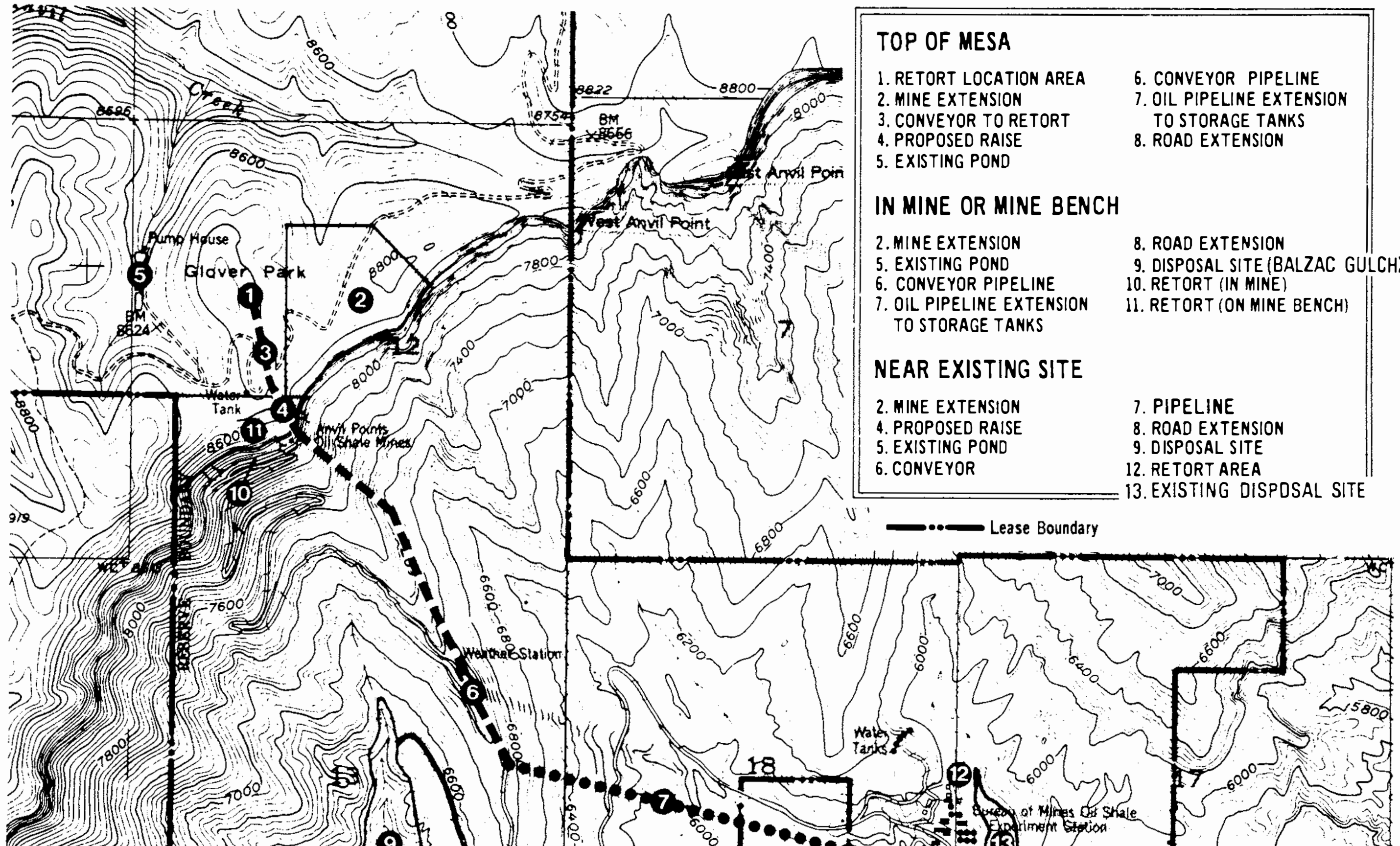


**FIGURE 4—2**

**PROPOSED SITE ADDITIONS TO ANVIL POINTS FACILITIES**



plateau. Mine entrances lead into large caverns supported by shale columns (room-and-pillar mining).

### 4.1.2 Geomorphology

NOSR 1 and NOSR 3 are different land forms, and, therefore, weather differently. NOSR 1 is drained to the south by the eastern tributaries of Parachute Creek. The upper tributaries' drainage direction is controlled by a northwest trending syncline.

The elevation of NOSR 1 varies from just under 7,800 feet to over 9,300 feet. Mass-wasting agents (e.g. landslides, debris avalanches, rock creep, etc.) vary from season to season; the warmer months produce rock creep while the colder months produce transportation by solifluction (i.e. gravitative transfer of water-saturated masses of soil or earth). Landslides and rock slides occur along lower courses of Parachute Creek where the valley walls are steep. Rapid melting of ground frost and snow may cause slumps and mudflows. Shallow soil development produces sheet wash.

NOSR 3 consists of the cuesta scarp of the Roan Plateau and part of the Colorado River Valley adjacent to NOSR 1. The top 700 to 1,000 feet consists of a vertical cliff with the slope moderating toward the bottom. Chemical and physical weathering (frost wedging) has loosened the rock and increased the occurrance of rock fall, rock slide, debris avalanche, and sheet wash. Rocks rolling and sliding downhill have carved gullies into the cliff face. The more moderate slopes below are under the influence of talus creep, talus slide, slump, landslide, and rock slide. Rock creep and earth creep also occur on the moderate slopes.

The degree of slope changes at the contact between the Green River and Wasatch Formations. The Wasatch, being less resistive, moderates the steep slope to nearly level near the Colorado River. Large gulches transect the Wasatch bajada, eroding up into the cliff face and often depositing large alluvial fans along the Colorado River flood plain.

### 4.1.3 Geology

The rock in the vicinity of the NOSRs varies in age from the late Cretaceous to Tertiary and Eocene periods, and in lithology from fluvial to lacustrine deposits. Table 4-1 shows the general lithology and stratigraphic relationships of the major units within the area.

The youngest unit in the area, excluding alluvial deposits along streams, is the Uinta Formation capping the Roan Plateau. Stream action has incised the plateau, eroding the Uinta Formation and exposing the older, local Green River Formation members. The oil shale beds of the Green River Formation have resisted weathering, resulting in a steep escarpment on some edges of the basin such as the Roan Cliffs. The Wasatch Formation, exposed near the bottom of the Roan Cliffs, underlies the Green River Formation and makes up the floor of the Colorado River Valley. The Mesa Verde Formation was formed during the Cretaceous period and underlies the Wasatch Formation.

Seismic activity in the site is minor, although seismic reflections of large earthquakes have been detected in the area. Surface modifications caused by earthquakes, if they exist, are not obvious.

TABLE 4-1

GENERALIZED DESCRIPTION OF ROCKS EXPOSED IN OR NEAR NAVAL OIL SHALE RESERVES 1 AND 3

<table>
<tr><th>SYSTEM</th><th>SERIES</th><th>FORMATION</th><th colspan="2">Member, thickness of unit, and character of rock.</th></tr>
<tr><td rowspan="5">TERTIARY</td><td rowspan="5">EOCENE</td><td>UINTA FORMATION</td><td colspan="2">1,000± feet<br>Fine, gray and brown sandstone with interbedded gray marlstone and a few thin beds of oil shale. Upper 200 feet contain massive sandstones that may belong in the lower part of the Bridger formation. Member weathers to rounded slopes.</td></tr>
<tr><td rowspan="3">GREEN RIVER FORMATION</td><td colspan="2">PARACHUTE CREEK MEMBER:<br>700-1230 feet<br>Black, brown, and gray marlstone including principal oil-shale units. Few thin key beds of altered tuff, analcite, and chert. Tongues of sandstone near base. Member weathers to light gray and light brown cliffs.</td></tr>
<tr><td>GARDEN GULCH MEMBER:<br>630-720 feet<br>Gray marlstone with some gray & brown shale and a few thin oil shales. Weathers to smooth steep slopes.</td><td rowspan="2">ANVIL POINTS MEMBER:<br>1100-1600 feet<br>Brown & gray sandstone & gray shale, & a little gray marlstone near top. Unit interfingers with Douglas Creek Garden Gulch, & lower part of Parachute Creek members. Weathers to slopes and low cliffs.</td></tr>
<tr><td>DOUGLAS CREEK MEMBER:<br>430-470 feet<br>Brown sandstone and gray shale, and a few thin beds of oolites and algae beds. Weather to buff slopes and low cliffs.</td></tr>
<tr><td>WASATCH FORMATION</td><td colspan="2">4000-5200 feet<br>Red, drab, gray, and Maroon shale, and irregularly distributed lenticular sandstones. Weathers to varicolored slopes with discontinuous sandstone ledges.</td></tr>
<tr><td>CRETACEOUS</td><td>UPPER CRETACEOUS</td><td>MESA VERDE FORMATION</td><td colspan="2">5000± feet<br>Massive sandstone and some shale and coal. Steeply tilted beds form ridges of Grand Hogback.</td></tr>
</table>

SOURCE: Adapted from Cameron Engineers, "Compilation of Existing Data and Preliminary Plans for Development of Naval Oil Shale Reserves 1 and 2," Department of the Navy Report NOSR 72-1, May 1972.

Following a north-west trending syncline, all of the oil shale beds to be mined are found under NOSR 1. DEI also leases parts of NOSR 3, which consist of the cliff face of the Roan Plateau and part of the valley floor below it. NOSR 3 will contain the facility site as well as the disposal site and auxiliary facilities.

### 4.1.4 Soils

A range of soil types exists on NOSR 1. All soils above the stream valley floors are residual soils. Podzolic soils, with dark, fine-textured, well-developed horizons, are found under a vegetative cover of conifers on the north and east exposures of moderate slopes. These soils are neutral to slightly acidic and may be up to five feet deep. Chestnut soils and brown aridic soils occur on southward facing slopes. Slope degree and direction have a major influence on the type and depth of soil formation. Generally, the soil cover is shallow (less than two feet deep), and usually supports a cover of grass or sagebrush.

Chernozem soils occur in regions of slight to moderate north-south facing slopes. They have more definable horizons than do the chestnut or brown aridic soils, but not the degree of definition that occurs in podzolic soils. Brown aridic and chestnut soils generally are more calcereous than podzol soil.

Soil development varies according to the vegetation zones. Conifer growth has developed podzolic soils, while juniper and sagebrush are associated with brown aridic soils. Soil development on the Wasatch Formation is limited, mainly due to the mineralogical composition of the formation. High percentages of hydrophylic clays wihtin the Wasatch, such as montmorillonite, bentonite, and illite types, absorb moisture and expnad. The resulting trapped water saturates a thin zone of material at the surface, preventing infiltration and thus restricting the depth of soil development. Water runoff is high, creating sheet wash and gullying. Therefore, vegetation has little soil in which to grow. The soil development that does occur is of the red desert type. The saturated zone, sometimes less than one inch thick, quickly dries, leaving a hard crust over fine to granular material.

### 4.1.5 Land Use and Mineral Resources

More than 65 percent of Garfield County is used for livestock grazing (see Table 4-2). An additional 22 percent is used for timber grazing. Rugged terrain and low annual rainfall limit the amount of cropland to less than five percent, which is irrigated. Urban land use in Garfield County comprises less than one percent of the land area. Approximately five percent of the county area is classified as wilderness, however, the project site does not lie within such an area. Developed recreation resources (i.e., parks and playgrounds), represent 0.6 percent of the total area. Oil shale deposits occur in 29% of the county (886 sq mi) and coal deposits are found in 59% of the area (1,793 sq mi).

TABLE 4-2

MAJOR LAND USES IN GARFIELD COUNTY

| LAND USE | AREA SQUARE MILES | PERCENTAGE* |
|---|---|---|
| Agricultural Uses | 2,840 | |
| Grazing | 1,995 | 65.23 |
| Timber Grazing | 645 | 21.52 |
| Dry Cropland | 11 | 0.37 |
| Irrigated Cropland | 125 | 4.17 |
| Timber | 104 | 3.47 |
| Wilderness | 153.45 | 5.12 |
| Urban Settlement | 4.0 | 0.13 |
| Recreation | | |
| Public | 15.6 | 0.52 |
| Private | 2.3 | 0.08 |
| TOTAL LAND AREA = 2,997 sq. mi. | | |

* Due to overlapping use of some areas, total exceeds 100 percent.

SOURCE: C-b Shale Oil Project, Ashland Oil, Inc., Shell Oil Company operator, "Socioeconomic Assessment, Oil Shale Tract C-b, Volume I, Baseline Description," March 1976, and "Socioeconomic Assessment, Oil Shale Tract C-b, Volume II, Impact Analysis," March 1976.

## 4.2 METERORology AND EXISTING AIR QUALITY*

### 4.2.1 Meteorology

The most common air-flow regime at Anvil Points is a weak surface layer drainage during the night and a stronger southwesterly flow during the day. The direction of the drainage flow generally is northeasterly at the site of the proposed retort facility and more variable at the existing semiworks site. The depth of this layer at the proposed retort site is approximately 300 yd, above which a southwesterly gradient flow prevails. Surface heating during the morning allows the flow at lower layers to couple with the prevailing gradient flow, typically at about 10:00 or 11:00 am.

During typical clear sky conditions, surface-based temperature inversions at the proposed site generally are destroyed shortly after sunrise, although isothermal conditions may prevail until a gradient flow regime is able to establish itself at the surface. Upslope flow towards the cliff face can occur when clear skies permit heating of the southwest facing slopes and cliff faces. However, the flow tends to be confined to a superadiabatic and highly unstable layer, although weak inversions may restrict dispersion into upward layers.

When skies are partly cloudy, a vigorous turbulent drainage flow regime cannot establish itself, since radiative cooling of the ground is minimized. This

* Unless otherwise noted, meteorological and air quality data given in this section are based on a 3.5 month monitoring program (beginning December 1977) conducted by AeroVironment. The results of this program are contained in "Meteorological and Particulate Baseline Study, Anvil Points, Colorado," D. Allard, AeroVironment, AV-R-7130, 1978.

situation, combined with an absence of strong pressure gradients, produces a weak drainage flow and a surface-based inversion at the site of the proposed retort faciltiy. Such conditions inhibit pollutant dispersion. The rugged terrain of the area enhances dispersion somewhat even under these conditions by contributing to mechanically-generated turbulence.

### 4.2.2 Existing Air Quality

Ambient air quality in the Anvil Points area has been characterized to some extent with respect to all criteria pollutants. Table 4-3 summarizes pollutant concentrations measured near the Anvil Points vicinity and compares them with applicable Federal standards. These measured pollutant background levels reflect information obtained from various sources.

Particulate concentrations at the proposed Anvil Points retort site were measured during a 3.5 month monitoring program (beginning December, 1977) as part of baseline environmental quality studies. As shown in Table 4-3, particulate concentrations averaged 14.4 $g/m^3$ (Allard, 1978). In comparison, annual mean particulate concentrations measured at three other sites within 20 miles of Anvil Points range from 7 $\mu g/m^3$ (Rio Blanco) to 79 $\mu g/m^3$ (Rifle) (Engineering Science, 1974; EPA, 1974). However, the higher value was measured at a substantially active commercial center. Estimates of particulate levels for the proposed facility can be represented best by measurements obtained at Rio Blanco (10 miles north of Anvil Points) and at the proposed site itself, both recording annual mean particulate concentrations of less than 15 $\mu g/m^3$, well below Federal and State ambient standards.

TABLE 4-3

ABERAGE BACKGROUND CONCENTRATIONS AT ANVIL POINTS VICINITY AND SUMMARY OF NATIONAL AIR QUALITY STANDARDS

| POLLUTANT | CONCENTRATION (Reflects Annual Average) | SOURCE |
|---|---|---|
| Particulates (TSP) | 14.4 $\mu g/m^3$ | AeroVironment |
| Oxidants ($O_x$) | 75.0 $\mu g/m^3$ | C-b data |
| Carbon monoxide (CO) | 1.0 $\mu g/m^3$ | C-b data |
| Nitrogen dioxide ($NO_2$) | 5.0 $\mu g/m^3$ | C-b data |
| Sulfur dioxide ($SO_2$) | 16.0 $\mu g/m^3$ | Colony data |
| Hydrocarbons (HC) | 571.0 $\mu g/m^3$ | C-b data |

NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

| POLLUTANT | TYPE OF STANDARD | AVERAGING TIME | FREQUENCY PARAMETER | CONCENTRATIONS $\mu g/m^3$ | ppm |
|---|---|---|---|---|---|
| Carbon Monoxide | Primary and Secondary | 1 hr | Annual maximum[a/] | 40,000 | 35 |
| | | 8 hr | Annual maximum | 10,000 | 9 |
| Hydrocarbons (nonmethane) | Primary and Secondary | 3 hr (6-9 am) | Annual maximum | 160[b/] | 0.24[b/] |
| Nitrogen dioxide | Primary and Secondary | 1 yr | Arithmethic mean | 100 | 0.05 |
| Ozone | Primary and Secondary | 1 hr | Annual Maximum | 240 | 0.12 |
| Particulate Matter | Primary | 24 hr | Annual maximum | 260 | -- |
| | | 1 yr | Annual geometric mean | 75 | -- |
| | Secondary | 24 hr | Annual maximum | 150 | -- |
| | | 1 yr | Annual geometric mean | 60[c/] | |
| Sulfur dioxide | Primary | 24 hr | Annual maximum | 365 | 0.14 |
| | | 1 yr | Arithmetic mean | 80 | 0.03 |
| | Secondary | 3 hr | Annual maximum | 1,300 | 0.5 |
| | | 24 hr | Annual maximum | 260[d/] | 0.1[d/] |
| Lead | Primary and Secondary | 3 month | Arithmetic mean | 1.5 | |

a/ All annual maximum standards given here are not to be exceeded more than once a year.

b/ As a guide in devising implementation plans for achieving oxidant standards.

c/ As a guide to be used in assessing implementation plans for achieving the annual maximum 24-hour standard.

d/ As a guide to be used in assessing implementation plans for achieving the annual arithmetic mean standard.

Gaseous pollutants were measured at the semiworks and pilot plants in test runs for $O_x$, CO, $NO_2$, $SO_2$, and HC. Pollutant levels are shown in Tables 5-3 and 5-4. In addition, monitoring for these pollutants has occurred at Oil Shale Tract C-b, about 20 miles northwest of the study area. Data collected during the first two years (November 1974 -October 1976) are summarized in a report by C-b Shale Oil Venture (C-b Shale Oil Venture, 1977). Sulfur dioxide and HC data also were collected by the Colony Development Operation in Parachute Creek (about 10 miles northwest of the study area). Samples for that study were taken in 1971-1972 during 10 separate periods, each lasting five weeks.

It is assumed that background pollutant concentrations at tract C-b and Parachute Creek would be representative of background concentrations at Anvil Points, because no significant man-made pollution sources exist at or near any of these locations. Based on data collected at tract C-b and Parachute Creek, background concentrations for all criteria gaseous pollutants at Anvil Points should be represented best by the concentrations given in Table 4-3. Except for HC, none of the pollutant concentrations given in the table exceeds applicable Federal standards. The very high HC concentration (exceeding the Federal guideline) most likely results from hydrocarbon volatilization of local vegetation, since it is unlikely that vehicles or other emissions sources could significantly impact such a rural area.

## 4.3 WATER QUALITY

### 4.3.1 Surface Water Quality in the Anvil Points Vicinity

The Naval Oil Shale Reserves are located in the Upper Colorado River drainage basin. Drainage occurs via the western tributaries of Government Creek on the eastern side, and via streams and washes which empty directly into the Colorado River on the south side. None of the areas in the proposed action is in either the 100 or 500 year floodplains of the Colorado River.

The only major body of water that could be affected by the proposed new facility is the Colorado River. As described in Section 4.1, the Colorado River lies about 1.5 miles south of the Anvil Points site area. EPA monitoring data for the river, collected at a station in Rulison (down-stream of the facility), are shown in Table 4-4. Table 4-4 compares the Colorado River water quality data to the appropriate State and Federal statutes. Criteria for Aquatic Life and Domestic Water Supply govern the quality of the Colorado River. A comparison of the monitoring data with the standards shows that the Colorado River is in compliance with all applicable water regulations.

Under the present lease agreement, DEI collected baseline data on surface water quality. Seven samples were taken from the creek that flows intermittently through the canyon where the existing retorted shale disposal site is located (see Figure 4-3). The samples were taken during two periods -- June 24-30 and July 22-August 5, 1974 -- before significant amounts of retorting had begun. Several weeks of dry weather preceded the first sampling period, while the second period was preceded by heavy rains and run-off.

The above DEI monitoring data also are shown in Table 4-4. A comparison of data to the standards shows that a few of the creek's parameters violate Federal criteria. Because the creek usually is without water, and has been diverted several times over the years, it does not support any aquatic life nor is it a domestic water supply.

TABLE 4-4

AMBIENT SURFACE WATER QUALITY IN THE ANVIL POINTS VICINITY

| PARAMETER | UNITS | LOWER CREEK | COLORADO RIVER | STATE STANDARDS |
|---|---|---|---|---|
| Silica | mg/l | 9-14 | 8.77 | NS |
| Dissolved Solids | mg/l | 783-1902 | 640 | NS |
| Ammonia | mg/l | --- | 0.47 | 0.02 |
| Iron | mg/l | .05-29.8 | .053 | 1.0 |
| Manganese | μg/l | --- | 27.0 | 1.0 mg/l |
| Selenium | μg/l | --- | .750 | 0.05 mg/l |
| Arsenic | μg/l | --- | .250 | 0.05 mg/l |
| Lead | μg/l | 2-130 | 1.75 | 0.004-0.150 |
| Mercury | μg/l | 1-17 | .000 | 0.00005 mg/l |
| Cadmium | μg/l | 2-5 | --- | 0.004-0.015 mg/l |
| Alumium | mg/l | .0-25 | --- | 0.1 |
| Copper | mg/l | .01-.04 | --- | 0.01-0.04 |
| Cyanide | mg/l | .002-.003 | --- | 0.005 |
| Oil & Grease | mg/l | 1-60 | --- | 10 and there shale be no visible sheen |
| Phenol | mg/l | .01 | --- | 0.001 mg/l |
| Suspended Solids | mg/l | 6-378 | --- | 45 (7 days) 30 (30 days) |

NS - No Standard

SOURCE: Creek data from DEI monitoring. Colorado River data from EPA STORET data. Reference 10.

TABLE 4-4 (Continued)

AMBIENT SURFACE WATER QUALITY IN THE ANVIL POINTS VICINITY

| PARAMETER | FEDERAL CRITERIA FOR FRESHWATER AQUATIC LIFE | FEDERAL CRITERIA FOR DOMESTIC WATER SUPPLY |
|---|---|---|
| Silica | NC | NC |
| Dissolved Solids | NC | NC |
| Ammonia | .020 un-ionized | NC |
| Iron | 1.0 | .3 (welfare) |
| Manganese | NC | 50 (welfare) |
| Selenium | 9.7 (24 hr)<br>22.0 (max) | 10 (health) |
| Arsenic | NC | 50 (health) |
| Lead | 1.51. in (hardness)-<br>3.37 (24 hr)<br>1.51 in (hardness)-<br>1.39 (max) | 50 (health) |
| Mercury | .05 | 2.0 (health) |
| Cadmium | 0.87 in (hardness)-<br>4.38 (24 hr)<br>1.30 in (hardness)-<br>3.92 (max) | 10 (health) |
| Alumium | NC | NC |
| Copper | 0.65 in (hardness)-<br>1.94 (24 hr)<br>0.88 in (hardness)-<br>1.03 (max) | 1.0 (health) |
| Cyanide | 1.4 (24 hr)<br>3.8 (max) | 0.2 mg CN-/1 |
| Oil & Grease | 0.01 times 96-hr. $LC_{50}$ value | free from (health) |
| Phenol | 600 µg/l (24 hour) | 3.4 (health) |
| Suspended Solids | should not reduce depth of condensation point for photosynthetic activity by more than 10 percent | NC |

NC - No Criteria.

SOURCE: Creek data from DEI monitoring. Colorado River data from EPA STORET data. Reference 10.

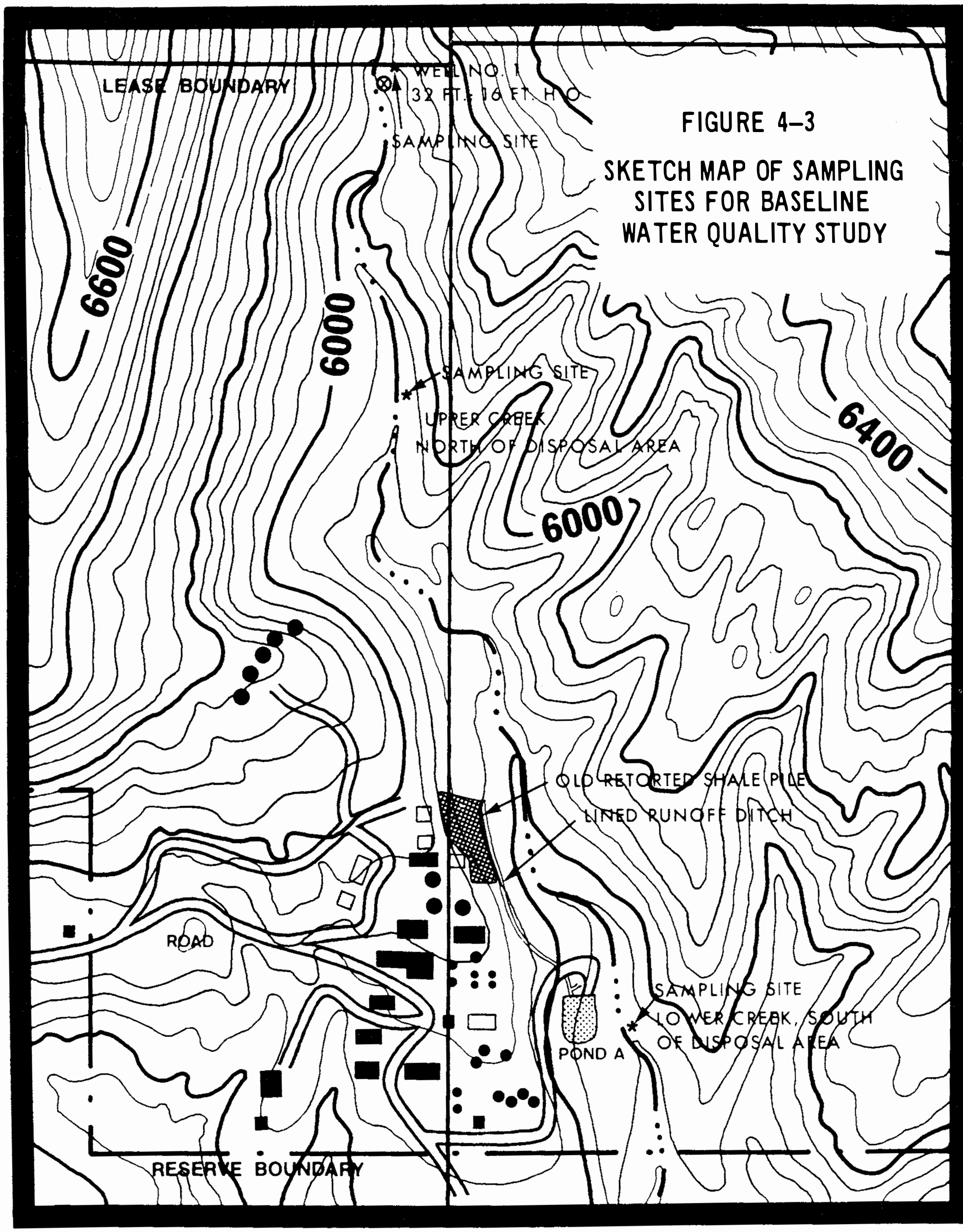



FIGURE 4–3

SKETCH MAP OF SAMPLING SITES FOR BASELINE WATER QUALITY STUDY

### 4.3.2 Groundwater Quality

Groundwater data in Balzac Gulch is not available. However, groundwater data were obtained from a well north of the existing facilities. Table 4-5 shows the results of the five samples and compares the data with Federal Drinking Water Standards. As seen in the table, only mercury concentrations exceed National Drinking Water Standards. Groundwater monitoring shows a mean concentration of 0.002 ppm over five years. Half of the 18 samples taken were below the limit of detection ($\leq$.007 to $\leq$.0002 ppm).

### 4.3.3 Water Quality Impacts of Existing Operations

Operation of the existing facility (the semiworks project) produces no significant discharge in surface or groundwaters.

Because the facility operates on a no-discharge basis, present operations do not require a National Pollution Discharge Elimination System permit governing point source discharges into navigable waters. It is expected that the proposed facility also will operate as a "No Discharge" system under State regulations (see Section 5.3.2.2).

## 4.4 ECOLOGY

The following subsections discuss the general ecology of the Naval Oil Shale Reserves, with respect to both regional and site-specific characteristics. Vegetation and terrestrial and aquatic wildlife are described; any endangered or threatened species present on the NOSR's or the proposed site area are

TABLE 4-5

AMBIENT GROUNDWATER QUALITY AT THE ANVIL POINTS SITE*

| Parameter | Well #1 (low-high) | National Interim Primary Drinking Water Standards |
|---|---|---|
| Na | 186-493 | NS ** |
| K | 5-23 | NS |
| Ca | 42-266 | NS |
| Mg | 73-156 | NS |
| Al | 0.4-2.6 | NS |
| Cd | 0.004-0.007 | .010 |
| Cu | 0.04-0.11 | NS |
| Fe | 0.03-2.5 | NS |
| Pb | <.002-0.028 | .05 |
| Hg | <.001-0.005 | .002 |
| Zn | 0.06-0.14 | NS |
| Cl | 3-23 | NS |
| F | 0.8-1.3 | 2.4 |
| CN | <.0002-1.002 | 0.2 |
| $SO_4$ | 400-1050 | NS |
| $PO_4$ | <0.01-0.12 | NS |
| Si | 10-16 | NS |
| Kjeldahl N | 0.2-2.6 | NS |
| Oil & Grease | 2-13 | NS |
| COD | 10-79 | NS |
| Phenol | <0.01 | NS |
| pH | 7.3-7.6 | NS |
| Alkalinity | 323-414 | NS |
| Total Diss Solids | 700-1556 | NS |
| Total Susp Solids | 36-134 | NS |

* Samples were collected during June 24-30 and July 22-August 5, 1974. All data and standards are in parts per million (ppm).

** NS = No Standard

SOURCE: DEI monitoring data.

metioned. Discussion of ecological environment for the site alternatives to the proposed action will be identical.

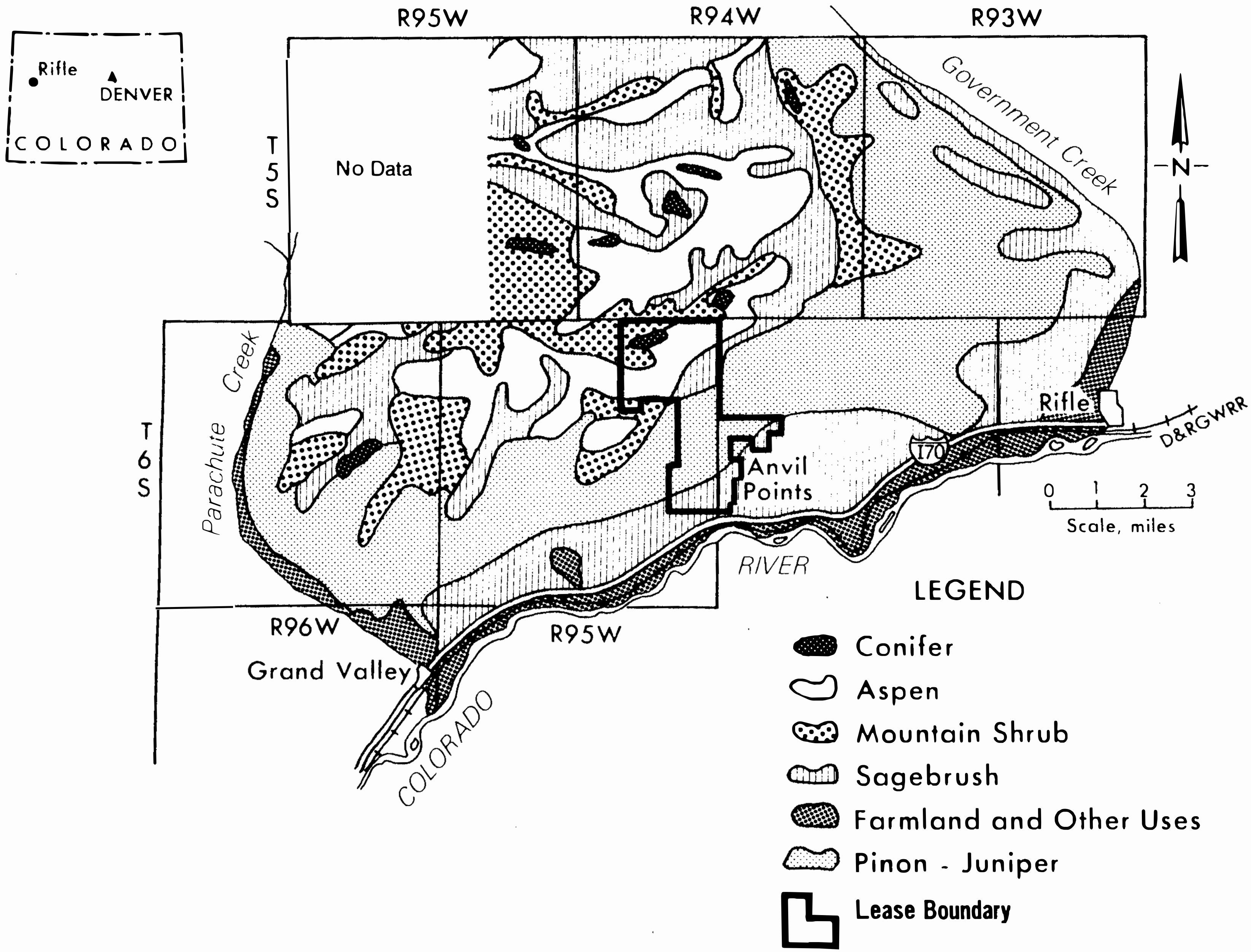
### 4.4.1 Regional Ecology

#### 4.4.1.1 Existing Vegetation

Figure 4-4 depicts the broad range of vegetation found on NOSR 1. This includes conifers, aspens, mountain shrubs, sagebrush, and pinion-junipers. In contrast, NOSR 3, located below the Roan Cliffs in the Colorado River Valley where the climate is much drier, has considerably less vegetation, consisting mainly of pinion-juniper and sagebrush.

Based on a 1976 survey of the Anvil Points site by DOE (Laramie Energy Technology Center), a partial checklist of plant species found in the experimental pastures of the Little Hills Experiment Station (some 25 miles north of the Naval Reserves) is believed to be representative of the vegetation occurring in the general vicinity of the reserves. The checklist includes four species of trees, 23 species of shrubs, 86 forb species and 20 grass or sedge species (Cameron Engineers, 1972).

## FIGURE 4–4
## MAJOR VEGETATION TYPES ON NAVAL OIL SHALE RESERVES



#### 4.4.1.2 Existing Terrestrial Wildlife

The best available Naval Oil Shale Reserves information was obtained from research and reports prepared for Wildlife Unit 22, the Piceance Unit (Grey, 1979). Most of Unit 22 lies north of the reserves, but may of the 220 animal and bird species found in the Piceance Unit also inhabit the reserves. Wildlife Unit 22 is more characteristic of NOSR 1 than NOSR 3, since the climate in NOSR 3 supports fewer wildlife species and sparser vegetation.

The most abundant big game mammals found on NOSR's 1 and 3 are elk and Rocky Mountain mule deer. Both species use that portion of the reserve which is on the Roan Plateau as summer range. Although the elk population is believed to be 70 to 80 head, no accurate count is available. The mule deer population is estimated to average less than 3,500 on the reserves.

Virtually all of NOSR 1 is summer range for deer, while portions of NOSR 3 are winter range. NOSR 1 is accessible to deer between May and November. The western portion of NOSR 1 and the south-facing slopes of its several stream valleys are the first areas clear of snow in the spring and last to accumulate snow in the fall. Thus, these areas may be accessible to deer for a longer time. The area along the base of the Roan Cliffs in NOSR 3 contains winter range for a limited number of deer. Most of the winter range on NOSR 3, however, is relatively steep and characterized by unstable soils. Superior winter deer range is found on private lands at lower elevations within the Piceance Creek Basin.

The principal small game mammal species found on the reserves are the cottontail rabbit (Sylvilagus audobonii), snowshoe hare (Lepus americanus), pine (red) squirrel (Tamissciurus hudsonicus), and white-tailed jackrabbit (Lepus townsendii). These species are found throughout the Piceance Creek Basin.

Coyotes are abudant on the reserves, particularly on NOSR 1. In some areas, substantial sheep and cattle losses to these predators have been reported. Mountain lions (Felis concotor), another predator in the Piceance Creek Basin, generally are confined to the Cathedral Bluffs area.

The three main drainages on NOSR 1 provide excellent habitat for beaver. Other fur-bearing animals inhabiting the reserves are the muskrat, ringtail cat, weasel, and mink, the species of which are undefined. Other small mammals found in the area are marmots (Marmota flaviventris), prairie dogs (Cynomys Leucurus), raccoon (Procyon lotor), badgers (Taxidea taxus), bobcats (Lynx rufus), spotted (Spilogale putorius) and striped skunks (Methitis mephitis); and several species of squirrels (Spermophilus spp.), chipmunks (Eutamias spp.), and foxes (Vulpes fulva, Vulpes velox, Urocyon cineraeargenteus). Although wild horses are found in other parts of the Piceance Creek Basin, none are known to inhabit the naval reserves.

Blue grouse (Dendragapus obscurus) appear to be well distributed throughout the Bureau of Land Management (BLM) Oil Shale Planning Unit, which includes the naval reserves, but population figures are not available. The Roan Plateau area is an excellent but not critical grouse habitat; fewer grouse inhabit the Gulch area (Behnke, 1976). Chukar (partridges, Alectoris graeca) exist along the south and east boundaries of the Oil Shale Planning Unit, and some ducks (species undefined) appear on the beaver ponds along the three main drainages during the summer.

### 4.4.1.3 Existing Aquatic Species

NOSR 1 has a limited potential for stream fishing in Trapper Creek, Northwater Creek, First and Second Anvil Creeks, and the East and East Middle Forks of Parachute Creek. Several beaver ponds are located along these streams. The existing fish are native brook trout (Salvelinue fontinalis) and mountain suckers. Sport fishing is relatively light in the area, primarily due to poor accessibility. None of the intermittent streams on NOSR 3 contains significant fish resources.

Other aquatic organisms, micro-organisms, amphibian aquatic life, and reptiles have not been recorded for the area, but one would expect to find frogs, toads, various lizards (at lower elevations), and both poisonous and non-poisonous snakes. Insect life also is unresearched.

### 4.4.1.4 Existing Endangered Species

It has been reported, although not officially verified, that native cutthroat trout are found in Northwater Creek, approximately five miles north of the proposed retorting facilities (Behnke, 1976). The green-back cutthroat trout, subspecies stomias, is on the Federal threatened list. Its distribution, however, is confined to the Platte River drainage system, away from the naval reserves. The distribution of the Colorado cutthroat trout, subspecies peiriticus, includes NOSR 1, but is not near the Anvil Points facility or any drainage area associated with Anvil Points. That subspecies is on the State threatened list.

Bald and golden eagles and Peregrine Falcons occasionally have been seen flying over the site area. Bald eagles inhabiting Colorado are on the Federal endangered list. Golden eagles are not designated as either threatened or endangered. Neither the bald eagle nor the golden eagle nest at the site; thus the proposed action should not threaten the critical habitat of either species. A final determination on endangered species in the area will be made (see Appendix D).

### 4.4.2 Site-Specific Ecology

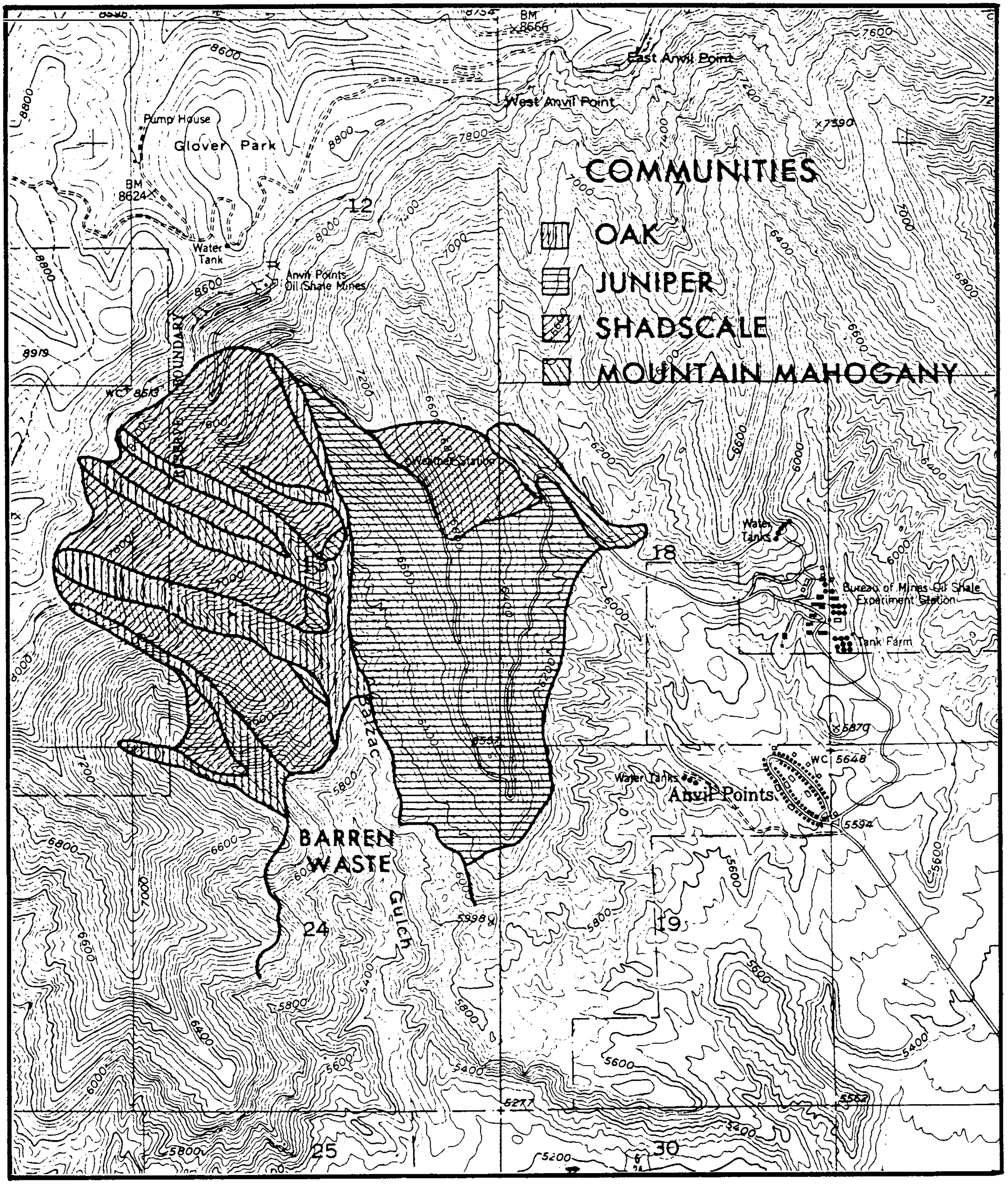
#### 4.4.2.1 Existing Vegetation at the Proposed Site

Four major vegetation types exist within the proposed site area: Utah junipers (*Juniperus utahensis*), true mountain mahogany (*Cerococarpus montanus*), oak (*Quercus gambellii*), and shadscale saltbrush (*Atriplex confertifolia*). These types are shown in Figure 4-5. Each vegetation type is associated with a particular slope exposure or terrain feature.

A grass community on top of the hogback separates two juniper stands. Crested wheatgrass, an introduced species used commonly as a component of reclamation seed mixtures, is the dominant grass species. Douglas rabbitbrush, also a reflection of land disturbance, is the dominant shrub on top of the hogback.

FIGURE 4-5

PLANT COMMUNITIES WITHIN PINION-JUNIPER TYPE



The juniper community surrounding the proposed site appears to be a mature forest. The average tree density is 13 trees/5,000 sq ft transect. Shrubs form a relatively uniform understory and provide considerable ground cover. Line intercept data from shrub studies indicate an average crown cover of 42%, consisting of true mountain mahogany, green Mormantea, and Saskatoon serviceberry. Herbaceous cover under the shrub layer is less than 5%.

True mountain mahogany shrub communities are scattered within the juniper forest in an open mottled pattern along the northeast face of the hogback.

Crown cover is 60%. Herbaceous cover under the shrub-layer is over 10% and consists of cheatgrass, wheatgrass, serviceberry seedlings, and Indian ricegrass. About 25% of the shrub communities cover bare grounds.

Shadscale shrub communities exist along the canyons, and on northeast and southern slopes of the hogback where erosion has occurred. Crown cover is 25% for the shrub layer, of which basin sagebrush makes up nearly 25%. Herbaceous cover under the shrub layer is over 40%. Nearly 33% of the ground within the shadscale communities is bare.

#### 4.4.2.2 Existing Wildlife at the Proposed Site

The proposed site is dry and sparsely vegetated, with little visible wildlife. Several deer were the only wildlife seen on a recent site visit. A discussion with a Colorado wildlife environmentalist confirmed that deer are common on the site (Hoover, 1978). Bighorn sheep, elk, or mountain elk also may be seen occasionally on the mesa above the site, according to the same spokesman.

The intermittent streams in the area are too small to carry significant aquatic life. The Colorado cutthroat trout is not present in the immediate Anvil Points area, and thus, the proposed action will not threaten its critical habitat.

## 4.5 SOCIOECONOMIC CHARACTERISTICS

Rifle (population 3,500) is the nearest town which may be affected by the Anvil Points project. This subsection describes the existing socioeconomic environment of Rifle, and factors possibly affecting other, outlying communities (See Figure 2-1).

### 4.5.1 Housing

A vacancy rate of five to six percent (housing that is for sale or rent) is normal, given average population growth. In Rifle, the vacancy rate currently is about five percent for both mobile homes and single family units, implying normal population growth. Rifle's vacancies presently consist of 46 to 47 available housing units; 27 houses for sale, and four to five houses for rent. Five trailer pads are for rent and 10 pads are being added to the Sleepy Hollow Trailer Court. In addition, there are 300 undeveloped trailer pads, 50 developed lots at the Anvil Points facility, and 55 lots which can be developed.

### 4.5.2 Public Services

#### 4.5.2.1 Schools

The West Garfield School District, RE 2, serves the area surrounding and including Rifle, Silt, and New Castle. The population of these towns is estimated at 3,500, 750, and 625, respectively, and the schools serve areas beyond the town boundaries. The service area for the school district runs approximately two miles east of New Castle, west 0.25 miles from Rulison, south to the Mesa County line and north to the Rio Blanco County line.

Each of the three towns has an elementary school. In 1979, Silt had 200 elementary students and 13 teachers; New Castle, 225 students and 15 teachers; and Rifle, 583 students and 27 teachers. There are 78 students at the New Castle Junior High School, 4 full time and 5 part time teachers. At the Rifle Junior High, there are 203 students and 17 teachers. The Rifle Senior High School had a 1979 enrollment of 526 students and 32 teachers. The area schools had a combined capacity of 1,890 students and a total enrollment of 1,846 students with 109 teachers.

#### 4.5.2.2 Water Supply

The city of Rifle owns its water system which serves around 1,200 water taps; including some located outside the city limits. The current population uses approximately 712,000 gallons per day (gpd).

Two treatment plants provide water for Rifle, the Graham Mesa plant and the Beaver Creek plant. The Graham Mesa plant is located northeast of town and pumps water from the Colorado River to the plant; a gravity flow system transfers water from Beaver Creek for treatment and consumption. A new treatment plant will be operational by the end of 1980. Phase I-pumping station and Phase II-storage tanks construction have already been completed.

Four water storage tanks serve the city: a 600,000 gallon tank at the Beaver Creek plant; a 250,000 gallon tank at the Graham Mesa plant; a 500,000 gallon tank at the Rifle cemtery; and a new 3,000,000 gallon tank Northeast of Rifle. The water distribution system for the city is a grid of four, six, eight, and 12 inch lines made primarily of cast iron pipe and asbestos cement pipe.

#### 4.5.2.3 Sewage

Rifle owns and operates a sanitation system serving about 360 sewer taps; including a few taps outside of town. Average daily flow into the plant at 112 gpcd is approximately 252,000 gpd.* The sewage treatment system is an aerated stabilization pond plus a nonaerated polishing pond. The present collection system consists of 55,600 feet of 3.0 to 15.0 in. sewer mains and an estimated 31,600 feet of service lines. The mains vary greatly in composition, consisting of either vitrified clay, asbestos fiber, asbestos cement, corrugated metal pipe, or PVC. A new sewage treatment plant will be operational by late 1980.

* gpcd = gallons per capita per day;
gpd = gallons per day.

4.5.2.4 Police Services

The Rifle police force consists of nine officers. The staff also includes one secretary and six part-time dispatchers. Two cars are used by the force. The force is headquartered in the basement of the Town Hall. The area is approximately 2,400 square feet with potential to expand by using the remainder of the basement. Two cells are available but only one is operable. This cell can contain up to three prisoners on a temporary basis.

4.5.2.5 Fire Protection Services

Rifle has one fire station, 25 volunteer firemen, one pumper truck, and two emergency vehicles. The rural fire department uses the same volunteer personnel in addition to one station, one pumper truck, and a 400 gallon capacity pick-up tanker. Approximately 69 fire hydrants are in the city's fire-protection water system. The hydrants mostly are equipped with 2.5-inch host nozzles and a few with a 4.0 inch pumper nozzle.

4.5.2.6 Medical Services

The Clagett Memorial Hospital serves Rifle, Grand Valley, and much of the remaining population in central Garfield County. Currently, 32 beds are available, with 18 generally in use. Full time medical staff for both hospital and nursing home includes five doctors (1 internist and 4 general practicioners) and 6 nurses. Part time staff includes 15-20 visiting doctors and 14 part time nurses.

## 4.6 REGIONAL HISTORIC, SCENIC, CULTURAL, AND RECREATIONAL FEATURES

The proposed Paraho project will be located along the southern edge of the Piceance Creek Basin in Colorado. The basin, one of four constituting the Green River Formation, has received considerable attention for its kerogen-rich shale. Several Federal and private projects investigating the possible commercial extraction of shale oil in the area are in various stages of development. No other known minerals of value are associated with the oil shale on the NOSR with the exception of isolated nahcolite pods found at Anvil Points mine locations over the past 26 years. Union Carbide's uranium-vanadium mill in Rifle is the only significant manufacturing industry in the immediate area. Sheep and cattle raising have been the leading industries. Two rail-heads are located at Rifle and Grand Junction, and two airlines at Grand Junction.

Generally, the Piceance Creek Basin may be characterized as a scenic, unspoiled natural setting. The basin constitutes one of Colorado's most important mule deer winter hunting ranges. Big game hunting is the major recreational pursuit in the basin. No recreation of any kind will be allowed on the Anvil Points site.

An Archaeological Survey of the NOSR, completed in 1973 by the Department of Anthropology, University of Colorado, recorded eighty archaeological and historical sites. Only one of these sites may represent a nonseasonal habitation; all other sites apparently were temporary camps or specialized areas used by prehistoric people for summer hunting and foraging activities. No surface architectural manifestations are evident at any of the sites, and presently the true extent of cultural features is unknown. None of the regional sites are on the proposed project area. Construction will be monitored, and if material of archaeological interest is discovered, a qualified archaeologiest and the State Historic Preservation Office will be requested to assess the site's archaeological significance (see Appendix D).

## REFERENCES

## SECTION 4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# 5. ENVIRONMENTAL EFFECTS OF CONSTRUCTION AND OPERATION

Under the proposed and alternative site actions, the authorized amount of oil shale to be processed would increase from 400,000 tons to 11 million tons, accompanied by construction and operation of a full-size retort module facility and the associated mine, crushing, storage, and spent shale disposal facilities. These proposed and alternative site additions, modifications, and the accompanying operations, pose potential impacts on the environment. These impacts, as they affect the land, water, air, vegetation, animal life, and social and economic environments of the areas involved, are discussed in the following subsections. Mitigating measures associated with the impacts are discussed also.

## 5.1 LAND USE

### 5.1.1 Impacts

The proposed expansion of retort facility operations at Anvil Points will cause minor changes in the existing land use patterns in the area, since the area has already been developed for semiworks operation. Major construction activities affecting land use include new roadway construction and existing roadway expansion; construction and modification of water and product lines; and construction of the oil shale conveyor system. The use of the estimated 64 acres required for the project are summarized in Table 5-1.

The use of Balzac Bulch as a disposal site will require the construction of a new access road. The road will be 1.5 miles long and 30 feet wide, and will disturb approximately 10.5 acres.

TABLE 5-1

ESTIMATED LAND USE ACREAGE REQUIRED FOR
EXPANDING OF PARAHO FACILITIES

| FACILITIES | ACRES |
|---|---|
| Retorting Plant | 5 |
| Product and Water Lines | 10 |
| Expansion of Existing Roads | 8 |
| New Access Road to Balzac Gulch | 10.5 |
| Retorted Shale Disposal Site | 30 |
| Soil Core Holes | 0.5 |
| TOTAL. . . . . . . . . . . . . . . . . . . . . . . . . | 64.0 |

SOURCE: DEI estimates.

An additional power line from the highway area to the process site will be designed and erected, using the existing corridor and poles. The existing mine road will be widened and improved in some areas to provide support for larger mining and transportation equipment. Expanding existing roads will disturb an estimated eight acres.

Approximately 10 acres will be disturbed by modifying and constructing water and product lines. Modification of the existing two mile water line from the site to the pumping station will require five acres. About two acres will be disturbed for the construction of a one mile line to the proposed retorting site for water and sanitation facilities. An additional three acres may be disturbed temporarily by the installation of a six inch product oil line from the retort site to the existing storage facilities -- a distance of about 1.5 miles.

The projected belt conveyor system to be installed from the mine to the retort site (a distance of 1.5 mile) will cause minimal surface disturbance. This system will be underground in a 12 x 14 ft drift. The excavated material will be piled and used later.

During operation, land will be disturbed by mine development and excavation, and spent oil shale disposal. Expanding the existing mine and associated facilities will require a new access adit (40 x 50 x 200 ft), a new ventilation adit (40 x 50 ft), a new crushing area (40 x 60 ft), and a wider portal bench (20 additional feet). The mine extension will not disturb the surface, since oil shale will be mined from a 73 foot seam by the underground room-and-pillar method. However, due to the flatter land covering the extensions, the overburden in the mine extension will be 200 feet, versus 400 feet in the present mine. A mining area of about 53 acres will be used during the first two-plus years of operation; with an extension of the program, mining area may involve up to 138 acres.

The major surface land disturbance will be the proposed disposal of retorted shale into the Blazac Gulch. This is expected to affect 30 acres of the gulch to depths of 400 feet, if 11 million tons of oil shale are retorted. Retorted shale will be compacted at the disposal site to stabilize the material and to minimize the affected area.* The initial deposition will establish a dike at the 6,200 foot elevation, running east-west across the gulch (see Figure 4-2). A 400 ft retention dam below the dike will contain runoff and leachate from the disposal site (see Section 2.2.2.5). Additionally, land disturbance will occur from the disposal or storage of raw shale fines. The exact amount of surface disturbance has not yet been determined. If the raw shale is used as a topping material over a retorted shale pile it will have to be stored until its use. One to three acres would be required for the storage, and the storage area would be prepared to prevent spontaneous combustion and mixing with hot-spent shale. It will also be necessary to determine the compatability of the raw shale with plants that will be used for revegetation.

If the raw shale is "sandwiched" between layers of compacted spent shale, or mixed with the spent shale prior to compacting, monitoring systems will be required to detect combustion of raw shale.

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* See section 5.3 on Water Quality Impacts for discussion of spent shale disposal methodology. General disposal plans are presented in Section 2.2.2.5.

Approximately three soil core holes will be needed for stability studies at the proposed retort site. These holes will disturb less than one-half acre of surface.

### 5.1.2 Summary of Mitigating Measures

The area most affected by changes in land use will be the Balzac Gulch disposal site. In addition, land will be disturbed by retort and mine development, and road, pipeline and conveyor construction.

These impacts will be reduced by revegetating the Balzac Gulch as soon as possible. Studies conducted on spent shale disposal show that revegetation of some plant species is possible, if adequate site management is instituted. In addition, the areas behind the retention and stream diversion dams could be filled; thus making the site appear to be an extension of the hogback. DEI has not finalized plans for the disposal site area; therefore, this is only a tentative possibility.

Pipeline and conveyor areas will be reseeded soon after completion of construction. In addition, under State reclamation laws, DEI is required to file a plan indicating their provisions for restoring the site to its original condition. DOE will ensure that the site will be restored in accordance with State requirements.

## 5.2 AIR QUALITY

### 5.2.1. Impacts

This subsection describes air quality impacts of the proposed Anvil Points oil shale facility, including impacts from mine development, shale extraction, construction, and operaton of the retort and support facilities. Fugitive dust particulate emissions would result from construction, mining, processing, transporting, and disposing of the shale. Vehicles and mining equipment would emit carbon monoxide (CO), nitrogen oxides ($NO_x$), minor amounts of hydrocarbons (HC), sulfur dioxide ($SO_2$), and particulates. The major air pollutants emitted during module operation would be nitrogen oxides ($NO_x$), sulfur dioxide ($SO_2$), and particulates. The results of dispersion modeling are presented to show the potential effects of these emissions on ambient air quality.* The planned environmental research program relating to air emissions from the proposed facility also is summarized briefly.

#### 5.2.1.1. Mine Development and Operation

The mine must be expanded for full-scale operation. This expansion would include preparing the crushing site, shale storage area, ore-pass, and mining

* The emission estimates and modeling results in this section were obtained from the air permit application prepared by the Anvil Points developers; this permit application, "Air Emission Source Construction and Operating Permit Application," was submitted to EPA and the Colorado Department of Health by Development Engineering Inc. July 5, 1978 and updated by the developers in September 1978. The modeling analysis is summarized in Appendix A. The complete permit application, with modeling details is on file at the Laramie Energy Technology Center, Office of Environment and Conservation, P. O. Box 3395, University Station, Laramie, WY 82071.

area. Although the same pollutants are emitted during mine development as during mining operations, development emissions should constitute no more than 20 percent of the mining emissions.

During module operation, mining activities include blasting; operating the mining equipment, extracting the oil shale, and crushing the oil shale. Pollutant emissions would include particulates generated during all activities, and CO, $NO_x$, HC, and $SO_2$ generated by mining equipment and blasting.

Table 5-2 shows uncontrolled emission rates, control measures used, and controlled emission rates for the pollutants emitted during mining operations. Particulates are the major mining pollutant and, consequently, the only pollutant controlled.

Mine vent particulate emissions would be controlled by wet suppression in the mine working areas and by routing the ventilation air through mined-out chambers, evoking baffled settling of airborne particles. A combined reduction efficiency of 98.5% is estimated (75% by wet supression; 23% by settling, as the air moves in circuitous routes through the mining area). During the early mining phases particulate emissions are expected to be slightly higher because wet suppression alone would be used until sufficient area has been mined out to permit baffled settling. Thus, the 98.5% combined control efficiency would be reduced temporarily to 75% particulate control by wet suppression alone.

The primary crusher would be located in the mine. Material handling points and other dust emission points associated with this equipment would be covered with collection ducts. Collected air would be ducted through a baghouse having a collection efficiency of 99 percent.* The baghouse emissions would travel with the ventilation air through the mine and would exit through the mine vent. The primary crusher baghouse exhaust would provide additional emission reductions since it would pass through active wet suppression zones, and cover the maximum chambered settling distance before exiting.

### 5.2.1.2 Construction of the Retorting Facility

Construction of the retort would involve the following activities:

- Vehicle traffic in the mining and module site areas
- Excavating the module site
- Building a road to the processed shale disposal area
- Improving the road between the gate and the module site
- Constructing the retort
- Installing product and water pipelines

Table 5-2 shows pollutant emission rates and control measures for construction activities. The major pollutant emitted during construction is particulate matter in the form of fugitive dust. Minor amounts of CO, HC, and $NO_X$ also are emitted by vehicle traffic.**

* Based on a shale size distribution of 0.25 to 3.0 in. and a load of 12,500 tons/day. 99 percent baghouse efficiency was obtained from a Colorado Air Pollution Control Division standard, found in "Emisson Factors for Mining Operations." Table A-2. Colorado Air Pollution Control Division.

** Vehicle emissions are not given in Table 5-2 because they are relatively low. They are included, however, in the dispersion modeling. Emission estimates are given in the air permit.

TABLE 5-2

SUMMARY OF DAILY EMISSION ESTIMATES DURING MINE DEVELOPMENT, MINING, CONSTRUCTION, AND OPERATION AT THE ANVIL POINTS OIL SHALE FACILITY

| ACTIVITY | SUBACTIVITY | MATERIAL HANDLED | POLLUTANT | UNCONTROLLED DAILY EMISSIONS (lbs/day) | CONTROL MEASURES | CONTROLLED DAILY EMISSIONS (lbs/day) |
|---|---|---|---|---|---|---|
| MINING AND MINE DEVELOPMENT[a] | Mining | 8400 tons/day oil shale | Particulate | 75.60 | Wet suppression and baffled settling - 98.5% | 1.13 |
| | Blasting | 8400 tons/day oil shale | Particulate | 84.00 | Wet suppression and baffled settling - 98.5% | 1.26 |
| | | 4540 lbs/day ANFO | $NO_x$ | 7.26 | none | 7.26 |
| | | | CO | 95.79 | none | 95.79 |
| | Mining Equipment | 1510 gal/day diesel fuel | CO | 135.90 | none | 135.90 |
| | | | HC | 42.28 | none | 42.28 |
| | | | $NO_x$ | 646.28 | none | 646.28 |
| | | | $SO_2$ | 46.81 | none | 46.81 |
| | | | Particulate | 33.22 | none | 33.22 |
| | Primary Crushing | 8400 tons/day oil shale | Particulate | 4200.00 | Baghouse - 99% Wet suppression and baffled settling - 98.5% | 0.63 |
| FACILITY CONSTRUCTION | Vehicle Traffic[b] | 180 VMT/day | Particulate (fugitive) | 828.44 | Wet suppression - 75% | 207.11 |
| | Excavation, Roads, and Pipe Lines | | Particulate (fugitive) | 340.06 | Wet suppression - 50% | 170.03 |
| FACILITY OPERATION[b] | Secondary Shale Crushing and Shale Transport | 8400 tons/day oil shale | Particulate | 20190.75 | Baghouse - 99% | 201.91 |
| | Gas Turbine/ Boiler/Thermal Oxidizer | $54.4 \times 10^6$ SCF/day of gas | $NO_x$ | 10172.80 | Gas treating - 90% | 1017.28 |
| | | | $SO_2$ | 6092.80 | Gas treating - 99% | 60.93 |
| | | | Particulate | 228.48 | Gas treating - 50% | 114.24 |
| | Spent Shale Disposal Area | 15 acres | Particulate (fugitive) | 6.42 | Wet suppression - 75% | 1.60 |
| | Shale Storage | 75,000 tons/year oil shale | Particulate (fugitive) | 48.74 | none | 48.74 |
| | Vehicle Traffic[c] | 120 VMT | Particulate (fugitive) | 552.21 | Wet suppression - 75% | 138.05 |

a/ Emissions given are for full-scale mining during module operation. Emissions during mine development are at most 20% of these.

b/ Emissions given are for maximum capacity module operation (8400 TPD).

c/ Gaseous emissions from vehicle traffic are not included in this table, but are considered in the dispersion modeling.

SOURCE: Air Permit. PSD Permit, See Footnote, p. 5-6

TABLE 5-3

BOILER STACK EMISSIONS

| Date | Boiler | $O_2$ | $CO_2$ | CO | HC | $SO_2$[1]/ | NOx[1]/ |
|---|---|---|---|---|---|---|---|
| 03-13-75 | N | 10.3 | 5.7 | 0.0 | 0.2 | Fl | |
| 03-24-75 | N | 8.0 | 4.5 | 0.0 | 0.3 | Fl | |
| 04-10-75 | N | | | | | | 91 |
| 10-15-75 | N | 12.3 | 5.5 | 0.0 | 0.0 | 3 | 94 |
| 03-13-75 | S | 10.9 | 5.2 | 0.0 | 0.1 | Fl | |
| 03-24-75 | S | 10.1 | 1.7 | 0.0 | 0.4 | 2 | |
| 04-10-75 | S | | | | | | 58, 63 |
| 10-15-75 | S | | | | | Fl | 128 |
| 03-13-75 | G | 10.9 | 4.8 | 0.0 | 0.3 | Fl | |
| 03-24-75 | G | 5.9 | 7.2 | 0.0 | 0.4 | Fl | |

[1]/Values in ppm; all others, vol% (wet basis).

SOURCE: DEI monitoring data. January 1977.

TABLE 5-4

THERMAL OXIDIZER STACK EMISSIONS

| Date | Run | Volume - Percent (Wet Basis) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $O_2$ | $CO_2$ | CO | HC | $SO_2$ | $NO_x$ | $NH_3$ |
| 12-30-74 | SW-5 | 9.8 | 6.2 | 0.0 | 0.0 | -- | -- | -- |
| 03-05-75 | SW-7 | 7.6 | 8.6 | 0.46 | 0.0 | -- | -- | -- |
| 03-05-75 | SW-7 | 7.2 | 9.6 | 0.18 | 0.0 | -- | -- | -- |
| 03-06-75 | SW-7 | -- | -- | -- | -- | 0.002 | -- | -- |
| 03-12-75 | SW-7 | 7.7 | 8.9 | 0.0 | 0.0 | 0.012 | -- | -- |
| 03-12-75 | SW-7 | -- | -- | -- | -- | 0.014 | -- | -- |
| 03-13-75 | SW-7 | -- | -- | -- | -- | 0.008 | -- | -- |
| 05-06-75 | SW-8 | -- | -- | -- | -- | 0.010 | 0.016 | -- |
| 05-06-75 | SW-8 | -- | -- | -- | -- | 0.014 | -- | -- |
| 05-08-75* | SW-8 | 7.7 | 8.1 | 0.0 | 0.0 | 0.038 | 0.022 | -- |
| 05-09-75 | SW-8 | -- | -- | -- | -- | 0.019 | -- | -- |
| 05-09-75 | SW-8 | -- | -- | -- | -- | 0.018 | -- | -- |
| 05-09-75 | SW-8 | -- | -- | -- | -- | 0.022 | -- | -- |
| 05-14-75* | SW-8 | 7.9 | 7.9 | 0.0 | 0.0 | 0.015 | 0.022 | -- |
| 05-29-75 | SW-9 | 8.6 | 8.8 | 0.0 | 0.0 | -- | -- | -- |
| 07-21-75 | SW-10 | -- | -- | -- | -- | 0.026 | 0.017 | -- |
| 07-30-75 | SW-14-4 | -- | -- | -- | -- | 0.005 | 0.022 | -- |
| 08-22-75 | SW-11 | 8.0 | 11.3 | 0.0 | 0.0 | 0.010 | 0.042 | -- |
| 08-26-75 | SW-11 | 11.0 | 7.9 | 0.0 | 0.0 | 0.017 | 0.030 | -- |
| 10-21-75 | SW-17 | -- | -- | -- | -- | 0.007 | 0.030 | -- |
| 11-05-75 | SW-20 | -- | -- | -- | -- | 0.003 | 0.036 | -- |
| 11-11-75 | SW-20 | 11.4 | 7.6 | 0.0 | 0.0 | 0.003 | 0.016 | 0.028 |
| 11-13-75 | SW-20 | 11.6 | 7.8 | 0.0 | 0.0 | 0.013 | 0.023 | 0.040 |
| 11-18-75 | SW-20 | 11.5 | 8.0 | 0.0 | 0.0 | 0.021 | 0.022 | 0.015 |
| 11-20-75 | SW-20 | 11.7 | 7.0 | 0.0 | 0.0 | 0.010 | 0.028 | 0.026 |
| 11-25-75 | SW-20 | 9.8 | 8.6 | 0.0 | 0.0 | 0.026 | 0.026 | 0.012 |
| 11-25-75** | SW-20 | | | | | 0.019 | | |
| 11-26-75** | SW-20 | | | | | 0.033 | | |
| 12-31-75 | SW-21 | -- | -- | -- | -- | 0.120 | | |

* Gulf
** R.M.T.

SOURCE: DEI Monitoring data. Laramie Energy Research Center. January 1977. Proposed Paraho Full-Size Module Project. Draft EIS, Table E-3.

TABLE 5 - 5

CONTROL MEASURES

| POLLUTANT | CONTROL TECHNIQUE | EFFICIENCY (Percent) |
|---|---|---|
| Particulates (From Mine) | Wet Suppression and Baffled Settling Chamber | 98.5 |
| Particulates (Shale Handling) | Baghouse | 99 |
| Particulates (Shale Handling) | Wet Suppression | 75 |
| Particulates (Construction) | Wet Suppression | 50 |
| $NH_3$ ($NO_x$) | Gas Treating - Ammonia Water Wash | 90 |
| $H_2S$ ($SO_2$) | Gas Treating - $H_2S$ Stretford removal | 99 |
| Particulates | Gas Treating - Particulate removal by ESP's, water wash, and Stretford cartridge | 50 |

Fugitive dust emissions are generated by land clearing, ground excavation, cut and fill operations, road improvements, new road construction, and construction of the facility itself. Dust emissions vary substantially from day to day, depending on the level of activity, the specific operation, and the prevailing weather, A large portion of the emissions would come from vehicle traffic over unpaved roads at the construction site.

Various control techniques can reduce dust emissions substantially. For example, watering twice daily can reduce dust emissions by about 50%. Additionally, chemical suppressants for dust control can achieve an 80% control efficiency on completed cut and fill operations (EPA, 1974). Limiting vehicle speed to 20 mph can reduct dust emissions by 65% (EPA, 1976).

Speed limits and wet suppression techniques would be the primary mitigating measures to limit fugitive dust emissions during construction at Anvil Points to the levels given in Table 5-2 (based on 50 to 75 percent reduction). The construction period is expected to last approximately 18 months.

#### 5.2.1.3 Operation of the Retorting Facility

Operating the retort presents three possible sources of air pollution. Shale handling and processing can produce large fugitive dust emissions unless proper control measures are used. Combustion of fuel gas in the gas turbine/boiler/thermal oxidizer complex causes $NO_x$, $SO_2$, and particulate emissions. Measurements of gaseous emissions from the pilot plant are given in Tables 5-3 and 5-4. Fugitive dust and minor emission levels of CO, HC, and $NO_x$ also would be generated by vehicle traffic during operation. Table 5-5 shows the emission control techniques that would be used and the expected control efficiency of each technique.

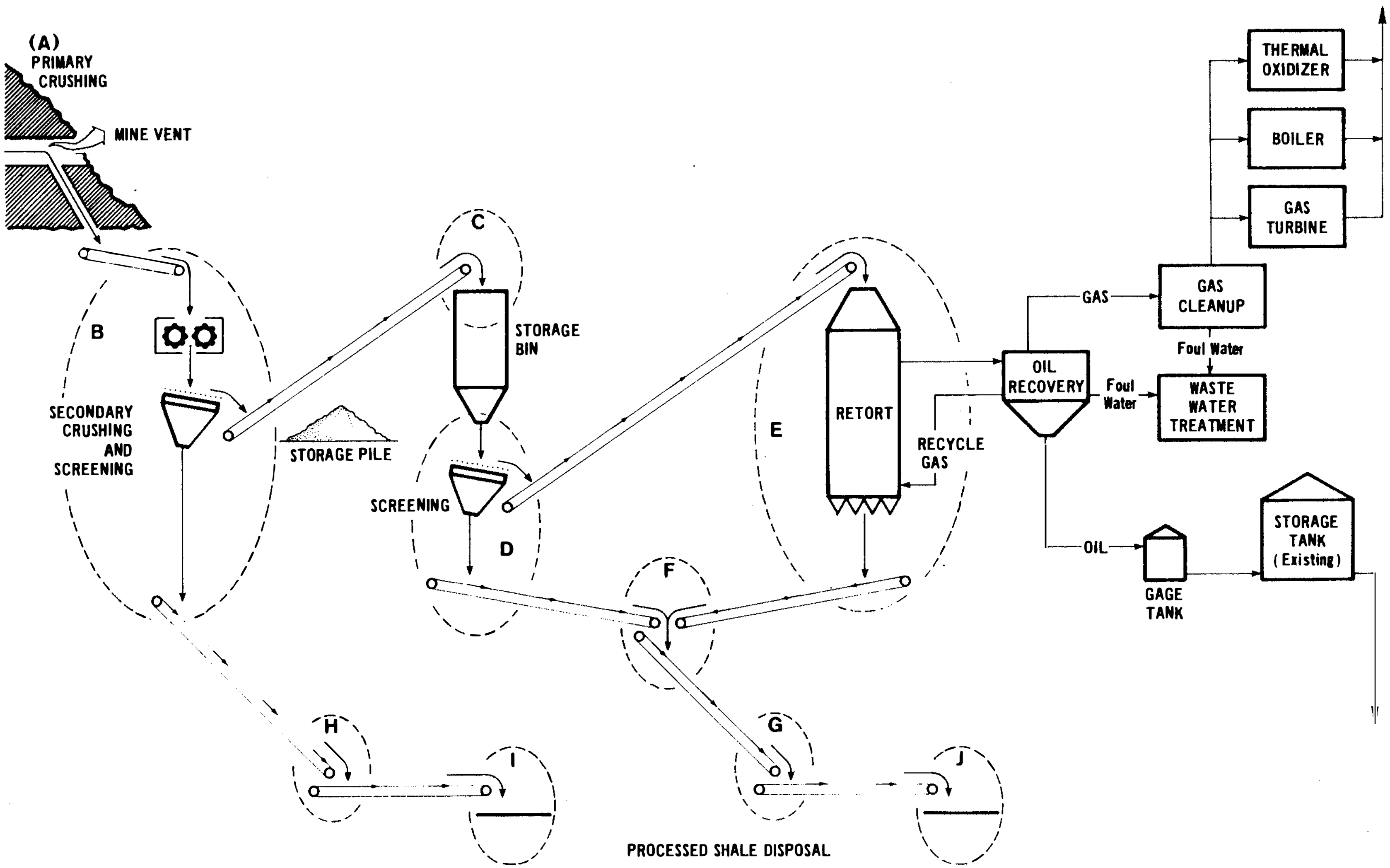
Shale rock is processed and handled several times between excavation and disposal. Fugitive dust from the shale rock is emitted during secondary crushing and screening, conveyor transport, and loading into retort storage bins, or disposal pile. Wind erosion also can affect the 75,000 ton shale storage pile at the retort site, the fine storage pile, and disposal areas.

Particulates will be found in:

- End product gas or oils (removed off-site)
- Ammonia removal wastwater stream (disposed of in processed shale pile)
- Cartridge filter at inlet to Stretford unit (disposed with sulfur in processed shale pile)
- Stack emissions from gas turbine/boiler/thermal oxidizer stack (subject to State and Federal emissions standards)

Several mitigating measures would be used to control fugitive dust during the Anvil Point operations. All conveyors would be covered. All major shale transfer points would have a dust collection duct leading to a baghouse, each of which would have a collection efficiency of al least 99 percent (see Figure 5-1). This efficiency ratio is based on equipment standards from the Colorado Air Pollution Control Division standard, found in "Emission Factors for Mining Operations, Table A-2, 1978. Conventional road wetting and pile spraying techniques would be used in the shale disposal area. These techniques should achieve a control efficiency of 75%, particularly since processed shale exhibits natural cementation properties (EPA, 1976). Controls for the fine disposal area have not yet been formulated. No control measures are planned for the shale storage pile because the retorting process is sensitive to shale

## FIGURE 5–1
## LOCATION OF BAGHOUSE COLLECTION DEVICES
## (Items A–J)



moisture content. However, the relatively large size raw shale feed (1.0-3.5 inches) discourages fugitive dust emissions from the storage pile.

Fuel gas combustion is also a major air pollutant source associated with facility operation. One of the retorting products is a low heating value off-gas. Analysis of previous small-scale Paraho equipment runs shows that the gas contains ammonia ($NH_3$) and hydrogen sulfide ($H_2S$) (Jones, 1977). To control $NO_x$ and $SO_2$ emissions from gas combustion, the concentrations of $NH_3$ and $H_2S$ must be reduced before burning.

Paraho lab tests show that most of the $NH_3$ gas can be removed by applying the U.S. Steel Phosam-w process. Although this process generally is used in coke plant operations, manufacturers expect the process to be applicable to other technologies. The system can be used for recovering the ammonia from any gas or vapor stream, and is particularly advantageous when other acidic gases (such as $H_2S$) are present. The $NH_3$ concentrations in the treated gas are expected to be approximately 140 ppm (volume), based on a 90% removal efficiency (although tests have shown that reductions to 20 ppm are possible). $NH_3$ controls should reduce fuel $NO_x$ emissions from the burned gas by at least 90%. Flame temperature in the gas turbine/boiler or thermal oxidizer unit would be low enough to prevent any significant thermal $NO_x$ formation from nitrogen gas in the combustion air.*

* Fuel $NO_x$ is that quantity of $NO_x$ which is traceable to organically bound nitrogen in the fuel; thermal $NO_x$ is that quantity of $NO_x$ which results from oxidation of molecular nitrogen in the combustion air.

Sulfur would be removed from the retort gas stream by a Stretford sulfur removal unit (or equivalent). A 99% removal efficiency is assumed; resulting in an outlet $H_2S$ concentration of about 77 ppm (volume). Process licensors predict a greater removal efficiency (99.999%), since data from the pilot and semiworks plant show that the sulfur in the retort off-gas is predominantly in the form of $H_2S$ (the primary sulfur compound removed by Stretford processing). A maximum recovery of about 1.5 tons per day of elemental sulfur from the gas stream is anticipated. Sulfur from the Stretford unit and all waste sludges would be disposed with the processed shale. Unit effluent streams will contain vanadium salts, sodium thiocyanate and sodium thiosulfate. Reductive incineration of these materials is reported to result in zero discharge from the unit. Presently, no plans have been made for marketing process by-products.

Particulates from the retort gas stream are removed at several points. Primarily designed for oil/gas separation, the wet ESP's also would reduce the particulate content. The water wash, the hydrocarbon recovery process, and a cartridge filter at the inlet to the Stretford unit are estimated to reduce particulate emissions by an additional 50%.

Oil collected from precipitators will be pumped through heat traced and insulated lines to one of two 4,000 bbl gauging tanks. Oil will then be transferred to storage tanks. The existing storage facilities for shale oil consist of a 1,000 bbl tank farm near the existing facility. These tanks are supplemented by rundown tanks for catching any overflow. Storage tanks on the facility are exempted from the "Standards of Performance for Storage Vessels for Petroleum Liquids," and no vapor control measures are proposed. Sampling vents from existing storage tanks at the semiworks and pilot plants show no detectable HC emissions; however, a scale-up in production capacity poses the potential for increased emissions. Controls would be established according to permit requirements.

### 5.2.1.4 Total Air Pollutant Emissions

Average daily and monthly pollutant emission rates were calculated based on the operation schedule for each phase of the Anvil Points project.* Emission rates for particular activities given in Table 4-2. In general, the major emissions during the construction and mine development phase will be 3.0 tons/month of fugitive particulates. The major emissions during full-scale mining and retort operation will be 21.5 tons/month of $NO_x$, 7.4 tons/month of particulates (mostly as fugitive dust), and 2.5 tons/month of $SO_2$. These figures include periodic emissions from the pilot and semiworks plants which will operate in support of the full-scale module. Emission rates are detailed in Appendix A.

### 5.2.2 Ambient Air Quality Impacts

This subsection presents the results of dispersion modeling conducted to predict the air quality of the Anvil Points facility. Impacts of $NO_2$, $SO_2$, and particulates were modeled. As discussed in the previous section, CO and HC are the only other air pollutants, and are emitted by vehicular traffic (less than 150 vehicle miles/day). These emissions are too low to impact ambient air quality significantly, and, therefore, were not incuded in the model.

* A detailed operating schedule is given in the air permit application.

The Federal ambient air quality standards applicable to Anvil Points are given in Table 5-6. The Federal PSD standards are incremental standards (i.e., they establish a limit on increases of ambient pollutant concentrations over baseline levels). Anvil Points is in a Class II area (limited development) under the incremental standard, and the allowable increments for this class are presented in Table 4-6. All other Federal standards apply to total ambient pollutant concentrations, rather than increments. All State ambient air quality standards are identical to Federal standards. To predict the impacts on the Anvil Points area, modeling was conducted for $NO_2$, $SO_2$, and particulates for each averaging period to which standards are applicable. In addition, modeling was used to predict possible $SO_2$ impacts from the proposed facility on the closest Class I area (under the Federal incremental ambient standards). This area is the Flat Tops Wilderness Area, 35 miles northwest of Anvil Points. The allowable Class I $SO_2$ increments for this area are 2 $\mu g/m^3$ (annual mean); 5 $\mu g/m^3$ (24 hour maximum); and 25 $\mu g/m^3$ (three hour maximum).

The modeling results presented here are based on maximum emissions during the mining and operation phase described earlier. Predicted impacts from the facility were added to the background pollutant levels and the resultant ambient levels compared with ambient standards. Impacts during the construction and mine development phases were not modeled. Nevertheless, the particulate emissions for facility operation can be considered worst-case impacts for this phase (since fugitive dust emissions during construction and mine development are less than those during full-scale operation).

The background pollutant levels assumed for the modeling are based on the ambient pollutant concentrations presented in the existing air quality section

(Section 5.2.2). The 5 μg/m$^3$ average $NO_2$ measurement at the C-b oil shale tract 25 miles from Anvil Points, and the 16 μg/m$^3$ average $SO_2$ measurement at the Colony site are used as background levels for these pollutants. These measurements were taken over a two year period and are assumed to represent the long-term average, equivalent to annual averages.

The 14 μg/m$^3$ average particulate concentration measured at the Anvil Points site is used as the background particulates level. Although this level is based on only four months of measurements, it is assumed to represent annual mean levels in the absence of more representative data. The 14 μg/m$^3$ background level assumption is supported by the 7 μg/m$^3$ and 14 μg/m$^3$ annual mean levels measured at Rio Blanco.

The predicted impacts during facility operation (including mining impacts) are presented in Table 5-6 and graphically in Appendix A. The maximum predicted annual mean and 24 hour particulate impacts are 14 μg/m$^3$ and 55 μg/m$^3$, respectively. These impacts are added to the 14 μg/m$^3$ background level, resultant ambient levels are below both the Federal and State particulate standards.

The maximum annual mean impacts for $NO_2$ and $SO_2$ are caused by vehicle emissions from the mine vent. The maximum annual mean $NO_2$ and $SO_2$ impacts of 33 μg/m$^3$ and 2 μg/m$^3$, respectively, are predicted to occur within 0.25 mile of the mine vent. The effluent gas from the mine vent is emitted at ground level at ambient temperatures, and therefore has a low plume height. When the $NO_2$ and $SO_2$ impacts are added to the corresponding background level, the resultant ambient concentrations are well below applicable Federal standards. No violations of the State's incremental $SO_2$ standard are predicted for the annual mean averaging period.

TABLE 5-6

MAXIMUM PREDICTED AIR QUALITY CONCENTRATIONS AND APPLICABLE AMBIENT STANDARDS

(all concentrations in μg/m³)

| POLLUTANT | AVERAGING PERIOD | ASSUMED BACKGROUND LEVELS | MAXIMUM PREDICTED FACILITY IMPACT | MAXIMUM PREDICTED IMPACT PLUS BACKGROUND LEVEL | APPLICABLE STANDARDS[a/]: AMBIENT[b/] FEDERAL (NAAQS) PRIMARY | APPLICABLE STANDARDS[a/]: AMBIENT[b/] FEDERAL (NAAQS) SECONDARY | APPLICABLE STANDARDS[a/]: INCREMENTAL AMBIENT[c/] COLORADO CATEGORY II | APPLICABLE STANDARDS[a/]: INCREMENTAL AMBIENT[c/] FEDERAL (PSD) CLASS II |
|---|---|---|---|---|---|---|---|---|
| $SO_2$ | 3-Hour | 16 | 258(277)[d/] | 274(293)[d/] | -- | 1300 | 512 | 25 |
| | 24-Hour | -- | 58(58)[d/] | 74(74)[d/] | 365 | -- | 91 | 3 |
| | Annual | -- | 2 | 18 | 80 | -- | 20 | 2 |
| $NO_2$ | Annual | 5 | 33 | 38 | 100 | 100 | -- | - |
| Particulate | 24-Hour | 14 | 55[e/] | 69 | 260 | 150 | 37 | 10 |
| | Annual | | 14[e/] | 28 | 75 | 60 | 19 | 5 |

a/ Standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

b/ Regular ambient standards require consideration of background pollutant levels along with facility impact.

c/ Incremental ambient standards apply to the maximum facility impact without consideration of background levels. The incremental standards given are those which apply to the area around Anvil Points. The Federal PSD standards are presented for comparison only, since $SO_2$ and particulate emissions from the proposed facility are low enough to exempt it from ambient impact review for PSD standards.

d/ Plume impingement impacts are in parentheses.

e/ Particulate impacts are based mostly on fugitive emissions and thus cannot be compared to the Federal PSD standard, which applied only to non-fugitive emissions.

In the case of short-term (24 hour and three hour) $SO_2$ impacts, highest concentrations are caused by emissions from the mine vent. Impacts from the turbine/boiler/thermal oxidizer complex are negligible. Highest overall facility impacts will occur in either of two cases: 1) when the wind blows away from the Roan Cliffs and the mine vent plume disperses in the direction of the retorting facility or 2) when the plume impacts the face of the Roan Cliff above the mine vent.* As shown in Table 5-6, the maximum predicted 24 hour $SO_2$ impact in both of these cases is 58 $\mu g/m^3$. The predicted 24 hour $SO_2$ concentrations fall below the allowable 91 $\mu g/m^3$ Federal ambient increment standard.

When the maximum 24 hour $SO_2$ impacts are added to the 16 $\mu g/m^3$ background $SO_2$ level, the resultant ambient levels are well below the applicable Federal ambient standard (365 $\mu g/m^3$). Similarly, the maximum three hour $SO_2$ impact of 277 $\mu g/m^3$ (associated with plume impact) is less than the allowable increment under the Federal incremental ambient standards (512 $\mu g/m^3$). When this impact is added to the 16 $\mu g/m^3$ background $SO_2$ level, the resultant ambient concentration is still well below the Federal ambient three hour standard (1300 $\mu g/m^3$).

The nearest Federal Class I area is the Flat Tops Wilderness Area, 35 miles to the northest. The modeling predicts that proposed scale up of the Anvil Points facility would not present significant deterioration of the air quality

* Although extended plume impacts on the Roan Cliffs over a 24 hour period is unlikely, this was assumed in the modeling as a worst-case assumption.

in the Flat Tops area. EPA has stated that preliminary analyses indicate that development of a 200,000-400,000 barrel per day industry could consume the Class I increment at Flat Tops. (Thoem et al, 1980). This prediction is surrounded by controversy between modelling experts.

In summary, the proposed facility is predicted to comply with all Federal ambient air quality standards, including PSD standards, and with all Colorado ambient standards.*

### 5.2.3 Anvil Points Research and Development Program for Air Pollution

As part of the environmental research and development program associated with the Anvil Points full-scale module, programs will be set up to accurately characterize air emissions, and to test emission control techniques. In general, this plan will involve monitoring the stack gas from the turbine/boiler/thermal oxidizer complex for the regulated pollutants, evaluating baghouse performance, and sampling the mine exhaust vent. In addition, the performance of the water wash/hydrocarbon recovery process and the stretford unit will be evaluated.

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* The Clean Air Act Amendments of 1977 gave EPA the authority to issue new regulations controlling air pollution from stationary sources. One such regulation is the Prevention of Significant Deterioration (PSD) provision, controlling ambient air quality degradation in clean air areas such as the Anvil Points area. Certain sources are not subject to PSD review for certain pollutants prior to facility construction. The Anvil Points facility qualifies as such a source since its total allowable $SO_2$ and TSP emissions are each below the diminimus level requiring pre-construction review. Consequently, ambient TSP and $SO_2$ impact analysis for the Anvil Points facility with respect to Federal and State Standards is presented for comparative purposes only. DEI and EPA have agreed to discontinue review of the permit until the time that DEI is assured that it will be able to build the proposed module. That decision depends on completion of the NEPA process and a commitment from DOE to make the Anvil Points facility available to DEI for construction and operation of a module.

5.2.4 Summary of Mitigating Measures

Fugitive dust will be the primary air pollutant associated with mine and retort facility construction and operation. The other pollutants, $NO_x$ and $SO_2$, are found in process gases and will be treated by gas cleanup. Particulates found in these gases also will be reduced by gas cleanup.

Fugitive dust resulting from mine development (blasting, hauling, etc.) will be controlled at levels of 98.5% reduction by wet suppression and baffled settling methods. These controls also will be used during mine operation. A baghouse will cover the primary crushing area, resulting in a 99 percent control efficiency for fugitive dust from the crusher.

Vehicle traffic, and land clearing for roads and the retort facility site will cause fugitive dust emissions during facility construction. Although there are a number of ways of mitigating this problem, limiting vehicle speed and wet suppression of disturbed areas appear to be the most applicable. These techniques should result in a 50% reduction in fugitive dust levels during construction.

Fugitive dust caused by vehicle traffic also will be a problem during retort operation. Controls (wet suppression, speed limits) during this phase are expected to produce 75% reduction, since emissions will be fewer and more manageable. Conveyors and transfer points also present potential fugitive dust problems. This will be mitigated by covering or burying all conveyors, and by covering transfer points with baghouses. Baghouse efficiency is estimated to be 99 percent.

Product gases pose particulate, $NO_x$ and $SO_2$ emissions problems. $NO_x$ in the form of $NH_3$, will be reduced by 90 percent through a water wash control system. $SO_2$ in the form of $H_2S$ will be controlled by 99 percent through a Stretford sulfur removal system. Particulates will be filtered through ESP's, and reduced 50% by the filters in the $H_2S$ and $NH_3$ removal systems.

## 5.3 IMPACTS ON WATER USE AND WATER QUALITY

### 5.3.1 Water Use

#### 5.3.1.1 Primary Water Use

Most of the water required for the proposed Paraho project will be used for consumption by plant employees, housing facilities, and to control dust from the retorted shale disposal site. Runoff from the retorted shale pile will be held in a retention pond while it evaporates. The proposed Paraho project should be a closed system, and no return flow from the project is expected. Table 5-7 shows consumption figures and water sources associated directly with the Paraho project.

The water requirements for the proposed Anvil Points facility will be fulfilled primarily by expanding the present water system that supplies Anvil Points from the nearby Colorado River. Projections also call for the possible use of 6.0 afy or 1,955,100 gallons from the spring-fed Glover Park Reservoir, which presently has only 2.0 acre-feet or 651,700 gallons of storage capacity. Expansion plans, subject to the archaeological limitations (see Section 4.6), are to deepen the Glover Park Reservoir using the muck to enlarge the encasement dam. (See Figure 3-2).

DEI has acquired water rights to 1.0 cu ft water/sec which is equivalent to 722.7 acre-feet or 1,187,950,795 gallons of water from the Colorado River per year. This amount will be more than adquate to accomodate the requirements of the modular project and support facilities, even if the retort process and the Glover Park Reservoir cannot provide the projected amount of water. The proposed water usage for the Paraho facility is based on a moderate projection from present experience at Anvil Points. (The modular project is a research and development project, and, as such, is more labor intensive per unit of production than commercial plants).

5.3.1.2 Secondary Water Use

In addition to the onsite water requirements of 122 afy or 39,753,700 gallons (183 acre-ft, or 59,630,550 gallons over 1.5 years), the proposed plant will cause the indirect consumption of 300 afy or 97,755,000 gallons (450 acre-ft or 146,632,500 gallons over 1.5 years). Thus, the total water requirements of the project are estimated to be 422 afy or 137,507,600 gallons (633 acre-ft or 206,263,050 gallons over 1.5 years). Cooling water for power generation will use 136 afy or 44,015,700 gallons (204 acre-ft or 66,473,400 gallons over 1.5 years). City services and offsite housing uses will constitute the remaining offsite water requirements.

Off-site water use will increase the sewage treatment load fo the City of Rifle. It is expected that the new sewage treatment facility (scheduled for operation in late 1980) will accomodate the increased load.

TABLE 5-7

WATER SOURCES AND DIRECT CONSUMPTION DURING
THE PROPOSED PARAHO PROJECT

| SOURCES | ACRE-FEET/YEAR |
|---|---|
| Colorado River | 104 |
| Retort Water Produced | 12 |
| Glover Park Reservoir (above mine) | 6 |
| TOTAL. . . . . . . . . . . . . . . . . . . . . . . . . . | 122 |

| CONSUMPTION | ACRE-FEET/YEAR |
|---|---|
| Housing Area | 22 |
| Plant Employees | 40 |
| Retort Requirements | 2 |
| Mine Employees | 4 |
| Mine Requirements | 2 |
| Retorted Shale Disposal | 52 |
| TOTAL. . . . . . . . . . . . . . . . . . . . . . . . . . | 122 |

| | |
|---|---|
| RETURN FLOW | 0 |

SOURCE: DEI Estimates

In addition, increased water use will impact the total dissolved solids (TDS) levels in the Colorado River. Exact TDS loading is not known; however, it is expected that the Rifle sewage treatment facility can handle the problem.

### 5.3.2 Potential Water Quality Impacts and Associated Mitigating Measures

#### 5.3.2.1 Impacts from Construction

Sediment runoff will occur during construction of the modular retort and support facilities, the construction/expansion of access roads, and the preparation of retorted shale disposal sites. This sediment runoff may affect the water quality during the 18 month construction phase. Based on the Gottschalk equation, the mean annual sediment production rate for the United States is 200 to 4000 tons/sq mi/yr (Franzizi and Linsley, 1972). If the soil is uncovered, this range can increase by a factor of 20. A maximum of 0.1 sq mi (65 acres) of land will be disturbed during the 1.5 year construction period at Anvil Points. Accordingly, sediment runoff could range from 600 to 80,000 tons during this period. Actual runoff into the Colorado River should be at the lower end of that scale, due to the rocky terrain of the site, and the relatively long distance over flat terrain to the river (about 1.5 miles).

Based upon the sediment production rates of basins with similar topography and soil characteristics, the sediment load of the Colorado River basin around Anvil Points is estimated at approximately 200 tons/sq mi/yr. The general drainage area in the vicinity of the site is 7,400 sq mi (DOI, 1974). Thus, in the vicinity of the site, the Colorado River could receive up to 1.5 million tons/yr of sediment loading. The potential sediment runoff of 600 to

80,000 tons during the 18 month construction period for the modular project is approximately six percent (worst-case) of the sediment loading generated in the general drainage area of the site over the course of a year.

Overall, potential water quality impact of facility construction will be mitigated substantially by conventional runoff control measures; preventing the generation and transport of sediment to downstream areas. Structures, with or without vegetation, will be devised to reduce or prevent excessive erosion and even to induce sediment deposition, by preventing runoff water from reaching erosive or transport velocities (Virginia Soil Commission, 1974). Such structures intercept, divert, and dissipate the energy of the runoff, reduce hydraulic gradients, prevent concentration of flows, retard and filter runoff, and contain concentrated flows in non-erodible channels.

Diversion structures used to prevent sediment runoff include: dikes and ditches, waterways, level spreaders, down-drains, check dams or flow barriers, filter berms and inlets. Grade stabilization structures also may be employed. Approximately 50% of construction-related sediment runoff can be controlled. During construction of the Anvil Points facility, it is expected that one or more of these measures will be used to control potential sediment runoff. Therefore, the potential sediment load to waterways generated during construction will be reduced.

#### 5.3.2.2 Impacts from Operation

Retort process water is the major potential source of water quality degradation related to operation of the proposed modular project. The only other potential waste stream affecting water quality may be the effluents generated by gas cleanup operations; chiefly the ammonia removal system. The effluent stream from the Stretford system (sulfur removal) contains byproduct salts, such as sodium thiosulfate, sodium thiocyanate (in some cases), and traces of vanadium salts, and must be treated prior to discharge. Four alternate methods to handle Stretford effluents are: evaporation or spray drying, biological degradation; oxidation combustion; and reductive incineration. The reductive incineration process produces no effluent discharge because all products from this step are recycled. DEI has not yet determined which treatment will be used.

Two operations to remove ammonia have been proposed. One would use a quench or water wash system, which removes ammonia from the product gas by direct water contact. The second option would remove ammonia during recovery of additional hydrocarbons via gas cooling, compression, and phase separation. Under either option, the water streams may be handled as a wastewater (the gas may proceed to sulfur recovery). In this case, it may be discharged into the spent shale disposal area (if feasible and acceptable, or subjected to further treatment before discharge. The best method of ammonia removal at the Paraho facility will be investigated during Phase I of the project. In all cases, existing options are technically and economically feasible, and can ensure minimum impact to water quality as well as compliance with all applicable air and water permits.

For each raw ton of oil shale processed, 0.6 to 1.5 gal waste water will be generated. At this rate, if the raw shale feed rate reaches 7,560 tons/day (maximum production), 11,340 gal/day of process water discharge will be generated. The largest effluent will be generated by the retort. Most of the process water, along with water pumped from the Colorado River, will be used for temperature control, compaction, and dust control during the disposal of raw and retorted shale.

Laboratory analysis data on process water samples from oil storage tanks and recycle gas lines in the semiworks plant are summarized in Tables 5-8 and 5-9. The analyses show that process water is characterized by relatively high ammonium, sulfate, nitrate, and chloride concentrations.

The retorted shale disposal site at Balzac Gulch will mitigate adverse water quality impacts of facility operations. The proposed plan for retorted shale disposal is to use an impervious cross-valley dam and an impervious lining in the valley disposal area (see Figure 5-2). The disposal site, dam, and lining will be constructed from compacted retorted shale, and virtually all leachates from the disposal pile will be prevented from reaching groundwaters. Surface runoff, which might otherwise contaminate surface waters in the area, will be captured. The small stream that flows intermittently through Balzac Gulch will be diverted.

The Woodward-Clyde consultant group conducted laboratory and field tests to determine the physical and chemical properties of retorted shale (Woodward-Clyde, 1976). Compaction, permeability, and leaching/effluent studies on retorted shale from the existing pilot and semiworks plants were evalutated to determine the feasibility of the proposed disposal scheme.

TABLE 5-8

PARAHO PROCESS WATER SAMPLES *

| LOCATION: | Storage Tank | Rundown Tank |
|---|---|---|
| DATE: | 3/12/75 | 8/25/75 |
| ANALYTICAL LAB: | RMT | Gulf |
| CATIONS | | |
| Aluminum | 4.6 | 2.4 |
| Ammonium | 830 | 40800 |
| Antimony | | <0.9 |
| Arsenic | | <0.005 |
| Barium | | <3 |
| Boron | 10 | 1.2 |
| Cadmium | <0.005 | <0.9 |
| Calcium | 100 | 18 |
| Chromium | | 0.3 |
| Cobalt | | 0.15 |
| Copper | 0.04 | 9 |
| Iron | 2.2 | 9 |
| Lead | 0.33 | 3 |
| Lithium | | <2 |
| Magnesium | 200 | 30 |
| Manganese | | 1.2 |
| Mercury | <0.06 | <0.0001 |
| Molybdenum | 0.43 | <0.2 |
| Nickel | | 0.2 |
| Potassium | 18 | 3 |
| Silicon | 3.5 | 3 |
| Silver | | 0.6 |
| Sodium | 140 | 30 |
| Strontium | | 0.6 |
| Tin | | <0.3 |
| Titanium | | <0.2 |
| Vanadium | | <0.3 |
| Zinc | | 1.2 |
| ANIONS | | |
| Chloride | 1550 | 70000 |
| Cyanide | <0.001 | <0.1 |
| Fluoride | 19 | 5 |
| Nitrate | | 2570 |

* All concentrations are in parts per million (ppm).

TABLE 5 - 8 (Continued)

| LOCATION: | Storage Tank | Rundown Tank |
|---|---|---|
| DATE: | 3/12/75 | 8/25/75 |
| ANALYTICAL LAB: | RMT | Gulf |
| Nitrite | | 0.3 |
| Phosphate | 33 | <1.5 |
| Sulfate | 210 | 5500 |
| Sulfide | <0.001 | <0.5 |
| MISCELLANEOUS | | |
| Ash | | 300 |
| Biol. Oxygen Demand | >5000 | |
| Chem. Oxygen Demand | 32000 | 86400 |
| Conductivity, M mho/cm | | 120000 |
| Kjeldahl Nitrogen | 6100 | 33600 |
| Oil and Grease | 900 | 964 |
| pH, units | 8.6 | 8.4 |
| Phenol | 19 | 8.7 |
| Phenolphthalein Alkalinity ($CaCO_3$) | | 620 |
| Threshold Odor Number, units x $10^{-3}$ | | 10-20 |
| Total Alkalinity ($CaCO_3$) | 5900 | 35200 |
| Total Diss. Solids | 23000 | 160000 |
| Total Organic Carbon | 1060 | 19300 |
| Total Sus. Solids | 11 | 70 |
| Total Volatile Solids | | 159700 |
| Turbidity, JTU | | 40 |

SOURCE: DEI

TABLE 5-9

PROCESS WATER ANALYSES

| SAMPLE: | Gas Condensation Distributor Lines Top | Mid. | Tank 522[a/] |
|---|---|---|---|
| | | | ---- |
| DATE: | 11-10-75 | 11-10-75 | 3-3-76 |
| pH | 9.3 | 9.1 | |
| Total Vol. Solids, Wt% | 0.70 | 6.67 | |
| Ash, Wt% | 0.01 | 0.04 | |
| Elemental | | | |
| Total C, Wt% | 1.48 | 3.09 | 1.01 |
| Total H, Wt% | 10.85 | 10.52 | 11.02 |
| Total N, Wt% | 1.09 | 2.01 | 0.97 |
| Min $CO_2$, Wt% | 1.93 | 1.55 | 0.82 |
| $NH_3$, Wt% | 1.52 | 1.05 | 0.63 |
| $H_2S$, Wt% | 0.0001 | 0.0002 | 0.02 |
| Mol ratio ($NH_3$-N/MinC)[b/] | 1.49 | 1.28 | 1.45 |
| Composition, Wt% | | | |
| $NH_4HCO_3$ | 5.3 | 4.0 | 1.8 |
| $(NH_4)2S$ | 0.0 | 0.0 | Trace |
| Soluble Oil[c/] | 1.2 | 3.3 | 0.9 |
| Water[d/] | 93.4 | 88.8 | 96.8 |
| TOTAL | 99.9 | 96.1 | 99.5 |

a/ Rundown from on-line bottom gas cooler

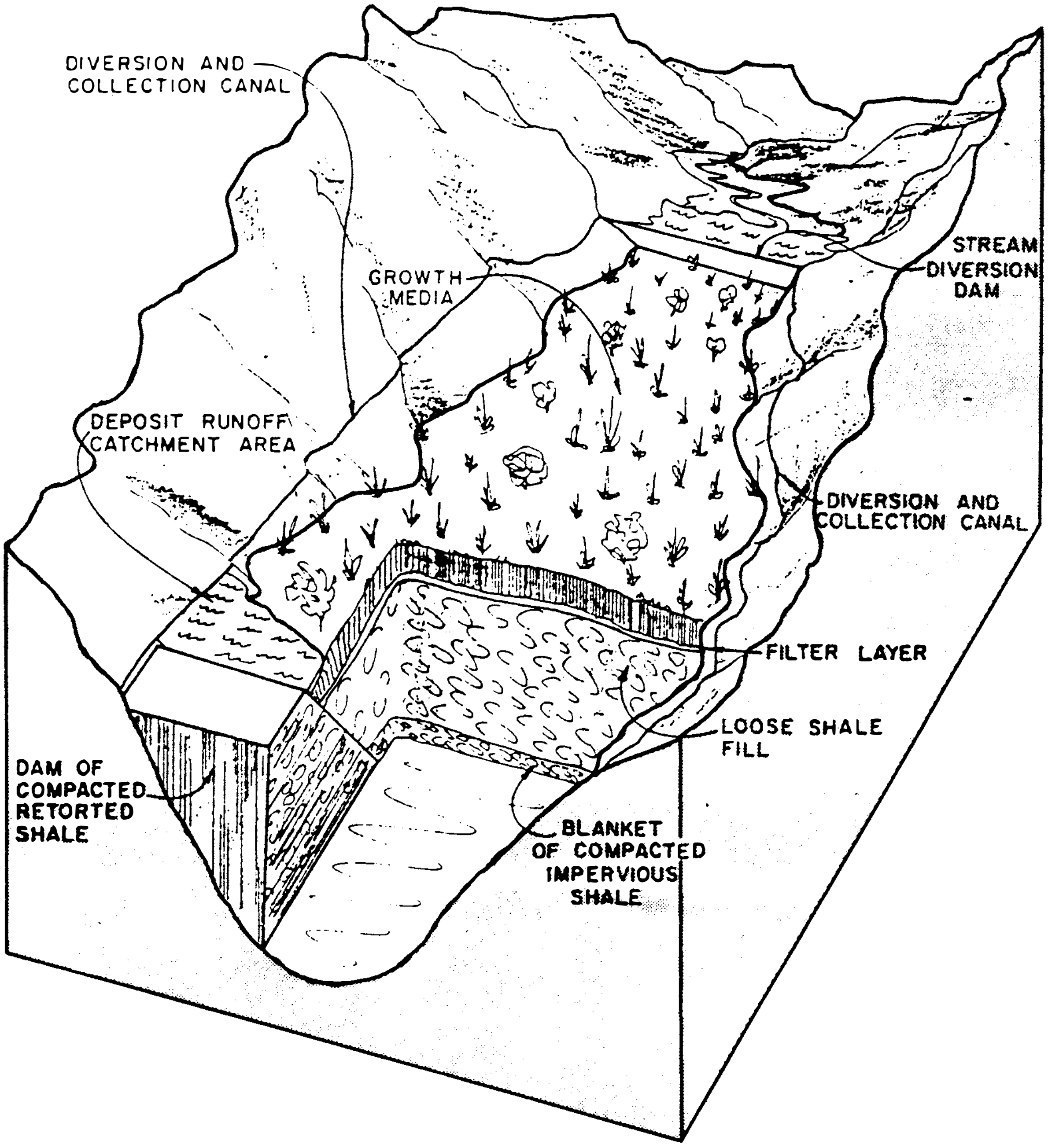
b/ Determined from $NH_3$ and min $CO_2$ data. ($NH_3$-N/Min $CO_2$ = 1.0 for $NH_4HCO_3$)

c/ Determined from calculated org C Value.

d/ Determined from total H- other H.

SOURCE: DEI

FIGURE 5-2
SCHEMATIC OF TYPICAL CROSS-VALLEY FILL



A large field compaction test section using about 14,000 cu yd of retorted shale from the semiworks plant was conducted at Anvil Points. Heavy sheepsfoot, rubber tire rollers, vibratory rollers, and tractors were used on retorted shale layers of varying thickness. It was found that retorted shale can be compacted to a dry density of up to 100 $lb/ft^3$.

Two large infiltration ponds, lined with compacted retorted shale, were constructed for the permeability study. In the first pond, the lining materials were placed with highly compacted materials to represent an impervious dam condition and an impervious lining condition. The second pond was constructed with less compacted materials to represent a main disposal pile condition.

The first test pond showed a permeability rate of about 1.0 ft/yr or less. In the loosely compacted second test pond, the range was 1.0 to 1000 ft/yr. When the permeability effluent liquid was recirculated, the permeability rates were reduced to as low as 3.0 ft/yr. Another permeability test showed that virtually 100 percent of the 4,600 gallons of water sprayed on a test pond (simulating a two inch rain in 30 minutes) was absorbed by the retorted shale. Only 1.85 gallons, or 0.4 percent, permeated through the mass.

Chemical tests were conducted on standard leachates from the retorted shale and effluent liquids from the permeability tests. These tests indicate a concentration of total dissolve solids on the order of only 1.4 percent by weight, with the principal components being potassium chloride, sodium sulfate, calcium sulfate, and calcium carbonate. The total dissolved solid concentrations are not considered high; soils containing three to four percent dissolvable solids are suitable for impervious earth dam construction. The results of chemical tests on effluent liquids are shown in Appendix B, Table B-1.

The results of shear strength studies showed that the high strength of retorted shale will allow high cross-valley dams to be constructed on relatively steep slopes. Time also increases the retorted shale strength. The downstream face of the dam can be constructed with retorted shale treated with cement for a normal thickness of about three feet; thus downstream face erosion would be controlled.

Evaporation and infiltration characteristics of the Balzac Gulch disposal site allow it to be classified as a no discharge system, exempt from the National Pollution Discharge Elimination System (NPDES) permit requirements pursuant to Section 402 of the Federal Water Pollution Control Act. To qualify as a no discharge system, evaporation from the area must exceed the precipitation rate by at least 20 inches. The sum of the natural evaporation rate at Anvil Points (60-72 in/yr), the evaporation caused by contact with the hot retorted shale (200°F), and the infiltration rate from the holding pond (12 in/yr) exceeds the site's precipitation (20 in/yr) by more than 20 inches; thus, the Balzac Gulch disposal site will not require an NPDES permit. DEI may apply for a State "no discharge" permit.

It is possible, although unlikely, that seepage from the disposal site may contaminate groundwater in the area. Balzac Gulch stands on the Wasatch Formation, a primarily sandstone and clay bed formation. Although no aquifers have been characterized under Balzac Gulch, it is probable that significant amounts of water are imbedded in sandstone, but are not in the form of an aquifer or water table.

Nevertheless, the Woodward-Clyde consultant group will conduct a groundwater quality monitoring study for the area during Phase I of the proposed project. The specific location of the disposal site within the Gulch will depend, to a large extent, on the findings of that study.

The results of a two year ground water monitoring program conducted during the operation of the semiworks plant are shown in Table 5-10. Quarterly samples were taken from the catchment pond below the existing disposal site, a well above the site, and two wells below the site (see Figure 5-3). Impacts of the existing operation on groundwater are difficult to assess from those data. No baseline data exist for the water quality of two of the wells below the disposal site. Furthermore, several parameters in the well above the existing disposal site (which are invulnerable to operation-related impacts) have a greater concentration than those of the other wells and the catchment pond. High ion concentrations of Na, Cl, K, Ca, $SO_4$ TDS, and COD in the pond would indicate groundwater contamination in the wells; however, this cannot be proven, since no baseline data are available.

In summary, proper construction and control measures in the shale disposal site should serve to make it a no discharge system with minimal potential water quality impacts. Optimum design and location of the shale disposal site encasement area will be determined during Phase I of the project.

#### 5.3.2.3 Summary of Mitigating Measures

An estimated 11,340 gal/day of process waste water will be generated by the scale-up retort facility. This water, containing salts and chemical by-

TABLE 5-10

WATER QUALITY MONITORING DURING OPERATION OF EXISTING FACILITY*

| PARAMETER | POND | WELL 1 | WELL 3 | WELL 4 |
|---|---|---|---|---|
| Na | 249 | 221 | 397 | 638 |
| K | 24.1 | 7.7 | 21.8 | 22.8 |
| Ca | 72 | 164 | 186 | 276 |
| Mg | 63 | 100 | 94 | 145 |
| Al | 0.5 | 1.1 | 0.9 | 0.4 |
| Fe | 0.3 | 1.1 | 0.7 | 1.7 |
| Zn | .04 | 0.1 | .04 | .04 |
| Cl | 176 | 9 | 41 | 49 |
| $SO_4$ | 633 | 750 | 1392 | 2000 |
| Oil and Grease | ND** | 1.3 | ND | ND |
| T.D.S. | 1320 | 1792 | 2335 | 3644 |
| T.S.S | 27 | 58 | 39 | 82 |
| Alkalinity | 140 | 459 | 357 | 522 |
| Cd | ND | ND | ND | .002 |
| Cu | .02 | .02 | .02 | .04 |
| Pb | ND | ND | .014 | .016 |
| Mg | .003 | ND | ND | .0003 |
| F | 2.7 | 1.0 | 1.6 | 1.2 |
| Cyanide | ND | ND | ND | ND |
| Sulfide | ND | ND | ND | ND |
| Phosphate | .03 | ND | .03 | .04 |
| Silica | 4.4 | 7.4 | 6.5 | 10.6 |
| TKN | 12.6 | 0.8 | 1.2 | 2.5 |
| COD | 103 | 7 | 21 | 80 |
| Phenols | ND | <.001 | .004 | .008 |
| pH | 7.6 | 7.3 | 7.2 | 7.2 |
| B | .2 | .03 | .6 | .31 |
| Mo | ND | ND | ND | ND |
| Arsenic | .040 | .003 | .006 | .012 |

*Data represents median value of sample measurements. Concentrations are in parts per million (ppm).

**Not Detected

SOURCE: DEI laboratory data

products, is primarily used for ammonia and sulfur gas cleanup. This effluent will present the greatest water quality impact. Water will be disposed in a specially prepared pond, lined with impervious compacted shale. Process waste water also will be used for dust control on the spent shale disposal pile. Runoff from the pile will be contained in a special catchment pond; runoff underneath the pile will be caught by a culvert. The disposal site, as well as the facility itself, is not expected to produce any return water flow. In addition, total water use will be reduced by the maximum feasible recycling.

Water requirements other than process waste water (sanitary needs, etc.) will be treated in four or five special packaged disposal plants purchased by DEI.

Sediment loading into the Colorado may affect water quality during the construction phase. This will be controlled by approximately 50% through runoff control measures such as ditches, grade stabilization structures, and flow barriers. Actual determination of design, and control decisions will be made during the detailed design phase.

Secondary water impacts (off-site water use) will be mitigated by new sewage and water treatment plants scheduled to be operational by late 1980.

## 5.4 ECOLOGICAL IMPACTS

### 5.4.1 Vegatation Impacts

Most of the ecological impacts of the proposed action probably will occur during the 18 month construction period. Ecological impacts during operation

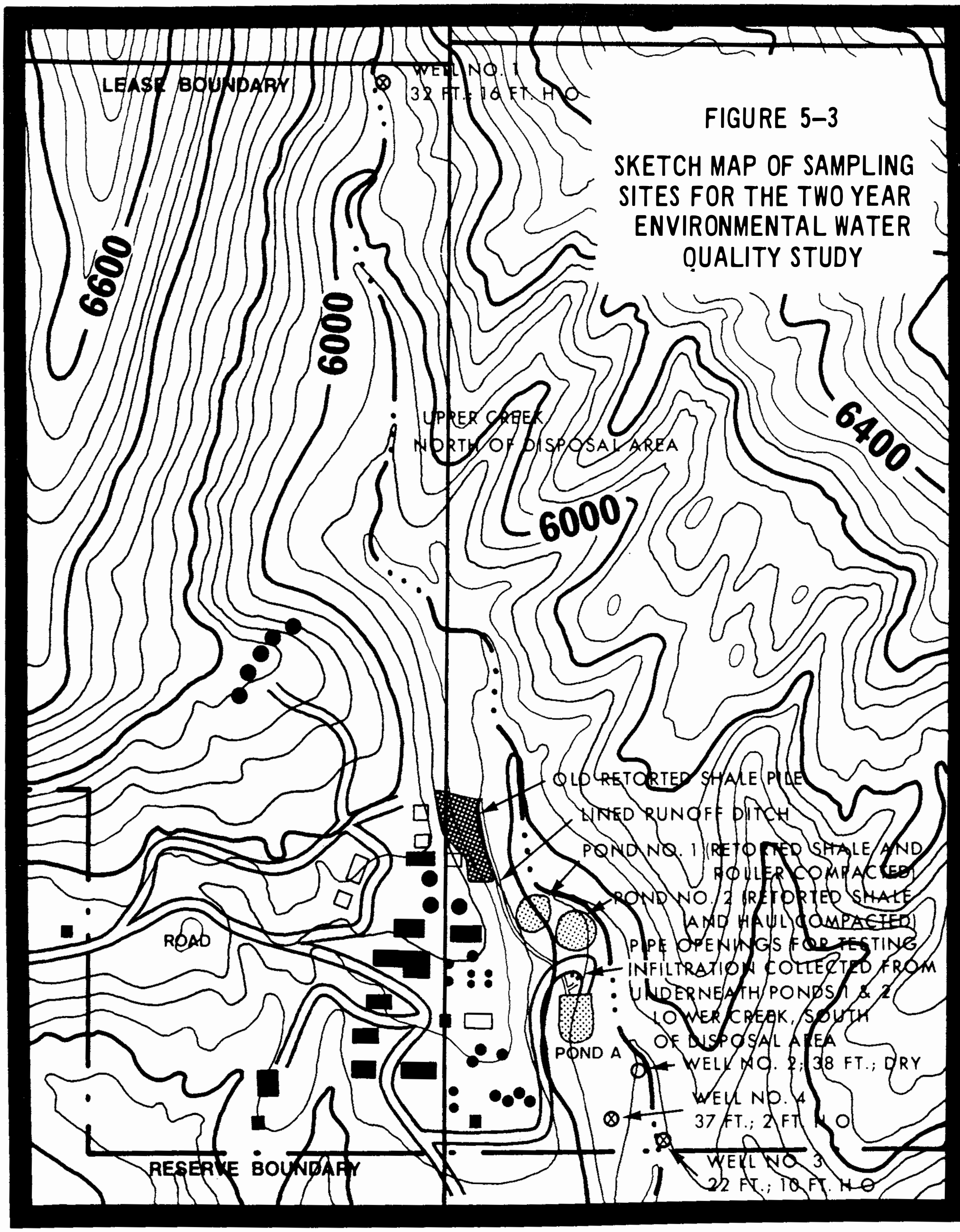



FIGURE 5-3

SKETCH MAP OF SAMPLING SITES FOR THE TWO YEAR ENVIRONMENTAL WATER QUALITY STUDY of the facility primarily will involve the disposal of retorted shale into Balzac Gulch. The total area disturbed by construction and operation is expected to be confined to 65 acres within the DEI lease tract, as is shown in Table 5-11.

In general, vegetation disturbance will increase the susceptibility of soil to wind or water erosion; and therefore decrease the chance of successful re-establishment of stable communities. The long-term stability and productivity of disturbed areas should be reestablished by minimizing soil erosion through correct containment and compaction, and by reseeding the disposal area as soon as possible. DEI is committed by their lease to mitigating these impacts. Final design plans will be formulated in Phase II-detailed design. Plans will be based on findings of DOE, EPA, and privately funded research on spent shale vegetation.

To ensure restoration, all disturbed areas will be reseeded with one or more vegetation species developed in the revegetation research being conducted for the Ca-Cb, Ua-Ub, and the Paraho projects. At this time plans for vegetating the spent shale pile have not been finalized. Plans will be finalized during the detailed design phase of the project, taking into account results of recent and ongoing spent shale vegetation experiments. Long-term success in establishing and maintaining a stable ecosystem on spent shale is still uncertain; however, short-term success has been demonstrated on several field plots. Once detail designs are prepared, they will be assessed in a supplemental EIS.

TABLE 5-11

ESTIMATED LAND AREA DISTURBED BY PROPOSED ACTION

| FACILITY | SURFACE ACREAGE |
|---|---|
| Waste Disposal Site | 30 |
| Access Road to Balzac Gulch | 10.5 |
| Expansion of Existing Roads | 8 |
| Water and Production Lines | 10 |
| Retort Site | 5 |
| Soil Core Holes | 0.5 |
| Belt Conveying System | - |
| Mine Expansion | - |
| Additional Power Lines | - |
| TOTAL | 64.0 |

SOURCE: DEI,

Colorado State University is studying problems of vegetating U.S. Bureau of Mines (USBM) retorted shale at test plots constructed in northwestern Colorado. The spent shale produced by the USBM retort process is similar to Paraho direct mode spent shale so that the results should be directly applicable. Experiments were conducted at both low-elevation (5,700 ft) and high-elevation (7,200 ft) sites. Three separate spent shale treatments were investigated at each test site, which are: 1) leaching the spent shale at the low-elevation site with a 100 cm layer of water in spring, and at the high-elevation site with a 50 cm layer of water in fall; then covering both sites with a 100 cm layer the following springs, another 100 cm layer of water in fall, 100 cm layer of water the following spring, and another 100 cm layer the spring of the next year; 2) covering leached spent shale with 15 cm of soil; and 3) covering unleached spent shale with 60 cm of soil. A soil control plot also was constructed.

The Department of Energy currently is sponsoring studies on the problems of vegetating spent shale disposal sites. One study is being conducted by Colorado State University using spent shale from the Anvil Points facility. The overall objective of the project is to study the effect of seeding techniques, species mixtures, fertilizers, ecotypes, improved plant materials, mychorrizal fungi, and soil microorganisms on the initial and final stages of reclamation obtained through seeding, and subsequent succession on disturbed oil shale land (CSU, 1979). Vegetation is being attempted on six test plots and one control plot. Each plot differs according to amount of topsoil, amount of fine and coarse gravel, amount and degree of compaction of retorted shale, and the amount of substrata under the compacted retorted shale. Tentative conclusions from the project suggest that between two and three feet of topsoil

## TABLE 5-12

## SALT TOLERANT PLANT SPECIES OF THE OIL SHALE REGION

### I. SHRUBS

| Common Names | Scientific Names |
|---|---|
| Fringed sagebrush | Artemisia frigida |
| Bud sage | Artemisia spinescens |
| Black sagebrush | Artemisia nova |
| *Big sagebrush | Artemisia tridentata |
| **Fourwing saltbush | Atriplex canescans |
| Shadscale | Atriplex confertifolia |
| Mat saltbush | Atriplex corrugata |
| Cuneate saltbush | Atriplex cuneata |
| Gardner saltbush | Atriplex gardneri |
| **Spreading rabbitbrush | Chrysothamnus linifolius |
| **Rubber rabbitbrush | Chrysothamnus nauseosus |
| **Greene's rabbitbrush | Chrysothamnus greenei |
| **Douglas rabbitbrush | Chrysothamnus viscidiflorus |
| **Winterfat rabbitrbush | Ceratoides lanata |
| Spineless hopsage | Grayia bradegei |
| Spiny hopsage | Grayia spinosa |
| Grassbush | Glossopetelon nevadense |
| Gray molly | Kochia americana |
| Prostrate hochia | Kochia prostrata |
| Antelope bitterbrush | Purshia tridenta |
| Greasewood | Sarcobatus vermiculatus |
| Utah juniper | Juniperus osteosperma |

### II. GRASSES

| Common Names | Scientific Names |
|---|---|
| Agropyron cristatum | Agropyron cristatum |
| Intermediate wheatgrass | Agropyron intermedium |
| **Western wheatgrass | Agropyron smithii |
| **Bluebunch wheatgrass | Agropyron spicatum |
| Saltgrass | Distichlis stricta |
| *Basin wildrye | Elymus cinereus |
| Russina wildrye | Elymus junceus |
| Salina wildrye | Elymus salina |
| *Galleta grass | Hillaria jamesii |
| **Indian ricegrass | Oryzopsis hymenoides |
| Sand dropseed | Sporobolus cryptandrus |
| Needle-and-thread grass | Stipa comata |

### III. FORBES

| Common Names | Scientific Names |
|---|---|
| *Utah sweetvetch | Hedysarum boreale |
| Globemallow | Sphaeralcea spp. |

* high elevation seeding

** low elevation seeding

SOURCE: McKell, C. M., 1979. Rinal Report: Revegetation Studies for Disturbed Areas and Processed Shale Disposal Sites. Utah State University, Institute for Land Rehabilitation.

are required for successful vegetation (Redente and Ruzzo, 1979). The study also indicates that intensive management of shale piles is necessary for adequate vegetation to occur. Although the Colorado State University study uses spent shale from the Anvil Points facility, the actual test site is in a much wetter, more varied climate than the proposed disposal area (Balzac Gulch). However, the study incorporates vegetation which is representative of Balzac Gulch. Test conclusions also are limited in their conclusiveness by the lack of knowledge concerning long term weathering impacts.

Test plots were compacted lightly by small loading equipment used to pile the materials. The test plots were constructed as piles with 4:1 side slopes having north and south aspects. Phosphorus and nitrogen fertilizers were applied to all plots at both study sites. Triple superphosphate was applied following plot construction at the rate of 400 kg P/hectare and then roto-tilled to a depth of 10 cm. Ammonium nitrate was applied following germination at the rate of 66 kg N/hectare, and an additional 66 kg N/hectare was applied later in the growing season. Both study sites were seeded with a mixture of native grasses, shrubs, and forbs (See Table 5-12).

Most recent results of this experiment indicate that the leached spent shale with 15 cm soil cover had the greatest vegetative cover (about 77 percent); however, the differences wer not statistically significant as measured by Tuckey's Q mean separation test at the five percent level.

Also, perennial grasses rather than annual tended to be the dominant species. This is significant in that it indicates a greater probability of vegetative cover in years of below-average precipitation conditions (Harbert and Berg, 1978).

Revegetation strategies in the early stages of development also may provide useful information for revegetating the Paraho spent shale site. The University of Utah is investigating an alternative vegetation strategy known as water harvesting. In this method of establishing vegetation, the spent shale is terraced and salt-tolerant container-grown plants with established root systems are placed, with a small amount of topsoil, in the trenches of the terraces. The topsoil should provide an inoculum of microorganisms (e.g. endomycorrhizal fungi) needed for root growth and native plant seed. A chemical buffering agent should be added to enhance the probablity of plant growth. A polyvinyl acetate sheet is used as mulch, increasing water harvesting and controlling dust. Runoff from the up-slope pile area is collected, or harvested, in the trenches to supply water to the plants. If necessary, the plants may require fertilizer and/or supplemental irrigation, especially in the early stage of growth and under drought conditions. In time, the mulch is removed to allow plants in the troughs to spread and cover the remaining portions of the spent shale pile. The native, salt-tolerant grasses growing from the seed added to the topsoil in the trenches should be most successful as a pioneer species on the barren spent shale. Little by little, as grasses die and decay, the natural organic content of the spent shale surface should increase, making it more inviting to higher-successional plant species. The success of this technique has not yet been proven (McKell, 1979).

#### 5.4.1.1 Impacts Related to Construction

To construct the retort site, topsoil must be removed and the ridge line must be leveled. All vegetation in the five acre site area will be removed to reduce fire hazards. Some soil spillage will occur into the adjoining juniper community, and selected trees will be removed. The forest and underlying shrubs, however, will act as a stabilizing agent for side hill cuts and berm placement. Approximately three soil core holes will be drilled for stability studies, disturbing one-half acre of surface.

Ten acres of sparsely vegetated land will be disturbed temporarily by modifying and constructing water and product pipelines. Modification of the existing two mile water line from the site to the pumping station will disturb five acres. Two acres will be disturbed to construct a one mile line to the proposed retorting site for water and sanitation facilities.

An additional three acres may be disturbed temporarily to install a six inch product oil line from the retort site to existing oil storage facilities, a distance of about 1.5 miles. Vegetation along the pipeline access ways should return quickly to its original condition without aid; nevertheless, all disturbed land will be reseeded to ensure restoration.

To use Balzac Gulch as a disposal site, a new access road must be constructed from the southern end of the hogback into the gulch. The road is expected to be 1.5 miles long and 30 feet wide, disturbing an estimated 10.5 acres. Widening and improving some portions of the existing mine road will disturb about eight acres. The sparse vegetation in those areas will be lost due to the construction and use of the roads.

#### 5.4.1.2 Impacts Related to Operations

The largest operations-related impact on surface vegetation will be the disposal of retorted shale in Balzac Gulch. Up to 30 acres of the gulch will be covered with retorted shale (assuming a depth of 400 feet) if 11 million tons of oil shale are mined. Vegetation and wildlife in Balzac Gulch are sparse. Retorted shale will be compacted to a density of 90 $lbs/ft^3$ to minimize the amount of the area affected. Vegetation will be lost due to the construction of a canal diversion system for the stream that flows intermittently through the gulch. The entire disposal area will be revegetated following the expected 18 month retort operation.

Mine expansion during operation will not cause any surface disturbance, other than the development of a new access adit, since the oil shale will be mined by the underground room-and-pillar method. Based on 26 years of experience at the Anvil Points mine and recent sagometer measurements, no subsidence problems are anticipated.

### 5.4.2 Wildlife Impacts

#### 5.4.2.1 Terrestrial Wildlife

No significant long-term impact on wildlife should result from the proposed action. Construction and operation will directly disturb only 64 acres of dry, sparsely vegetated habitat that is not critical to any wildlife species. (Woodward-Clyde Consultants, 1978). Moreover, much of the disturbed habitat will be restored through revegetation.

Wildlife in the site area may be displaced from their home ranges, particularly during the construction phase when vegetation and habitats are disturbed or destroyed. Some smaller vertebrates, such as reptiles, amphibians, or burrowing mammals, may be killed during construction of the retort plant, roads, pipelines, and disposal area.

For some species, physical displacement effects may be magnified by the continued presence of humans, by increased dust and effluent levels, and by noise associated with construction and operation. Sources of such disturbances could include diesel engines, air compressors, and vehicular traffic. Species that can tolerate these disturbances will tend to replace species that cannot.

The proposed activities and increased human population in the region may temporarily affect the local game populations through increased harrassment and hunting in outlying areas. Mule deer and elk may be affected more severely than other game species. The local deer population has not been affected greatly by research activities at the site. Small herds of deer are seen near the present Paraho retort site and housing area, and frequently are fed by the local residents.

Construction impacts (i.e., the presence of humans and noise), should be reduced considerably during operation. Accordingly, wildlife impacts during construction should be reduced during operation. Moreover, some wildlife should reinhabit areas disturbed during construction as revegetation begins to occur.

#### 5.4.2.2 Aquatic Wildlife

Construction and operational activities do not cause any direct discharge into surface waters, and mitigating measures discussed in Section 4.3 should prevent significant water impacts.

#### 5.4.2.3 Endangered Wildlife

The endangered bald eagle occasionally is seen flying over the area but does not nest in the site area. Its critical habitat will not be affected by the proposed action. The greavack cutthroat trout, subspecies stomias, does not inhabit western Colorado. While the distribution of the threatened pleuriticus subspecies does include the naval reserves, it does not inhabit streams in the vicinity of the site area. (Skinner, 1977 and Woodward-Clyde, 1978).

### 5.4.3 Summary of Mitigating Measures

The proposed action will disturb 65 acres of sparsely vegetated and sparsely inhabited land. Major disturbances will occur over 30 acres in Balzac Gulch. The Colorado Department of Natural Resources, Division of Wildlife has stated that the bald eagle and Peregrine falcon have been sighted over Balzac Gulch. A study determining whether the site is a critical habitat to either of these endangered species has not been made.

In addition to wildlife, vegetation in the area also will be disrupted. Success in revegetating the spent shale disposal area (the major mitigating measure for restoring the terrestrial environment) will determine the success in re-establishing wildlife in the disturbed areas.

Terrestrial disruption associated with construction of pipelines and conveyors will be mitigated by reseeding the area as soon as possible, and reclaiming the area to the extent the State and DEI agree is feasible.

## 5.5 SOCIAL, ECONOMIC, AND SECONDARY IMPACTS

### 5.5.1 The Work Force

A substantial labor force will be required to construct and operate the Paraho oil shale project. DEI estimates that 450 workers, at most, will be needed during the construction phase, and 300 during the operation phase. Table 5-13 shows the breakdown of construction workers needed, excluding mine development workers. Table 5-14 shows that during the first nine months of development, 47 mine workers will be needed. The specific labor breakdown for the operation phase will be estimated during Phase I of the project.

Beacuse of its proximity to Anvil Points, the city of Rifle is expected to experience most of the population impact from the proposed Paraho project. Although some of the population may be spread over the 95 mile span from Grand Junction to Glenwood Springs, it is assumed in this assessment that all of the population influx will be concentrated in the Rifle area. Those workers and their families who live nearby but outside the city are assumed to use Rifle's public services.

TABLE 5-13

MAJOR SKILL REQUIREMENTS
FULL-SIZE MODULE CONSTRUCTION

| SKILL | AVERAGE | PEAK |
|---|---|---|
| Boiler Maker | 20 | 33 |
| Iron Work | 27 | 45 |
| Millwrights | 12 | 20 |
| Operators | 12 | 20 |
| Pipe Fitters | 50 | 85 |
| Carpenters | 15 | 25 |
| Cement Finishers | 1 | 2 |
| Laborers | 20 | 33 |
| Brick Layers | 19 | 32 |
| Teamsters | 3 | 5 |
| Electricians | 26 | 43 |
| Insulators | 25 | 42 |
| Painters | 8 | 13 |
| Sheet Metal Workers | 4 | 7 |
| TOTAL | 243 | 405 |

SOURCE:

TABLE 5-14

MINE DEVELOPMENT MAJOR SKILL REQUIREMENTS
FOR FULL-SIZE MODULE DEVELOPMENT

| SKILL | ADIT | RAISE | CRUSHER | MINE | TOTAL |
|---|---|---|---|---|---|
| Superintendent | 1 | 1 | 1 | 1 | 4 |
| Miner | 4 | | | 8 | 12 |
| Driller | | 2 | | | 2 |
| Driller Helper | | 4 | | | 4 |
| Mechanic | 1 | 1 | | 2 | 4 |
| Iron Worker | 4 | | 6 | | 10 |
| Electrician | 1 | | 2 | 1 | 4 |
| Carpenter | 2 | 2 | 2 | | 6 |
| Cement Finisher | 2 | 2 | 2 | | 6 |
| Millwright | | | 3 | | 3 |

The total employment impact will be less than the aggregate sum due to the peak labor requirements being staggered over the 18-month construction period.

Employment Period By Months

| SKILL | ADIT | RAISE | CRUSHER | MINE |
|---|---|---|---|---|
| Superintendent | 1-9 | 9-15 | 15-17 | 3-18 |
| Miners | 1-9 | 9-15 | | 3-18 |
| Drillers and Helpers | | 9-15 | | 3-18 |
| Mechanics | 9 | 9-15 | | 3-18 |
| Iron Workers | 9 | | 15-17 | |
| Electricians | 9 | | 15-17 | 3-18 |
| Carpenters | 2 | 15 | 15-17 | |
| Cement Finishers | 9 | 15 | 15-17 | |
| Millwrights | | | 15-17 | |

Other major oil shale development projects in the area could greatly affect the number of available local workers. A best case/worse case analysis was made. The best case analysis assumes no other major development projects are ongoing. For DEI's past demonstration project at Anvil Points, local labor represented 75 percent of the work force.* DEI plans to continue trying to minimize socioeconomic impacts by hiring local labor and establishing training programs. Therefore, it may be assumed for the best case analysis, that 75 percent of the work force will be local and 25 percent will be outside labor. Conversely, the worst case approach assumes that other oil shale developments are occurring simultaneously. The local labor market thus is strained, and 100 percent of the workers required must be obtained from other regions. This best case/worst case approach offers a realistic range for evaluation and is carried through the following analyses of housing and public services impacts. During the 18 month construction period, total incoming population (including worker and family)** may reach 333 for the best case analysis. For the operation phase, which may last longer than the estimated 1.5 years, the total incoming population could drop to 223, yielding a total Rifle population of 3,723.*** Assuming the worst case, total incoming workers and their families could reach 1,328, increasing Rifle's population to 4,828 during the construction phase. This total could drop to 4,385 during the operation phase when only 885 new persons would be entering Rifle.

* Local labor is defined as labor within a two-hour drive of Rifle-Anvil Points area.

** These estimates were obtained by using a multipler of 3.5 representing the number of persons per family, with 78 percent representing the number of workers with families (DOC, 1975).

*** Operation may last longer than 1.5 years depending on the success of program, the need for further development work, and extension of the current lease (DEI, 1978).

### 5.5.2 Housing

Guidelines for estimating housing demand for the proposed project may be based on assignments used in DEI's demonstration project. The following breakdown was assigned for the demonstration project and is assumed to be applicable to the proposed project:

- 75 percent of the construction workers are assigned to mobile homes and 20 percent to permanent homes (the remaining 15 percent represent single workers who have doubled up or workers with spouses who also work).
- 15 percent of the operation personnel are housed in mobile homes and 85 percent in permanent homes.

For the best case analysis 113 workers will be needed from other areas during the construction phase. Of these, 85 will be housed in mobile homes and 11 in permanent homes. During the operation phase, 75 workers will be outside labor. In this case, 11 will be housed in mobile homes and 64 in permanent homes. If the worst case analysis is assumed, 450 workers will be needed for the peak construction phase. According to the guidelines, 338 of these will be situated in mobile homes and 45 in permanent homes. Of the 300 workers needed for operation, 45 will be in mobile homes and 255 in permanent homes.

Two approaches can be taken to meet the demand for housing. Based on decisions made by DEI and the City Planning Commission, the actual outcome may lie somewhere between the two. One approach uses the guidelines strictly for both the construction phase and the operation phase. The other approach supplies housing according to the guidelines for the operation personnel and requires construction workers to use this housing during the construction phase. The latter seems more probable, since operation personnel may be employed for a longer period of time. Table 5-15 summarizes each situation with respect to the best and worst cases.

The best case, supplying housing for the operation-phase workers on the basis of construction-phase personnel guidelines, ultimately may lead to a significant excess of mobile homes and shortage of permanent homes. If operation personnel and their families occupy vacant construction-phase homes as much as possible, there could be up to 74 excess mobile homes while a need for 53 more permanent homes would exist. However, if 11 mobile homes and 64 permanent homes, were supplied for the operation workers, construction workers and their families could use those dwellings for the duration of the construction phase. This would result in a smaller number of excess mobile homes and decrease the shortage of permanent units during operation. Only 21 more units would be needed for the construction phase. These would become vacant during the operation phase.

Assuming the worst case, an excess of 293 mobile homes and a shortage of 210 permanent homes could occur when the operation period begins if guidelines are pursued strictly. On the other hand, 83 housing units built during shortage of the construction phase would become excess during the operation phase. (See Table 5-15).

Regardless of which approach is taken, the city of Rifle will have substantial number of vacancies when the proposed project is terminated. Two options could help to resolve this problem. A normal growth rate in the Rifle area may absorb the vacated housing; and/or if housing units constructed for the Paraho project workers are designed for later conversion to other uses, vacant housing may not be left idle. As of January 1978, Rifle did not have enough available housing to support either the best or worst cases based on the guidelines for either construction or operation phase. It is possible to meet the Paraho project housing requirements by utilizing undeveloped housing sites. Rifle has 55 sites which can be developed for permanent housing. Kings Crown Mobile Home Park, which has 300 undeveloped trailer pads, has been annexed and approved by the city, and temporary efficiency housing could be used as an alternative or complement to mobile homes. Moreover, some housing exists at Anvil Points, as do approximately 50 vacant, developed lots where housing was constructed in 1944-1950. The 50 housing units have been torn down, and the lots remain available for new construction.

Finally, a number of additional vacant lots and approved trailer spaces are available within the city boundaries of Rifle. Contractors have indicated a willingness to build on these lots if they receive some sort of market guarantee. Several developers are drawing up annexation proposals. One preliminary plan of the Rifle City Planning Commission involves more than 500 single and multifamily building sites.

Since Rifle's available housing would not be adequate under any situation examined, some housing planning and construction will occur before the Paraho labor force arrives. DEI and the City Planning Commission probably will be involved in the planning, however, DEI has no plans to subsidise housing. Oil Shale Trust fund grants also may be utilized for building needed housing.

TABLE 5-15

SUMMARY OF BEST/WORST CASE HOUSING SITUATIONS

1. If guidelines for both construction and operation workers are used:

   A. BEST CASE

      - Construction phase will have 85 mobile homes, 11 permanent homes
      - Operation phase will require 11 mobile homes, 64 permanent homes
      - Result in excess of 74 mobile homes, shortage of 53 permanent homes

   B. WORST CASE

      - Construction phase will have 338 mobile homes, 45 permanent homes
      - Operation phase will require 45 mobile homes, 255 permanent homes
      - Result in excess of 293 mobile homes, shortage of 210 permanent homes

2. If guidelines for operation workers only are used:

   A. BEST CASE

      - Housing amounts and types designed for operation personnel: 11 mobile homes, 64 permanent. Total = 75.
      - Construction workers use operation personnel housing totalling 75 units, but need 96 units. Shortage = 21 units.
      - 21 more units provided become excess units during operation phase.

   B. WORST CASE

      - Housing amounts and types designed for operation personnel: 45 mobile, 255 permanent. Total: 75.
      - Construction workers use operation personnel housing totalling 300 units, but need 383 units. Shortage = 83 units.
      - 83 more units provided become excess units during operation phase.

### 5.5.3 Public Services

A large labor force will create an increased demand for public services as well as indirect socioeconomic impacts. The public services affected by the Paraho project will be: schools, water and sewage systems, police and fire protection, and medical care. Possible impacts on these services by incoming population are addressed in the following subsections.

#### 5.5.3.1 Schools

Because a lag exists between the time students enroll and the time provisions can be made for additional teachers and classrooms, it is likely that shortages of teachers and classroom space will exist during the Paraho project. The West Garfield School District, RE2, serves the area surrounding and including Rifle, Silt, and New Castle. There are three elementary schools, two junior high schools, and one senior high. Total enrollment in 1976 was 1,846 with a capacity for 1,890. Of these six schools, Rifle and New Castle Junior High Schools were below capacity. Table 5-16 compares the current student enrollment to capacity of the schools. Impacts from the influx of Paraho workers will be mitigated by plans for using Oil Shale Trust Fund monies to build four additional classrooms (100 student capacity) at the Silt Elementary School, and a 15 acre addition to the Rifle Elementary School. The RE-2 school district has filed an application for these monies, however no detailed plans have been made. In addition, Rifle currently is building a 46,000 sq ft addition to their Junior High School. When completed, Junior High students will be moved to the present Senior High School, and Senior High Students will use the new building. This building will have a 650 student capacity and probably will be completed by September 1981 (Ekhardt, 1980). Using the following criteria, the incoming school-age population can be estimated:

- Each family has 1.18 school-age children
- Of the total number of children, 0.20 are nursery school age
  0.54 are elementary school age
  0.22 are junior high school age
  0.22 are senior high school age

twenty-five students per teacher and 25 students per room may serve as the criteria for desirable school conditions in Rifle.

For the best case, in which only 25 percent of the labor force is outside labor, 113 workers will be brought in from other regions for the construction phase. Since 78 percent of all households may be families, 88 families may move into the area with a total of 104 school-age children. This may create a need for two new rooms and two new teachers for the elementary school; one room and one teacher for the junior high; and one room and one teacher for the senior high -- a total of four new rooms and four new teachers. Table 5-17 shows similar calculations for the operation phase.

Under the worst case assumption, a total of 17 rooms and 17 teachers may be needed for the three Rifle schools during the construction phase. This could cause a surplus of teachers and rooms, since requirements during the operation phase will be less. Table 5-17 shows more detailed estimates.

Only impacts from Paraho population increases were considered in the above estimates. However, the schools, except the Rifle and New Castle Junior High Schools now operate above capacity. Table 5-17 therefore, also shows the combined effects of present conditions with estimated Paraho population increases.

#### 5.5.3.2 Water

Rifle residents now use 0.675 MGD at an average consumption of 300 gpcd.* City water is obtained from several sources. Rifle has absolute rights to 8.5 cfs from the Colorado River, 1.8 cfs from Rifle Creek, and 0.67 cfs from Beaver Creek. It also has conditional rights to 7.5 cfs from the Colorado River and 0.25 cfs from Beaver Creek. The water system has 980 taps and two treatment plants; namely, the Graham Mesa and Beaver Creek plants.

Assuming the best case analysis, Rifle will be a total peak population of 3,723. An estimate of current per capita consumption can be used to predict total use by the incoming population. Assuming 300 gpcd, 333 additional persons will consume approximately 0.10 MGD. Added to the present consumption of 0.675 MGD, Rifle will require 0.775 MGD at the peak period.

For the worst case, the number of incoming workers and their families, 1,328, will bring the total Rifle population to 4,828 during the construction phase. At 300 gpd, an additional 1,328 persons will consume 0.398 MGD creating a total consumption for Rifle of 1.073 MGD. The Rifle water system is adquate for the estimated 1975 population, 2,500-2,750. That is, it supplied the residents with up to 0.810 MGD. It has been determined that upgrading the system will be necessary for normal population growth. A system designed to accommodate approximately 10,000 people will be operational by late 1980 (Merkle, 1979). Since the peak population of the project is predicted to be

* MGD - million gallons per day
gpcd - gallons per capita per day

TABLE 5-16

CURRENT ENROLLMENT, CAPACITY, AND NUMBER OF TEACHERS IN RE2 DISTRICT SCHOOLS

| | SCHOOL | SCHOOL CAPACITY | CURRENT ENROLLMENT | NUMBER OF TEACHERS |
|---|---|---|---|---|
| ELEMENTARY SCHOOLS | Rifle | 525 | 583 | 27 |
| | Silt | 190 | 200 | 13 |
| | New Castle | 250 | 255 | 15 |
| JUNIOR HIGH SCHOOLS | Rifle | 300 | 203 | 17 |
| | New Castle | 125 | 78 | 5* |
| SENIOR HIGH SCHOOLS | Rifle | 500 | 526 | 32 |
| | TOTALS | 1890 | 1845 | 109 |

* Number represents full-time equivalency

SOURCE: Ekhardt, 1980

# TABLE 5-17

BEST/WORST CASE IMPACTS ON RIFLE SCHOOLS

| | NUMBER OF WORKERS/FAMILIES | NUMBER OF SCHOOL AGE CHILDREN | | PARAHO ALONE | | CURRENT ENROLLMENT | FUTURE ENROLLMENT | CAPACITY | STUDENTS ABOVE CAPACITY | CUMULATIVE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | | NEW ROOMS | NEW TEACHERS | | | | | NEW ROOMS | NEW TEACHERS |
| BEST CASE | | | | | | | | | | | |
| CONSTRUCTION | 113/88 | 104 | elem. 56 | 2 | 2 | 583 | 639 | 525 | 114 | 5 | 5 |
| | | | junior high 23 | 1 | 1 | 203 | 226 | 300 | - | - | - |
| | | | senior high 23 | 1 | 1 | 526 | 549 | 500 | 49 | 2 | 2 |
| OPERATION | 75/59 | 69 | elem. 37 | 1 | 1 | 583 | 620 | 525 | 95 | 4 | 4 |
| | | | junior high 15 | 1 | 1 | 203 | 218 | 300 | - | - | - |
| | | | senior high 15 | 1 | 1 | 526 | 541 | 500 | 41 | 2 | 2 |
| WORST CASE | | | | | | | | | | | |
| CONSTRUCTION | 450/351 | 414 | elem. 224 | 9 | 9 | 583 | 807 | 525 | 282 | 11 | 11 |
| | | | junior high 91 | 4 | 4 | 203 | 294 | 300 | - | - | - |
| | | | senior high 91 | 4 | 4 | 526 | 617 | 500 | 117 | 5 | 5 |
| OPERATION | 330/234 | 276 | elem. 149 | 6 | 6 | 583 | 732 | 525 | 207 | 8 | 8 |
| | | | junior high 61 | 2 | 2 | 203 | 264 | 300 | - | - | - |
| | | | senior high 61 | 2 | 2 | 526 | 587 | 500 | 87 | 3 | 3 |

NOTE: Total number of school age children does not correspond to sum of elementary, junior high, and senior high school children due to elimination of nursery school category.

2,582 for the best case and 3,577 for the worst case, Rifle's water system can adequately handle any impact from Paraho development if the improvements proceed as scheduled. If not, the 1975 system will be adequate for the best case, but not for the worst case.

#### 5.5.3.3 Sewage

In 1975, the Rifle sewage treatment system had the capacity to serve 2,600 persons. At an average daily flow of 112 gpcd, it was handling approximately 0.291 MGD of wastes. A new sewage treatment system has been designed to accommodate approximately 10,000 people and will be operational by late 1980 (Merkel, 1979).

Peak population for the best case is 3,723 which may generate 0.289 MGD of waste--significantly below the planned capacity as well as the 1975 capacity. If the worst case is assumed, the population may generate an average flow of 0.401 MGD which is below planned capacity but above the 1975 capacity. If Rifle's system is improved on schedule, any population increases caused by the Paraho project can be accommodated.

#### 5.5.3.4 Police Protection

Presently, the Rifle police department consists of six officers, two cars, and 2400 sq ft of office space. The following criteria can be used to determine if police services are adquate for the current population and for projected population increases:

- o Two officers per 1,000 people
- o One vehicle per 1,500 people
- o 200 sq ft office space per 1,000 people

According to these criteria, the police force is more than adequate for the current population. Under the best case assumption, police services will be adequate for the peak construction phase population of 3,723 people. However, under the worst case assumption, the police force will have to expand by one officer and, perhaps, one vehicle to serve the peak population, 4,828. (C-b Shale Oil Project, 1976).

### 5.5.3.5 Fire Protection

The fire department facilities are adequate to serve the present population and the projected population increases. However, the standard maximum distance between fire hydrants is 500 feet, and Rifle needs 7 to 10 more hydrants to properly cover the town. More hydrants will have to be installed if new housing areas are developed for incoming workers and their families. Also, tests of the water flow system shows flows are adequate for downtown, but inadequate for outlying areas to the north and west. This problem will be resolved by water system improvement plans being conducted by the city. (C-b Shale Oil Project, 1976).

### 5.5.3.6 Medical Services

The Clagett Memorial Hospital serves Rifle, Grand Valley, and much of the population in central Garfield County. There is space for 32 inpatients and a staff of five doctors, and six nurses. According to State standards, 2.45

hospital beds are required per 1,000 people. Thus, the hospital can serve a population of about 20,000. The hospital administration estimates that is now serves 6,000-7,000/year. By national standards, the hospital could serve an additional 19.5 people/day. (C-b Shale Oil Project, 1976).

Rifle area peak population for the best case and the worst case, 2,582 and 3,577, respectively, will not burden the hospital's present capacity significantly. There is concern, however, that as a possible need for outpatient care increases, the hospital's laboratory facilities may be strained. Thus, the hospital has applied for Oil Shale Development grants to expand their radiology facilities, lab, and emergency room facilties (Hanson, 1980).

### 5.5.4 Summary of Mitigating Measures

- DEI has limited ability to mitigate socioeconomic impacts. However, in most cases additional workers into Rifle will have minimum effect, particularly if grants from the Oil Shale Development Trust Fund are approved for the town of Rifle.
- The Paraho project may create a shortage of housing for its workers unless sufficient lead time is given for planning and building new housing.
- School-age children of the Paraho workers may place additional stress on the already overburdened Rifle school facilities. This could be offset by plans in the RE-2 school district for additional facilities, and by busing students to nearby schools.
- Water supply will be sufficient for both the best and worst cases if improvements in the Rifle system proceed according to schedule.
- The 1975 water system can provide adequate water for the peak population increase expected under the best case, but not under the worst case.
- The 1975 sewage system can provide adequate service for the peak population increase expected under the best case, but not under the worst case. With the scheduled improvements, the sewage treatment facility can handle wastes generated from the peak population for both the best and worst cases.

- The police and fire departments and the medical facilities can serve the best and worst case population increases with minor expenditures.

## 5.6 OCCUPATIONAL HEALTH AND SAFETY IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

### 5.6.1 General Occupational Health and Safety Practices Related to the Proposed Action and Alternatives

Crude shale oils, upgraded or refined shale oil products, and certain waste streams associated with shale oil processing contain substances which may be hazardous to industrial workers. The main concern focuses on the presence of polycyclic aromatic hydrocarbons (PAH) in shale oil which may significantly increase the risk of mutations and cancer in exposed individuals. Crude shale oil contains approximately 3 ppm of benzo(a)pyrene (B(a)P), a known carcinogen. This concentration is the same order of magnitude as that found in petroleum crude oils. Additionally, the highly carcinogenic 3-methylcholanthrene (MCA) and 7,12-dimethylbenzanthracene (Guerin, 1978; Coomes, 1976; Schmidt-Collerus, 1974) have been tentatively identified in both raw and processed shale. Many PAH present in shale oil products remain unidentified. The presence of additional mutagenic or carcinogenic compounds in these materials is likely (Guerin, 1978).

The mutagenic/carcinogenic hazard of spent shale is thought to be considerably less than that of shale oil products. The B(a)P content of spent shale has been reported at values between 15 and 115 ppb (0.015-0.115 ppm), or about 100-fold less than that of crude shale oil. (Guerin, 1978).

Some controversy exists concerning the appropriateness of B(a)P content as an indicator of carcinogenic potential. Other carcinogenic PAH may predominate and B(a)P does not occur in a constant proportion relative to other PAH that may be present in a given PAH-containing environmental sample. Other compounds present, including co-carcinogens of PAH and non-PAH nature, may represent the majority of mutagenic/carcinogenic activity. Nevertheless, B(a)P may still provide a rough basis for comparions between PAH sources within a given technology (e.g., crude shale oil vs. refined shale oil vs. spent shale).

Available data concerning risks from the extraction and production phases of various fossil fuel energy technologies indicate that workers are at increased risk of cancers occuring at various tissue sites. Many of the epidemiological studies completed for various types of energy technologies have inherrent weaknesses (e.g., not accounting for smoking as a confounding factor), but even so, the majority of studies represent strong suggestive evidence (Bridbord and French, 1978).

Early awareness of the potential carcinogenicity of shale oil occurred in the British cotton industry (Commoner, 1975). A high incidence of scrotal cancer was attributed to direct worker contact with shale oil lubricants used on the spinning machines. However, studies of workers in the Scottish oil shale industry during the same period did not reveal a particularly high cancer incidence in that industry. The Scottish experience indicated that only certain types of processed shale oils possessed carcinogenic properties.

The Estonian oil shale industry (USSR) is one of the largest and oldest oil shale industries in the world. For over 20 years the Institute of Experimental and Clinical Medicine of the Estonian Ministry of Health had conducted clinical, industrial hygiene, and toxicological studies on the workers employed in this industry (Commoner, 1975; Bogowsky and Jons, 1974; Vosmae, 1966). Incidence of cancer among Estonian shale workers has not been found to be greater than among the general population. The Estonian shale industry attributes this lack of cancer problems to good hygienic practices, automation, and isolation of workers from potentially hazardous materials. However, the results of this study may be due to a lack of sufficient follow-up or insufficient time for development of cancer above the background incidence rate.

The worker population is subject to exposure via two major routes - dermal and inhalation. Handling of shale, crude shale oil, refined shale oil, and to a lesser extent spent shale can result in chronic dermal exposure to PAH. This represents a considerable risk since many PAH are potent carcinogenic compounds by this route. This also has implications for those workers involved in distribution of the refined products. Furthermore, both solid and liquid waste streams from these processes may contain PAH and may warrant special handling precautions.

Another potential route of exposure (i.e., inhalation) comes about as a result of fugitive dust and off-gases from the retorting processes, as well as dust and aerosols generated in the routine handling of shale oil liquids, accidental leakage during the process, and in the handling and treatment of liquid and solid waste streams. Inhalation of certain PAH, such as B(a)P has been associated with cancer of the lung and other tissues in animals and man. There is good reason to believe that chronic inhalation of carcinogenic PAH present in shale oil or related process streams would result in an increased risk of cancer for exposed persons.

The degree of risk which shale oil products represent to humans is a matter of controversy. Several authors have suggested that shale derived oils may create more of a cancer hazard than is currently associated with petroleum oils (Schmidt-Collerus, 1974; Bingham, 1975; Sauter, 1975). However, recent animal and human toxicological data are available which indicate that the cancer risk to humans from exposure to oil shale products may be not greater than that expected from exposure to conventional petroleum-derived fuel oils. (Coomes, 1979). Risk can be assessed on the basis of length of exposure, concentration, and relative potency of toxic substance involved. At this time it is not possible to complete a meaningful quantitative risk assessment of this problem due to lack of validated models and adequate dose-response information for shale oils. Furthermore, risk varies from individual to individual as a function of risk factors which can be genetic, developmental, nutritional, physiological, or behaviorially related (Boulos, 1978).

### 5.6.2 Summary of Mitigating Measures

Early attention to potential occupational health and safety (OHS) hazards is especially important in a demonstration plant such as the Anvil Points Facility since there is a general lack of information concerning the possible magnitude of these impacts for this newly-developed technology. The types of impacts will be the same for the two process alternatives although there may be some variation in the magnitudes of these impacts as a function of process. It is expected that the types and magnitudes of impacts will be the same for all site alternatives, with one exception. The in-mine or mine-bench site will have an increased overall occupational health and safety risk due to the potential for raw shale fires in or near the mine as a result of fire or a major accident at the retort facility. In this case, miners as well as retort personnel could be affected.

The proposed Anvil Points facility provides the opportunity for many OHS studies by several government agencies. However, the scope of the studies are not yet known and detailed OHS programs for the proposed facility have not been designed. A program will be instituted during full scale facility operation based on data from early tests of the facility and other oil shale OHS studies. These include a National Institute of Occupational Safety and Health study of Colorado oil shale workers to investigate and determine possible relationships between exposure to oil shale and shale products and cancer incidence (Cameron Engineers, 1976).

As part of an industrial hygiene study of the oil shale industry, an air monitoring program may be instituted at the proposed Anvil Points facility (DOE, 1977). The program will monitor total hydrocarbons, particulates, respirable dust, trace metals, carbon monoxide, and free silica. Sampling sites will include the mine, crusher, retort area, and shale disposal pile.

Operation of the existing mine for the semiworks facility complies with all OHS regulations as well as regulations governing mine safety under the Mine Safety and Health Act. Also, subsidence monitoring conducted on-site serves as an additional check on the adequacy of mining practices. No subsidence has occurred during the operation of the existing mine; OHS practices in the mine for the proposed full-scale facility will be the same as for the existing mine.

The major OHS concern for the Anvil Points facility for both direct and indirect processes remains human exposure to mutagens/carcinogens associated with shale materials. Recent studies indicate a high correlation between the ability of a compound to induce genetic damage and the carcinogenic potential of the compound, (Epler, et.al., 1979). Any OHS program associated with the Anvil Points facility should emphasize protection of workers, particularly those who are especially susceptible, from these genetic hazards.

There are several mitigating measures that can be implemented to reduce the impact of oil shale processes on worker health. An obvious one is to provide the maximum degree of containment feasible, and the use of automated machinery to reduce worker contact with PAH-containing materials. Another is to provide direct protection for those who are exposed. Workers in process steps that inherently contain a high likelihood of dermal contact can be provided with gloves, worksuits, etc., which should not leave the premises and which should be replaced on a periodic basis, e.g., daily or twice weekly. Respirators should be provided to those workers in process steps that have a high likelihood for contact with fugitive aerosol, particulate, and gaseous emissions. Such a respriator should contain a high efficiency filter and an activated carbon cylinder for absorption of organic materials, and it should remove as small a diamter of particulate as is compatible with maintaining acceptable air flow rates.

Additionally, any program to mitigate the impact of oil shale technology at this site should protect the inherently high-risk worker subpopulation which is already predisposed to mutagenic and/or carcinogenic processes. Those persons who may be especially susceptible to such processes could be screened prior to job assignment by determination of aryl hydrocarbons hydroxylase (AHH) in isolated or cultured lymphocytes obtained from these persons. AHH is the enzyme responsible for activating various PAH to their ultimate mutagenic/carcinogenic forms. Those persons demonstrating high AHH activity would be deemed high risk cases and should be assigned to low-risk tasks within the facility. From a similar perspective, worker exposure to PAH-containing materials can be monitored by periodically determining their lymphocyte AHH activities (which can be induced to high levels of PAH exposure) or by checking for PAH metabolities in body fluids by the mammalian microsomal-assisted Ames bacterial mutagenesis test. A series of such tests results, if available over the history of employment of personnel and if adjusted for confounding factors such as smoking, can provide a profile over time of worker exposure to such materials. Additionally, such in vitro tests can be used to determine which shale oil fractions and materials produced in the process steps will require the most worker protection (Epler, et.al., 1979; Bridbord and French, 1978).

Such mitigating measures should significantly reduce worker health and safety impacts for all site and process alternatives.

## 5.7 NET ENERGY FACTORS

With the increasing importance of developing energy technologies that will use scarce resources efficiently, the concept of net energy has been advanced as a policy-making tool to supplement traditional economic analysis. Net energy is defined as the amount of available energy after the energy costs of discovering, producing, and delivering the energy have been paid. All inputs to an energy-producing system -- including labor, capital, information, and materials -- are measured in terms of the energy required for their production. The sum of these quantities is subtracted from the system's lifetime energy output to obtain the net energy. Net energy analysis endeavors to provide an accurate measure of the useful energy society receives from a system after all the energy embodied in the various inputs has been recouped. It is possible that an energy system would produce negative net energy; that is, requiring more energy in the form of various inputs than it would generate.

The utility of net energy analysis as a policy-making tool has been a controversial topic since Congress mandated its use as a "consideration" in developing priorities for funding new energy technologies (Non-Nuclear Energy Research and Development Act of 1974, PL93-577). The controversy over net energy theory centers on whether net energy analysis or traditional economic analysis provides better insight into the combination of energy technologies that will maximize social welfare. Net energy theory expresses the view that social welfare has a physical basis that can be optimized by adjusting energy flows to obtain maximum net energy. The economist, on the other hand, perceives that social welfare is defined necessarily by the wants and preferences of the individual as expressed through the marketplace. Neither approach is without its flaws, but extra care must be taken in using net energy analysis as a basis for making economic decisions, since the net energy value of an energy form will not necessarily coincide with the true economic value of that energy to society. The following discussion is not concerned with the utility of net energy factors, but is intended only to show that oil shale technologies will achieve positive net energy.

The Non-Nuclear Energy Research and Development Act requires net energy analysis to be applied to energy technologies "at the stage of commercial application." Since the Anvil Points facility will not be a full-scale commerical operation, this section will examine instead a hypothetical 100,000 BPD oil shale facility using Paraho retorting technology.

Joseph McKee and Kumar Kunchal (1976) developed a model of a 100,000 BPD Paraho oil shale plant with energy flows and process efficiencies based on data derived from operating experience with smaller Paraho retorting units and conventional oil shale mining techniques. The 100,000 BPD facility represents a fully integrated large-scale operation, incorporating process steps such as raw shale oil upgrading and total onsite power generation that are not part of the Anvil Points plan, and thus gives a better idea of the energy requirements for a commercial scale plant than would a specific analysis of the Anvil Points facility.

The 100,000 BPD facility model and its internal energy flows are based on the following assumptions:

- The oil shale facility includes mining, shale crushing, retorting, internal power generation, spent shale disposal, and raw shale oil upgrading. All processing operations are located near the mine mouth.

- Oil shale mined for the plant is assumed to average 30 gallons oil per ton, slightly higher than the deposits that will feed the Anvil Points faciltity.

- The plant is fed by an underground mine employing room and pillar techniques. Shale recovery rate is 60 percent, with the remaining 40 percent left underground as pillars.

- Diesel fuel needed for mining, hauling, and other plant operations is produced onsite from a small fraction of the upgraded shale oil.

- The retort can operate in either indirect or direct modes. For both modes, all byproduct coke and low-Btu gas is used for onsite electricity generation; excess electricity beyond internal needs is sold to the grid and counted as an output of the facility.

- Onsite electricity generating efficiency is 10,000 Btu/kwh, or 34 percent, assuming the use of water cooling for the generating plant. With air cooling, generating efficiency would be considerably lower, resulting in slightly lower net energy factors.

Figures 5-4 and 5-5 illustrate the net energy inputs, outputs and losses associated with Paraho direct- and indirect-mode retorting at the 100,000 BPD facility. In both cases, the facility handles the same amount of oil shale daily. However, due to the slightly lower process efficiency of indirect mode retorting, the energy value of the outputs differs. The width of the arrows indicates the relative amounts of energy contained in the inputs and outputs.

The oil shale facility receives the bulk of its energy input in the form of oil shale ("resource input" in the diagrams). The system also receives energy inputs from sources outside the facility, though they are small compared with the oil shale input. The external inputs consist primarily of the energy embodied in materials for the mine, retort facility and other plant equipment, as well as externally produced fuels and explosives.

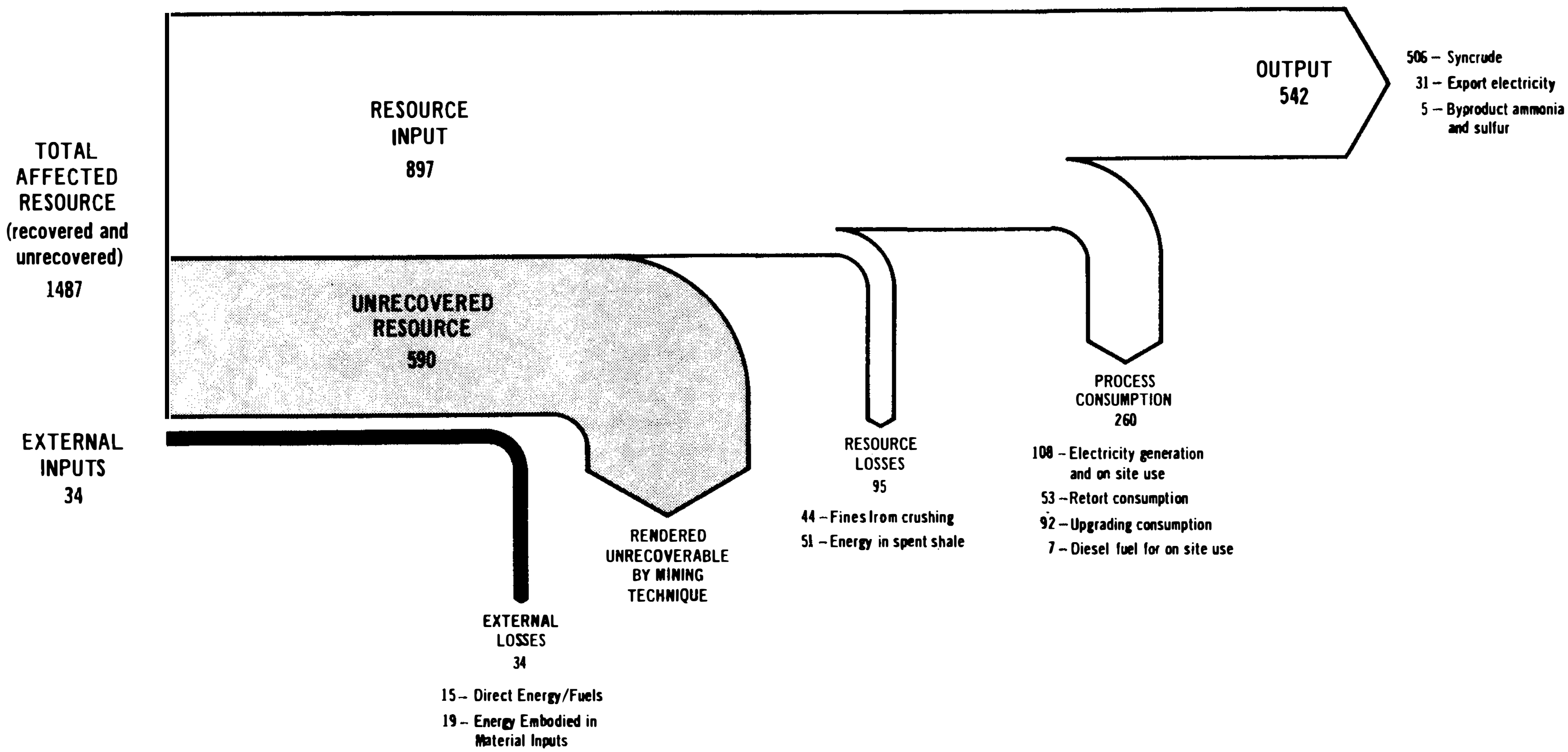
The usable plant outputs differ somewhat between direct and indirect mode retorting. Direct-mode retorting and subsequent upgrading produces syncrude, byproduct sulfur and ammonia, and exportable electricity in excess of onsite needs. Indirect-mode products include syncrude, exportable electricity, high Btu exportable gas, sulfur and ammonia. For both modes, the bulk of useful energy output is contained in the syncrude product.

Downward arrows indicate energy lost from the system as unutilized resource, waste heat, or discarded materials. The largest energy loss is the oil shale rendered unrecoverable by underground mining techniques. Since this energy never enters the shale oil production process as such, it often is not counted as a loss from the system. The unrecovered shale energy is included in these diagrams to show the efficiency of resource recovery.

Energy losses from the actual production process can be divided into three categories, as shown in the diagrams. Resource losses (the shale energy not extracted by the production process) include the unusable shale fines generated during crushing and the energy remaining in the spent shale after retorting. Process consumption losses constitute those portions of the energy input that are consumed by various plant processes such as retorting and electricity generation, and ultimately leave the system as waste heat. External losses are simply the external inputs, which are counted as losses because they are consumed by the system (even in the case of buildings and machinery which have relatively long useful lifetimes), yet do not become part of the useful output physically.

# FIGURE 5-4
## PARAHO DIRECT MODE RETORTING FACILITY ENERGY BALANCING

- 100,000 BPD Plant
- Processes included: mining, crushing, retorting, spent shale disposal, upgrading/pre refining, onsite electricity generation,
- Figures represent billion Btu's of energy per day

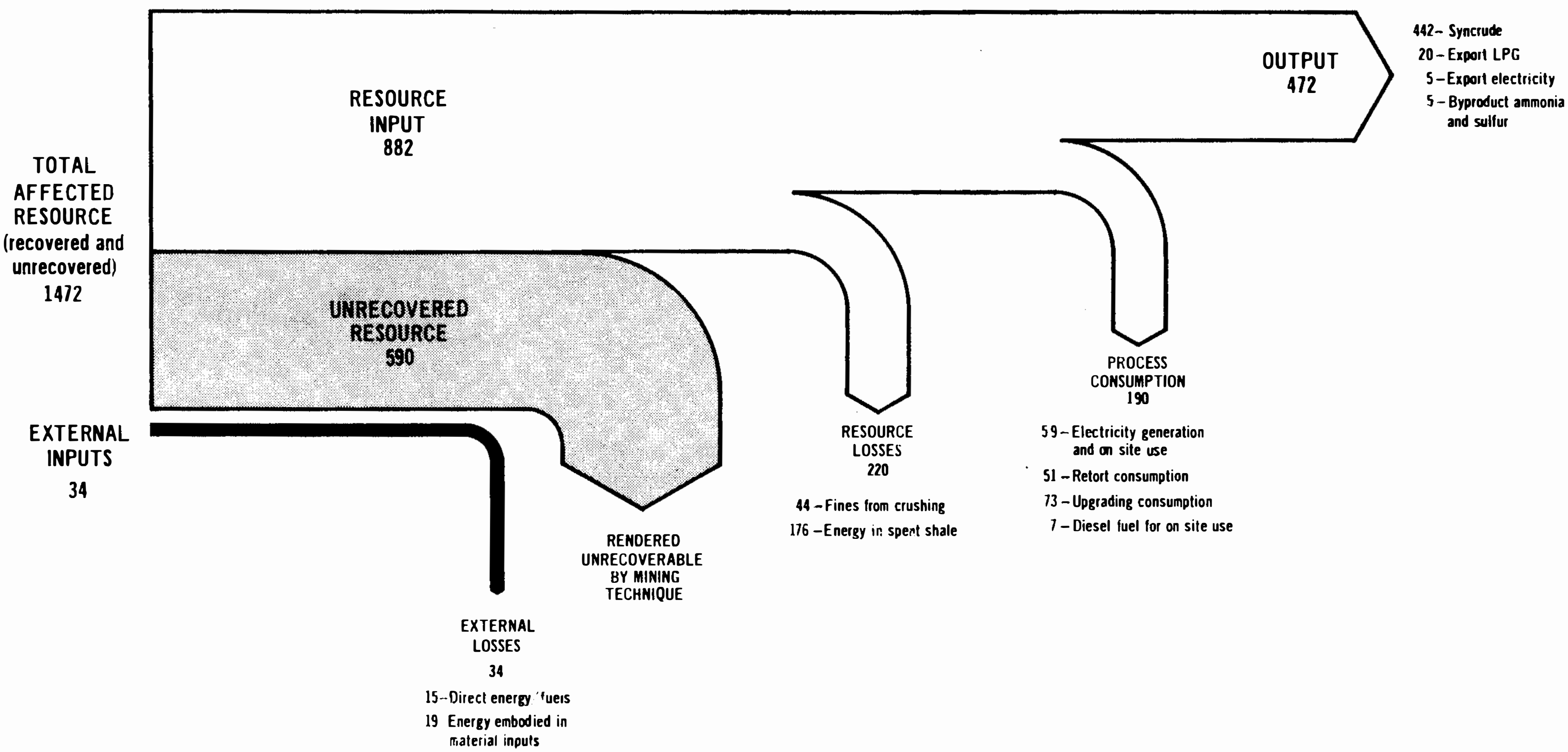



SOURCES: J. M. Mckee and S. K. Kunchal, "Energy and Water Requirements for an Oil Shale Plant Based On Paraho Process," Colorado School of Mines Qtly. Vol. 71, No. 4 (1976)

Colorado Energy Research Institute, Summary Report, Net Energy Analysis: An Energy Balance Study of Fossil Fuel Resources (April, 1976)

# FIGURE 5–5
## PARAHO INDIRECT MODE RETORTING FACILITY ENERGY BALANCING

- 100,000 BPD commercial plant
- Processes included: mining, crushing, upgrading, spent shale disposal, upgrading, pre–refining, electricity generation.
- Figures represent billions Btu's of energy per day.




SOURCES: See Figure 5-4.

The diagrams demonstrate that the 100,000 BPD oil shale facility does not rely heavily on external energy inputs. For both modes of retorting, the ratio of energy outputs to external inputs is high, as shown in Table 5-18 (ratio "A"). In other words, the amount of energy that society must allocate to an oil shale facility, and thus forego using in an alternative way, is small compared to the energy produced by the facility.

On the other hand, considerable amounts of the energy in the oil shale resource are lost during the production of syncrude. Resource and process losses account for up to one-half of the shale energy fed into the system. The ratio of energy outputs to resource and external outputs (ratio "B" in Table 5-18) indicates the efficiency of resource utilization in the oil shale facility. For both retorting modes, roughly two units of resource and external energy enter the system for every unit of syncrude produced. Adding the unrecoverable shale fraction to the inputs (ratio "C") further decreases the net energy ratios, although as mentioned before, the unrecovered resource fraction is not necessarily considered as an input.

The net energy ratios in Table 5-18 serve primarily to illustrate that shale oil production consumes substantial amounts of energy. Most of the energy requirements are derived from energy in the oil shale; therefore, that the overall process does not require large amounts of external energy inputs. The Paraho retorting technology yields substantial net energy, as shown in the ratio of energy output to external inputs.

TABLE 5-18

NET ENERGY RATIOS FOR A COMMERCIAL SCALE OIL SHALE FACILITY USING PARAHO RETORT

| Net Energy Ratio | Retorting Mode Paraho Direct | Paraho Indirect |
|---|---|---|
| A) OUTPUT: EXTERNAL INPUTS | 16.0:1 | 13.9:1 |
| B) OUTPUT: RESOURCE INPUT + EXTERNAL INPUTS | 0.6:1 | 0.5:1 |
| C) OUTPUT: AFFECTED RESOURCE + EXTERNAL INPUTS | 0.4:1 | 0.3:1 |

SOURCES: See Figure 5-4.

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# 6. POTENTIALLY UNAVOIDABLE ADVERSE EFFECTS

In the course of the proposed action, constructing and operating the Paraho module, and associated mining and spent shale disposal, all reasonable mitigating measures will be taken to reduce the environmental impacts, and to comply with applicable Federal, State, and local regulations. However, certain impacts are both unavoidable and adverse:

- Approximately 64 acres of land surface, its vegetation and wildlife habitats will be disturbed by the plant site, storage areas, conveyors, roads and utility corridors, shale disposal areas, pipelines, and mine development. Much of this disturbance is expected to be temporary.

- Up to 30 acres of Balzac Gulch will be filled to a depth of 400 feet with disposed spent shale. Recontouring and revegetation will create a new surface which will alter topography permanently, disturb some wildlife habitats, and probably change the vegetation cover.

- Approximately 300,000 barrels of shale oil will remain unrecovered in unretorted fines from crushing and screening 11 million tons of shale.* However, since plans for ultimate disposal fines remain uncertain, potential for recovery and/or re-use exists.

- Some atmospheric emissions will be added to the regional air environment, temporarily degrading local air quality during construction and operation. These emissions will include particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons. Despite control efforts, fugitive dust levels will increase during construction and operation of the facility, due to emissions from disturbed land, unpaved roads, and shale handling.

- There will be an increase in general noise levels in the area over the three-year project period; with possible adverse noise effects limited to the 18-month construction period. Noise levels at the site and for mining and shale disposal will comply with statutory limits. Nearby towns such as Rifle should not be affected, but some impact on wildlife near the site may result.

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* Based upon a five percent fines loss, 25 gallons of oil per ton of shale and a retorting efficiency (Fischer Assay) of 95 percent.

## 7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed action to mine 11 million tons of oil shale on NOSRs 1 and 3 will involve the following irreversible and irretrievable commitment of resources:

- Mining and processing 11 million tons of oil shale, averaging approximately 25 gallons per ton, will yield as much as 5.9 million barrels of shale oil.* Eleven million tons of raw shale mined by underground room-and-pillar methods with a 70 percent in-place recovery of the resource will commit 15.7 million tons of raw, in-place oil shale to the proposed action. This amount of in-place shale is only a fraction of one percent of the 11.4 billion tons of shale on NOSRs 1 and 3 and is approximately 1.3 percent of the 1.2 billion tons of reserves in the DEI lease.

- Thirty acres of Balzac Gulch on the Anvil Points site will be filled to a depth of 400 feet with 11 million tons of disposed retorted shale. Drainage and catch-basins are planned to control runoff and leaching. The disposal area will be vegetated and cared for until the new cover is self-sustaining.

- Due to the activities described above, 64 acres of naturally occurring flora and existing wildlife habitats will be lost. However, some of this may be reclaimed by revegetation. The lost wildlife habitats are not critical.

- A maximum of 122 acre-ft/year of 39,753,700 gallons of water (183 acre-ft or 59,630,550 gallons over 1.5 years), primarily for domestic use, mining, and dust control, will be consumed onsite. 90 percent of this water is expected to come from the Colorado River. The remainder will come from an existing NOSR 1 reservoir on the plateau and from process waters. All water consumed will be surface water; it is not expected that any groundwater will be used onsite. An additional estimated 300 acre-ft or 97,755,000 gallons of water/year (450 acre-ft or 146,632,500 over 1.5 year period) will be consumed offsite by the increased population associated with the project. Total onsite and offsite water use for a 1.5 year operation phase based on these estimates will be 633 acre-ft, or 206,263,050 gallons.

- A maximum of approximately 13.5 megawatt-years of outside electrical power will be consumed over a 1.5 year operating period. This in turn will require the offsite consumption of 46,200 tons of bituminous coal (or its heating value equivalent in natural gas, 1.02 billion SCF) for power generation. There also will be the offsite concomitant consumption of 204 acre-ft or 66,473,400 gallons of cooling water for power generation over a 1.5 year operating period.

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* Based on five percent loss of fines and a retorting efficiency (Fischer Assay) of 95 percent.

- A maximum of 300,000 barrels of shale oil in the unretorted fines from crushing and screening will be lost irretrievably, unless they are stored for later use.

## LIST OF PREPARERS

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# GLOSSARY

Adit - A mining tunnel.

AFY - Acre-feet per year.

Baghouse - A device for removing particulate matter from a gas stream by passing the stream through a series of finely meshed "bags" which screen out the particulates.

Bajada - An alluvial plane formed at the base of a mountain by the coalescing of several alluvial fans.

Bench - A shelf-like area of rock with steep slopes above and below.

Class I Area - A federally designated area of high amibient air quality where no degredation of the air quality by unnatural causes will be allowed.

Cuesta - A long low ridge with a relatively steep face or escarpment on one side and a long gentle slope on the other side.

DEI - Development Engineering, Incorporated.

Direct Mode - A mode of heating oil shale by direct contact with the original heat source.

Drift - An approximately horizontal passageway in underground mining.

Drill Jumbo - A specialized piece of drilling equipment capable of drilling 4.5 inch holes 30 feet deep.

ERDA - Energy Research and Development Administration.

Fines - Pieces of raw oil shale less than 0.5 inches in diameter.

Fischer Assay - A method of determining the oil content of oil shale.

Fuel $NO_x$ - $NO_x$ produced by direct combustion of fuels.

Indirect Mode - A mode of heating oil shale by indirect contact with a heat source, such as a preheated gas.

MGY - Million gallons per year.

Mahogany Zone - Name given to the Mahogany Ledge, a rich (30 gallons per ton) layer of oil shale running through the upper shale zone of the Piceance Creek Basin of Colorado.

NOSR - Naval Oil Shale Reserves.

Off Gas - Gas evolved during the retorting of oil shale.

Ore Pass - A passageway for the transportation of ore.

PSD - Prevention of Significant Deterioration.

RCRA - Resource Conservation and Recovery Act.

Ribs - A structural member of a "room" which furnishes support.

Room and Pillar Mining - An underground mining method in which materials are mined from square or rectangular "rooms," leaving pillars of the mineral layer between rooms for support.

Sagometer - A device for measuring the amount of sag in the roof of a mining chamber or tunnel.

Thermal $NO_x$ - $NO_x$ produced by indirect heating of a fuel or other substance.

# APPENDIX A

# AIR POLLUTION DISPERSION ANALYSIS

# 1. MODELING ANALYSIS

Air quality impacts of the proposed project were analyzed through dispersion modeling. The PTMAX model was used to derive worst-case meteorological conditions. The highest one hour, three hour, and 24 hour $SO_2$ concentrations were predicted by the PTMTP model with adjustments made to account for rough terrain. The AVDUST model was used to predict 24 hour average particulate concentrations. The CDM model was used to calculate annual average $SO_2$, $NO_2$, and particulate concentrations.*

The models used do not consider background pollutant levels. Long-term pollutant averages (equivalent to annual mean levels) were used as background levels for all modeling impacts, even short-term (24 hour and three hour) $SO_2$ and particulate impacts. Although short-term concentrations of these pollutants may exceed annual mean levels, it is difficult to determine if the higher measured short-term levels will correspond in time and location with the predicted maximum concentrations resulting from the facility's emissions. Furthermore, the impacts predicted by the modeling are worst-case impacts which represent possible, but unlikely, occurrences. For purposes of this analysis, it is unreasonable to assume that the sum of the higher short-term ambient measurements and the corresponding predicted maximum facility impacts is a realistic approximation of facility impact. The estimated background concentrations based on long-term averages more nearly represent the expected contribtuions from the other sources to the total ambient particulates and $SO_2$ levels.

* For details of these models, see References 1 and 2.

## 2. MODELING INPUTS

### 2.1 GASEOUS POLLUTANTS

The characteristics of the sources modeled are given in Table A-1. Total daily and monthly gaseous and particulate emission rates for each phase of the proposed project are given in Table A-2. Besides these input parameters, the models PTMTP and CDM also require meteorological data. For CDM, a joint frequency distribution of wind speed, direction, and stability class is needed. Based on 3.5 months of wind speed and direction data collected by AeroVironment at the existing facility, a frequency distribution was developed. Because these data were collected during the winter months only, this approach was considered conservative, representing worst-case conditions.

Stability was assumed to be neutral during the day and neutral or stable at night, depending upon the wind speed. This assumption also was considered to be conservative.

The outputs of the PTMAX model were used to determine the worst-case meteorological conditions to be simulated by PTMTP. The highest concentration for the proposed oxidizer/boiler/turbine stack was predicted to occur during class A stability (Pasquill) and a 3.0 m/sec wind speed. For the mine vent, the low-plume rise was predicted to cause the highest, very localized concentrations. However, the inaccessibility of the vent location will prevent anyone from being exposed to these concentrations; therefore, meteorological conditions giving high concentrations at least 200 m away were chosen as being more realistic for assessing the impacts.

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* The source-specific emission rates used in the modeling are contained in the air permit, Reference 3.

Thus, stability class E with a wind speed of 2.0 m/sec was chosen as the worst-case for this source.

To model one hour concentrations, both sets of the aforementioned conditions, plus a mixing height of 350 m was used. The meteorology for the three hour simulation was identical, again to be conservative.

For the 24 hour case, a wind meander of 30° was used. The prevailing direction was chosen to be 345° because it would line up the mine and the module emissions, causing the highest impacts. The occurence of such a wind direction all day (even with a 30° meander) is unlikely, but remotely possible. Because the proposed oxidizer/boiler/turbine stack was not a significant source, stability and wind speed were chosen that would give highest impacts from the mine. Since stability class E, wind speed 2.0 m/sec was shown above to be the worst-case for the mine, it was used during the nighttime hours. For the daytime, stability class D, wind speed of 3.5 m/sec was used, in order to give high concentrations in the same general area and the highest additive impacts.

Separate one hour and 24 hour model runs were made to assess the effect of plume impact on the Roan Cliffs. Because plume impact occurs chiefly under stable conditions, the one hour case was modeled with class E stability and 2.0 m/sec wind speed. Also, this case was modeled with a wind direction for 165° blowing from the module site to the mine vent and toward the cliff.

The modeling analysis of 24 hour impacts to determine plume impact on the ridge was executed with the same meteorology as the other 24 hour run, except that a prevailing wind direction of 165° was used. Because this area has a predominating valley flow regime, wind direction blowing toward the cliffs during stable atmospheric conditions is highly unlikely especially with only a 30° meander all day. However, the results are included for completeness in assessing all possible impacts.

## 2.2 PARTICULATES

Meteorological inputs for CDM particulate modeling were the same as for the gaseous pollutants. The line source emissions were assumed to be coming from the end points of the roads only and the area source emissions were assumed to be released at one point. Also, no particle fall-out was included. These assumptions lead to very conservative predictions of particulate concentrations in the module area.

Meteorological inputs to the AVDUST model to assess particulate impacts were very similar to the PTMTP inputs. Only the 24 hour case was modeled because there are no one or three hour standards applicable. The wind speed and stability classes are identical to those in the 24 hour runs for gaseous pollutants, because most sources were assumed to have an affective stack height of 10 m and so would impact surrounding areas the same way that the mine would. However, the prevailing wind direction was assumed to be 270° because it aligns the highest particulate emitting sources to give highest impacts. It also is a highly probable direction, although it generally is associated with higher wind speed when occurring all day.

Because particulate fall-out is included in the model, an additional input of particule-size distributions for the different types of operations is needed. These distributions were obtained from studies by DEI and AeroVironment.[4]

All nonstack point source emissions were assumed to be released at 10 m, the average height of the operation or storage pile. Line and area source emissions were assumed to be generated at groudn level. The only stack with particulate emissions was that of the module oxidizer/boiler/turbine stack and the stack parameters used are the same as those presented in Table A-1.

TABLE A-1

SOURCE CHARACTERISTICS FOR NONFUGITIVE EMISSIONS

| SOURCE | STACK HEIGHT (m) | STACK EXIT TEMPERATURE (°K) | VOLUME FLOW ($m^3$/sec) |
|---|---|---|---|
| Turbine/Boiler Oxidizer Stack | 45.7 | 450.0 | 58.27 |
| Mine Vent | 10.0[a/] | 293.0 | 283.20 |

a/ Initial stack height is assumed to be 10 m due to momentum of plume.

TABLE A-2

TOTAL DAILY AND MONTHLY EMISSION RATES FOR THE PROPOSED ANVIL POINTS OIL SHALE FACILITY[a/]

| | CONSTRUCTION AND MINE DEVELOPMENT | | MINING AND RETORT OPERATION[b/] | |
|---|---|---|---|---|
| | lbs/day | tons/mo. | lbs/day | tons/mo. |
| $NO_x$ | 133.8 | 1.5 | 2124 | 21.5 |
| $SO_2$ | 9.9 | 0.1 | 353 | 2.5 |
| Particulate | 271.4 | 3.0 | 675 | 7.4 |

a/ Emission rates include emissions from all sources discussed in the pollutant emissions section (3.3.1) including fugitive dust and vehicle emissions.

b/ Emission rates include periodic emissions from the pilot and semi-works plant.

## 3. AIR QUALITY IMPACT MAPS

Figures A-1 through A-6 show particulate, $NO_2$, and $SO_2$ impacts from the Anvil Points facility, as predicted by the dispersion modeling.

FIGURE A-1

PREDICTED ABOVE BACKGROUND ANNUAL AVERAGE TSP CONCENTRATIONS ($\mu g/m^3$).

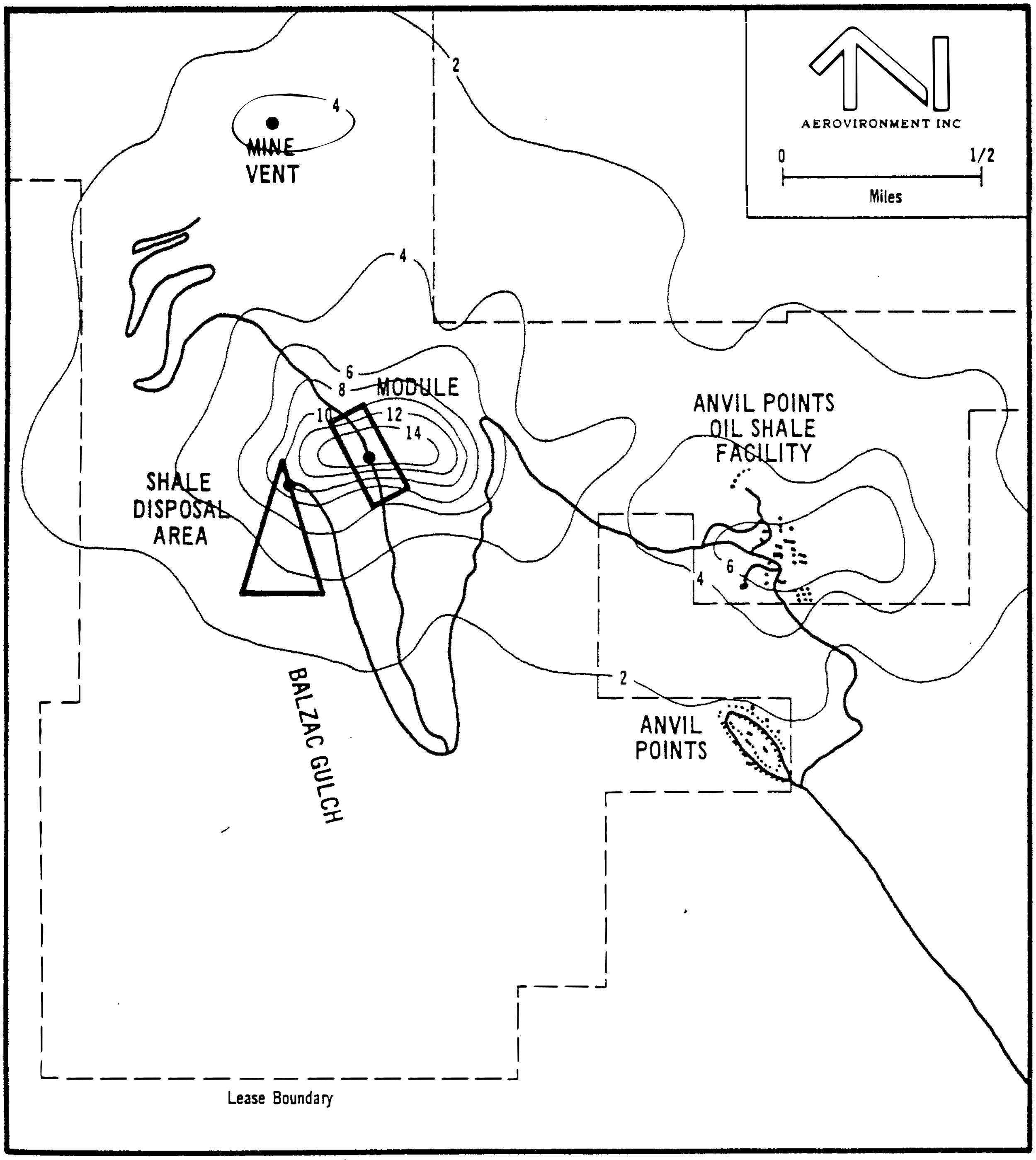
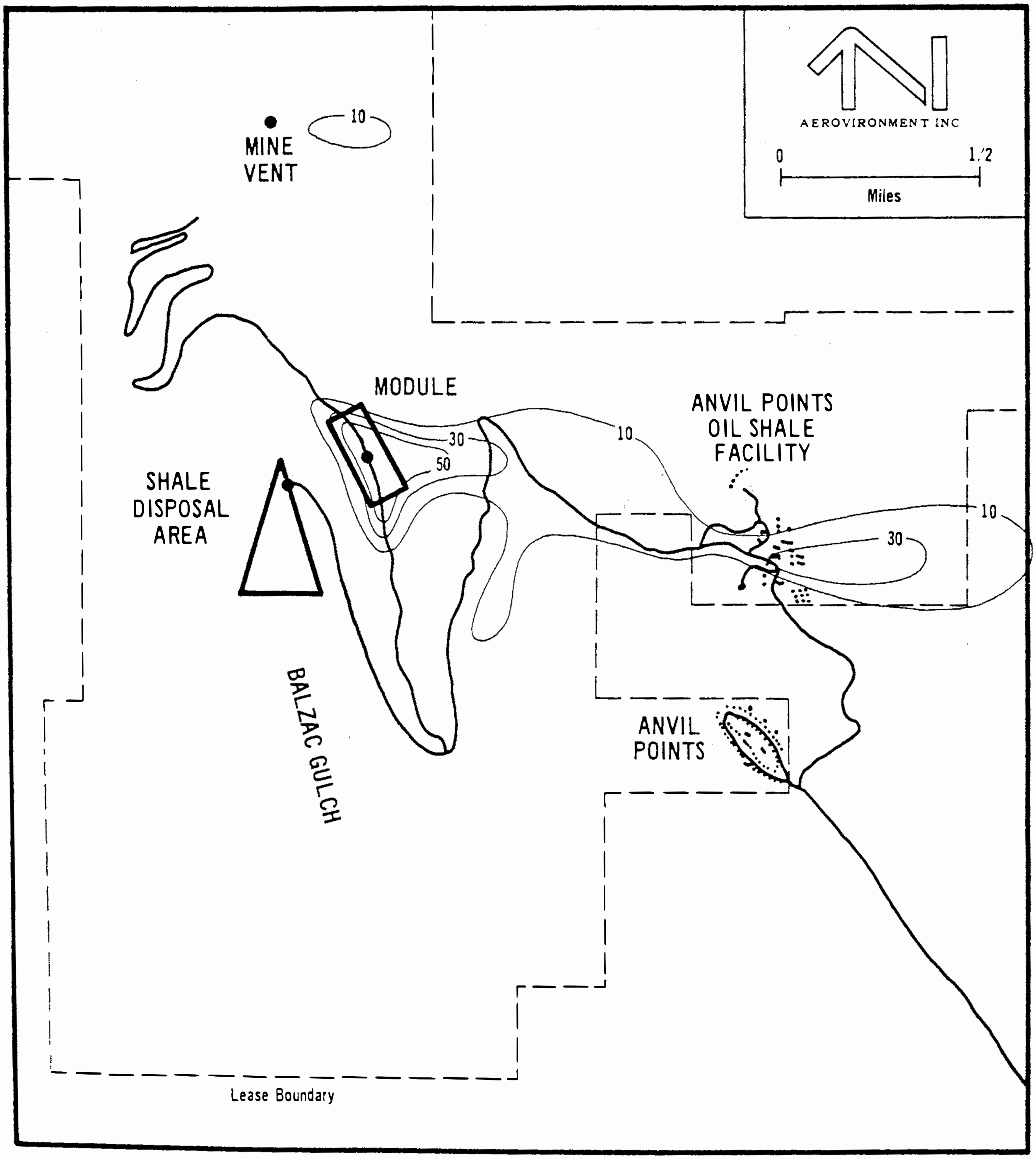


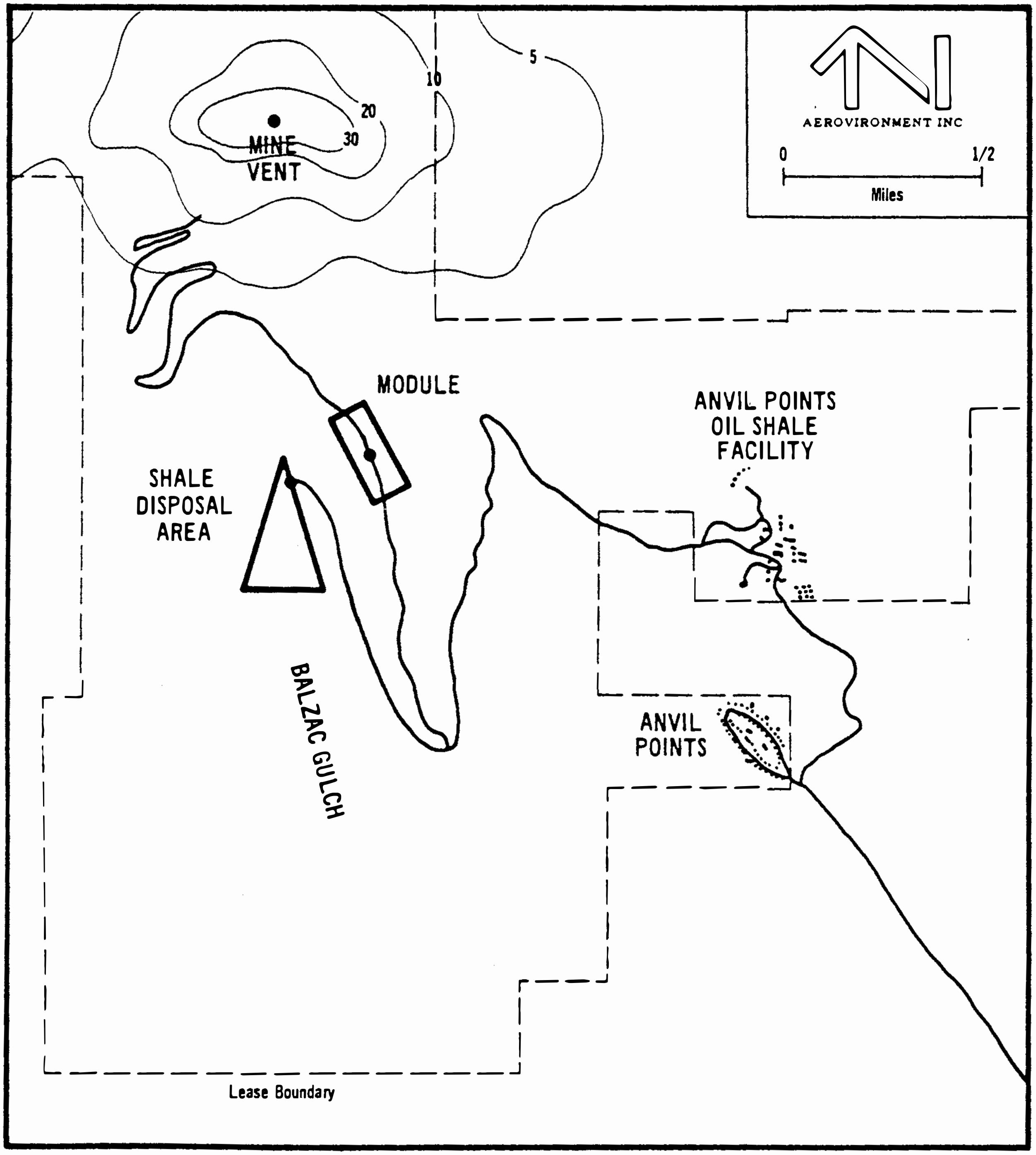
FIGURE A-2

PREDICTED ABOVE BACKGROUND
24-HOUR TSP CONCENTRATIONS($\mu g/m^3$).



## FIGURE A-3

## PREDICTED ABOVE BACKGROUND ANNUAL AVERAGE $NO_2$ CONCENTRATIONS ($\mu g/m^3$).



## FIGURE A-4

## PREDICTED ABOVE BACKGROUND ANNUAL AVERAGE $SO_2$ CONCENTRATIONS ($\mu g/m^3$).

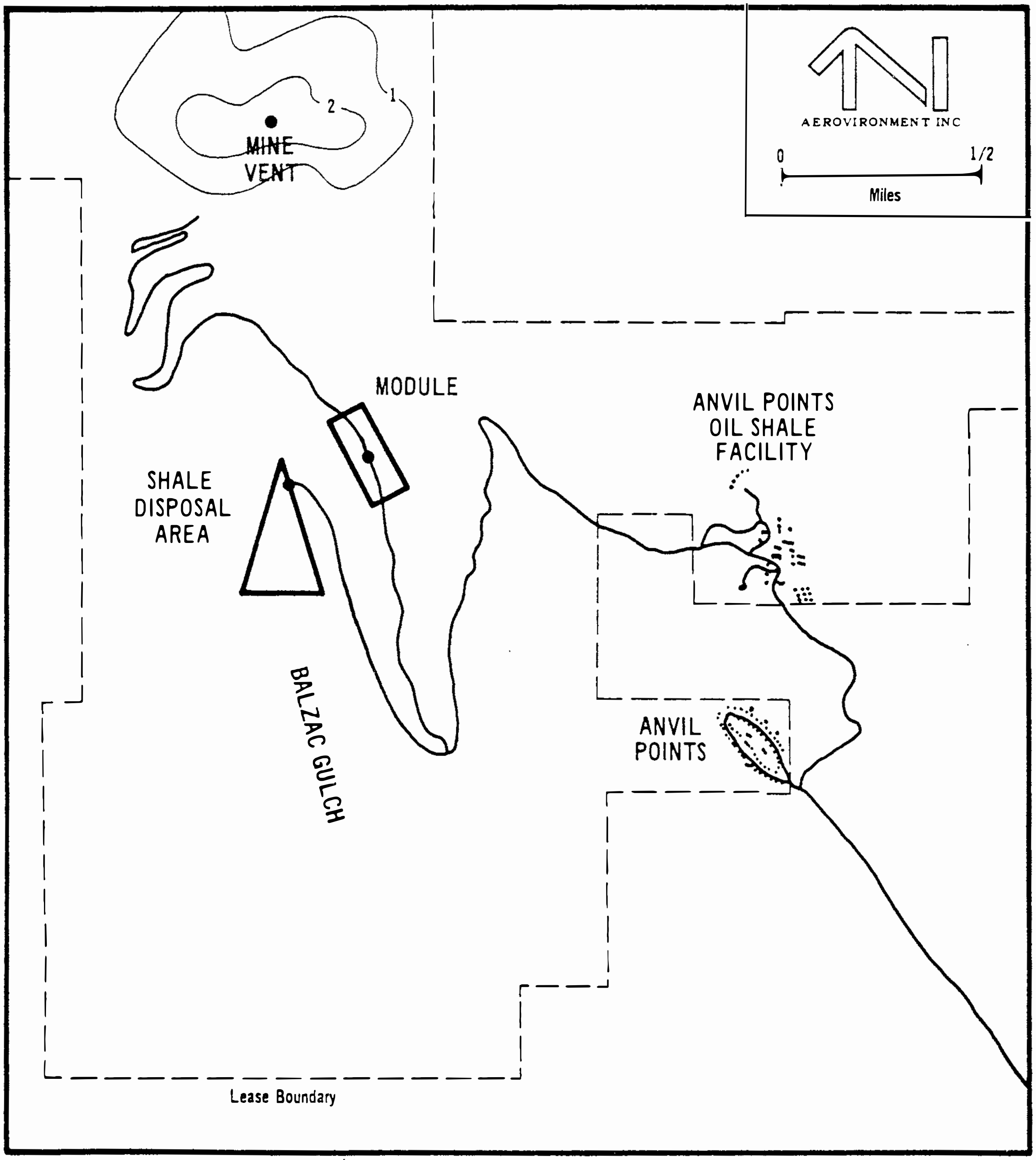
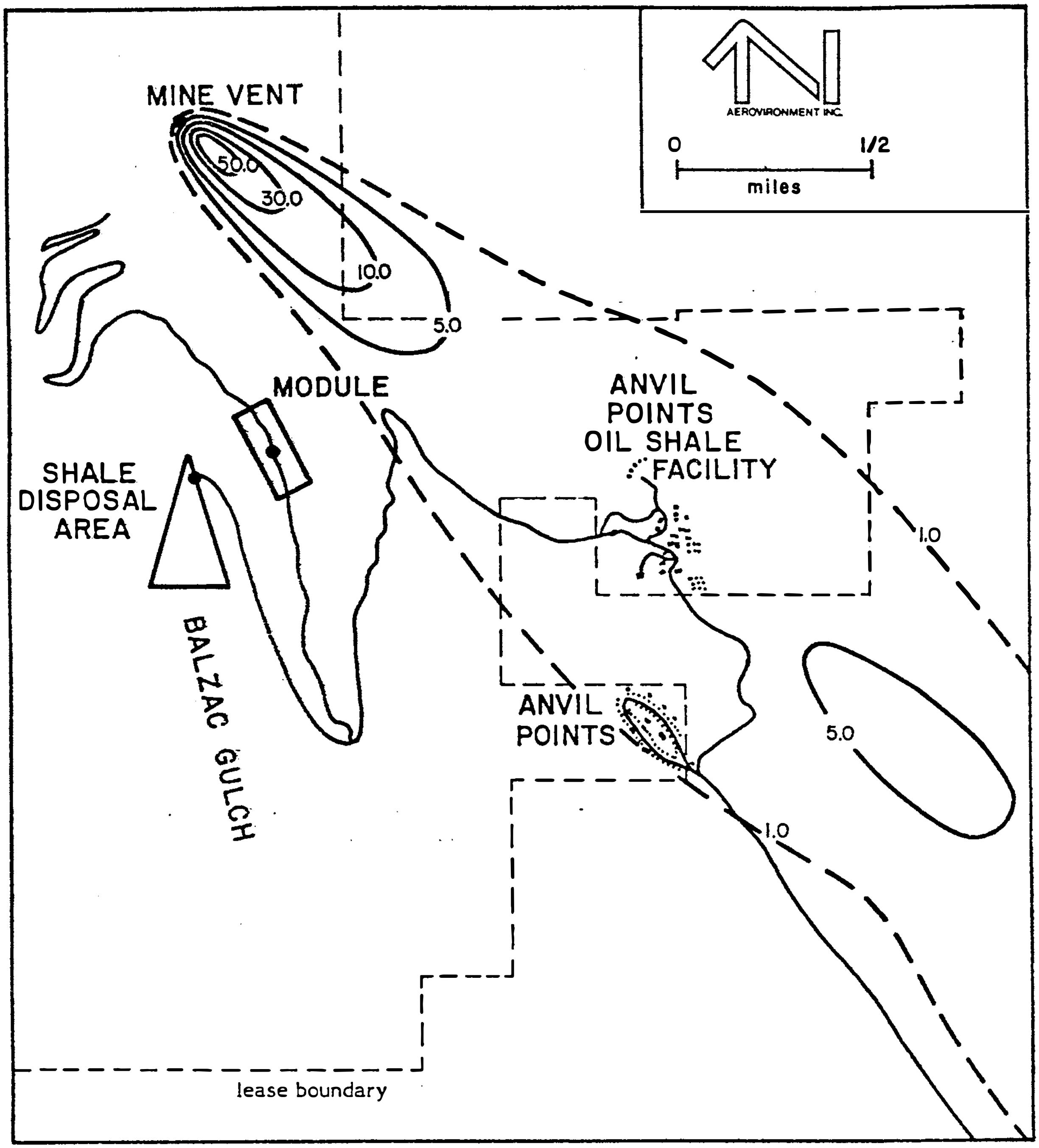


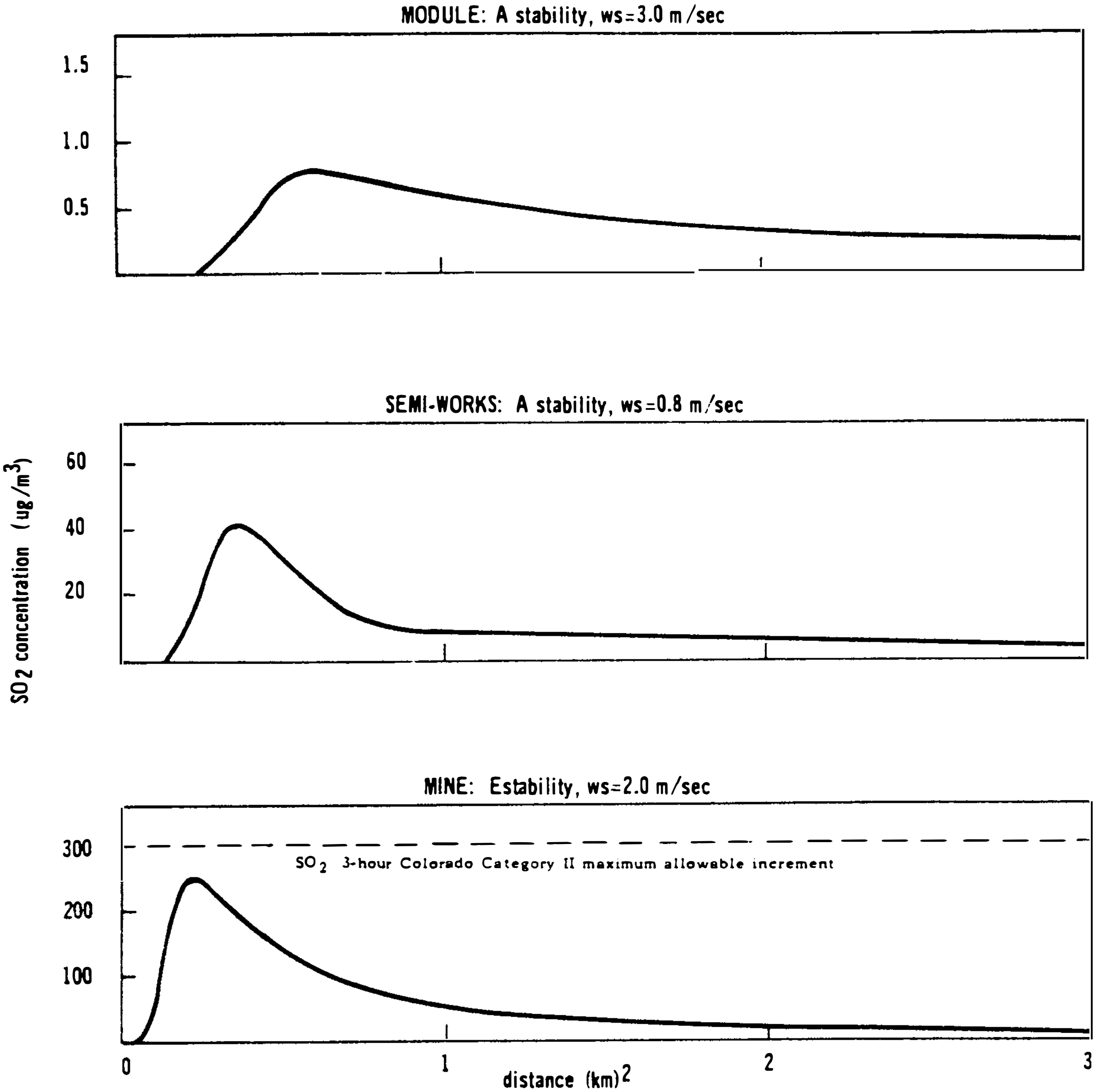
FIGURE A-5

PREDICTED ABOVE BACKGROUND
24-HOUR $SO_2$ CONCENTRATIONS ($\mu g/m^3$).



## FIGURE A-6

## PREDICTED ABOVE BACKGROUND DOWNWIND ONE-HOUR $SO_2$ CONCENTRATION ALONG PLUME CENTERLINE



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3. Development Engineering, Inc. September 1978. "Air Emission Source Construction and Operating Permit Application." Submitted to Colorado Department of Health, July 5, 1978, updated September 1978.

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# APPENDIX B

## SUMMARY OF CHEMICAL TEST RESULTS FROM WOODWARD-CLYDE LEACHATE STUDY

TABLE B-1. SUMMARY OF CHEMICAL TEST RESULTS FROM WOODWARD-CLYDE LEACHATE STUDY

| SPECIMEN NUMBER | SPECIMEN TYPE | COMPACTIVE EFFORT | PERMEABILITY RATE - (FT/YR) | EFFLUENT TAKEN - (DAYS) | pH | TDS (ppm) | % TDS BY WEIGHT | CHEMICAL ANALYSIS (ppm) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $SO_4$ | $Na_2O$ | $K_2O$ | $CO_3$ | $HCO_3$ | Cl | (OH) | Li |
| I-B | STANDARD LEACH | - | - | | 11.1 | 1,391 | 1.391 | 18 | 2.4 | 0.12 | 280 | 15 | 520 | 230 | 67 | 180 | <0.1 | 69 | 10 | |
| I-B (A) | PERMEABILITY EFFLUENT | LOW | 30 | 1 | 7.5 | 6,938 | 0.070 | 10 | <0.05 | 0.06 | 570 | 78 | 3,330 | 1,750 | 390 | <0.01 | 230 | 580 | <0.1 | - |
| I-B (B) | | | 15 | 5 | 11.4 | 2,422 | 0.025 | 10 | 0.48 | <0.05 | 350 | 13 | 310 | 740 | 100 | 700 | <0.1 | 68 | 130 | - |
| I-B (C) | | | 7.5 | 10 | 9.0 | 5,643 | 0.062 | 20 | <0.2 | 1.6 | 25 | 25 | 2,890 | 1,910 | 320 | 90 | 290 | 71 | <0.1 | - |
| I-B (D) | | | 2.3 | 20 | 8.9 | 4,432 | 0.080 | 13 | 2.7 | 1.1 | 18 | 2.2 | 6,910 | 1,470 | 230 | 98 | 550 | 120 | <0.1 | 17 |
| I-B (E) | PERMEABILITY EFFLUENT | MEDIUM | 22 | 1 | 8.0 | 7,201 | 0.083 | 8 | 0.31 | 0.11 | 340 | 11 | 3,060 | 2,440 | 420 | 72 | 180 | 670 | <0.1 | - |
| I-B (F) | | | 7.5 | 5 | 11.4 | 3,319 | 0.080 | 10 | <0.05 | 0.06 | 230 | 9 | 830 | 1,050 | 340 | 410 | <0.1 | 230 | 210 | - |
| I-B (G) | | | 2.2 | 10 | 9.6 | 5,585 | 0.073 | 32 | <0.2 | 1.4 | 8 | 4 | 2,630 | 1,990 | 330 | 310 | 280 | 36 | <0.1 | - |
| I-B (H) | | | 0.8 | 20 | 8.4 | 3,694 | 0.100 | 18 | 3.0 | 1.6 | 9 | 4.6 | 1,400 | 1,068 | 410 | 45 | 710 | 31 | <0.1 | 2 |
| I-B (I) | PERMEABILITY EFFLUENT | HIGH | 3.2 | 1 | 7.8 | 9,171 | 0.070 | 20 | <0.05 | 0.4 | 220 | 61 | 4,320 | 2,830 | 600 | <0.1 | 330 | 790 | <0.1 | - |
| I-B (J) | | | 1.0 | 5 | 7.4 | 8,220 | 0.078 | 20 | <0.05 | 0.17 | 220 | 70 | 3,970 | 2,590 | 450 | <0.1 | 320 | 580 | <0.1 | - |
| I-B (K) | | | 0.4 | 10 | 9.0 | 11,568 | 0.113 | 20 | <0.2 | 0.56 | 23 | 17 | 6,300 | 3,930 | 410 | 96 | 630 | 71 | <0.1 | 70 |
| I-B (L) | | | 0.09 | 20 | 7.8 | 6,849 | 0.067 | 14 | 1.6 | 3.2 | 80 | 19 | 3,740 | 2,200 | 420 | <0.1 | 300 | 62 | 0.1 | 9.5 |
| I-B (M) | PERMEABILITY (1) | LOW | 36 | 10 | 9.0 | 2,916 | - | 13 | 2.1 | 0.9 | 16 | 2.5 | 1,100 | 840 | 330 | 100 | 380 | 120 | <0.1 | 11 |
| I-B (N) | EFFLUENT (2) | | 2.2 | 42 | 9.1 | 4,618 | - | 33 | <0.05 | 0.19 | 22 | 2.8 | 1,790 | 1,240 | 650 | 210 | 630 | 31 | <0.1 | 9 |
| | RECIRCULATED (3) | | 2.4 | 49 | 7.8 | 1,070 | - | 20 | <0.05 | <0.06 | 3.5 | 2.3 | 480 | 260 | 170 | <0.1 | 110 | 20 | <0.1 | 4 |
| I-B (O) | PERMEABILITY (1) | MEDIUM | 22 | 10 | 9.8 | 3,180 | - | 31 | 3.8 | 1.0 | 4.1 | 4.8 | 1,050 | 970 | 390 | 310 | 190 | 210 | <0.1 | 15 |
| I-B (P) | EFFLUENT (2) | | 8.5 | 42 | 7.6 | 3,310 | - | 58 | <0.05 | 0.09 | 8.0 | 0.7 | 1,720 | 960 | 510 | <0.1 | 310 | 27 | <0.1 | 6 |
| | RECIRCULATED (3) | | 14 | 49 | 9.0 | 1,410 | - | 10 | <0.05 | 0.09 | 5.7 | 3.2 | 550 | 460 | 130 | 74 | 230 | 17 | <0.01 | 4 |
| I-B (Q) | PERMEABILITY | MEDIUM | 14 | 1 | 7.8 | 10,845 | - | 10 | 1.2 | 1.4 | 193 | [illegible] | 5,660 | 3,190 | 1,010 | <0.1 | 340 | 400 | <0.1 | 18 |
| I-B (R) | EFFLUENT | | 12 | 5 | 8.2 | 7,741 | - | 20 | 2.1 | 1.9 | 88 | 8.3 | 3,970 | 2,250 | 860 | 18 | 220 | 290 | <0.1 | 13 |
| I-B (S) | SPECIMEN CURED | | 11 | 10 | 8.0 | 1,975 | - | 26 | 1.6 | 1.0 | 25 | 0.5 | 920 | 470 | 320 | 12 | 140 | 52 | <0.1 | 7 |
| I-B ([illegible] | (25 DAYS AT 125 F) | | 12 | 20 | 7.7 | 426 | - | [illegible] | 4.3 | 2.2 | 11 | 0.6 | 130 | 60 | 100 | <0.1 | 76 | 7 | <0.1 | 1.0 |

TABLE B-1. (Continued)

| SPECIMEN NUMBERS | SPECIMEN TYPE | COMPACTIVE EFFORT | PERMEABILITY RATE - (FT/YR) | EFFLUENT TAKEN - (DAYS) | pH | TDS (ppm) | % TDS BY WEIGHT | CHEMICAL ANALYSIS (ppm) $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $SO_4$ | $Na_2O$ | $K_2O$ | $CO_3$ | $HCO_3$ | Cl | (OH) | Li |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-B2 | STANDARD LEACH | | | | | 1120 | | 18 | <0.05 | <0.05 | 270 | 3 | 310 | 210 | 23 | 140 | <0.1 | 41 | 105 | <0.1 |
| | PERMEABILITY EFFLUENT, PLASTIC PERCOLATION CYLINDERS | LOW | | 1 | 9.7 | 5763 | | 35 | <0.05 | 0.07 | 540 | 71 | 3,240 | 1,440 | 280 | 19 | 100 | 34 | <0.1 | 4 |
| | | | | 5 | 10.8 | 1918 | | 34 | <0.05 | <0.05 | 310 | 10 | 1,040 | 360 | 83 | 36 | 13 | 31 | <0.1 | 1 |
| | | | | 10 | 9.3 | 804 | | 41 | 0.05 | <0.05 | 150 | 6 | 370 | 160 | 14 | 2.4 | <0.1 | 14 | 25 | <1 |
| | | | | 20 | 9.9 | 444 | | 37 | <0.05 | <0.05 | 100 | 4 | 110 | 80 | 30 | 60 | <0.1 | 14 | 23 | <1 |
| | | | | | 7.4 | 1047 | | 20 | <0.05 | <0.10 | 110 | 23 | 570 | 230 | 47 | <0.1 | 36 | 10 | <0.1 | 1 |
| | | MEDIUM | | 1 | 9.7 | 5542 | | 33 | <0.05 | <0.05 | 410 | 20 | 3,100 | 1,500 | 290 | 65 | 20 | 100 | <0.1 | 4 |
| | | | | 5 | 10.6 | 1747 | | 30 | <0.05 | <0.05 | 300 | 6 | 880 | 320 | 8.9 | 91 | <0.1 | 21 | 6 | 1 |
| | | | | 10 | 9.6 | 746 | | 32 | 0.05 | <0.05 | 150 | 4 | 320 | 150 | 11 | 24 | <0.1 | 20 | 32 | <1 |
| | | | | 20 | 10.1 | 454 | | 33 | 0.05 | <0.05 | 130 | 5 | 110 | 46 | 34 | 42 | <0.1 | 14 | 10 | <1 |
| | | | | | 7.4 | 1310 | | 28 | 0.2 | 0.5 | 210 | 33 | 1000 | 400 | 80 | <0.1 | 66 | 21 | <0.1 | 1 |
| | STANDARD PERMEABILITY EFFLUENT | HIGH (1) | | 1-20 | 8.3 | 11,610 | | 11 | 0.05 | 0.10 | 25 | 20 | 6340 | 4130 | 400 | 53 | 570 | 49 | <0.1 | 12 |
| | | (2) | | 1-20 | 7.6 | 10,177 | | 23 | <0.05 | 0.14 | 35 | 12 | 5660 | 3560 | 400 | <0.1 | 410 | 62 | <0.1 | 15 |
| 1-1H | STANDARD LEACH | | | | 10.9 | 393 | | 17 | <0.05 | <0.05 | 6 | 3 | 25 | 150 | 4 | 1.40 | <0.1 | 41 | 7 | <1 |
| | STANDARD PERMEABILITY EFFLUENT | LOW | | 1-20 | 7.0 | 1903 | | 49 | <0.05 | 2 | 8 | 2 | 710 | 710 | 22 | <0.1 | 305 | 95 | <0.1 | <1 |
| | | MEDIUM | | 1-20 | 7.3 | 2832 | | 18 | 0.05 | 1 | 13 | 10 | 1110 | 1050 | 30 | <0.1 | 460 | 140 | <0.1 | <1 |
| | | HIGH | | 1-20 | 7.0 | 1793 | | 58 | <0.05 | 4 | 9 | 4 | 770 | 670 | 17 | <0.1 | 220 | 41 | 0.1 | <1 |

TABLE B-1. (Continued)

| SPECIMEN NUMBER | SPECIMEN TYPE | CHEMICAL ANALYSIS % BY WEIGHT | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ASH CONTENT | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | $SO_4$ | $Na_2O$ | $K_2O$ | $CO_3$ | $HCO_3$ | Cl | (OH) | Li |
| I-B | TOTAL MATERIAL AS RECEIVED | 85.1 | 28.0 | 6.9 | 2.7 | 18.3 | 6.5 | 0.2 | 2.6 | 6.6 | 13.3 | | | | |
| I-B 2 | | 81.3 | 24.9 | 8.6 | 3.4 | 15.7 | 7.0 | 1.6 | 2.2 | 2.4 | 15.5 | | | | |
| SALTS ON DRY TRIAXIAL TEST SPECIMEN | | 86.9 | 17.3 | 10.2 | 2.7 | 19.1 | 7.1 | 216 | 6.4 | 2.4 | 19.1 | | | | |
| I-IH | TOTAL MATERIAL AS RECEIVED | 79.1 | 23.1 | 8.0 | 2.7 | 15.3 | 6.5 | 0.7 | 2.3 | 2.4 | 18.1 | | | | |

TEST BY DEI LABORATORY:

I-B
- ASH CONTENT = 79.1%
- MINERAL $CO_2$ = 15.2%
- TOTAL CARBON = 6.33 %
- INORGANIC CARBON = 4.15 %
- ORGANIC CARBON = 2.18 %
- FREE LIME AT 1000° F.= < 0.1
- FREE LIME AT 1200° F = < 0.1
- FREE LIME AT 1400° F = 8.2

I-IH
- ASH CONTENT = 79.4%
- MINERAL $CO_2$ = 18.14%
- TOTAL CARBON = 6.79%
- INORGANIC CARBON = 4.95%
- ORGANIC CARBON = 1.84%
- FREE LIME = 0.05%

NOTES

CHEMICAL DATA BY THE INDUSTRIAL LABORATORIES COMPANY.

* (1) DISTILLED WATER CIRCULATED 8 DAYS (2) EFFLUENT RECIRCULATED 34 DAYS. (3) DISTILLED WATER CIRCULATED 26 DAYS.

**(1) DISTILLED WATER CIRCULATED 7 DAYS. (2) EFFLUENT RECIRCULATED 35 DAYS. (3) DISTILLED WATER CIRCULATED 26 DAYS.

*** DISTILLED WATER CIRCULATED 20 DAYS. EFFLUENT RECIRCULATED 10 DAYS.

**** STANDARD LEACH: 10 PARTS OF DISTILLED WATER TO 1 PART SHALE BY WEIGHT. TUMBLED FOR 6 HOURS AT ROOM TEMPERATURE.

***** COMPACTIVE EFFORT: LOW = 6,200 FT. LBS./CU. FT. (D-698)
MEDIUM = 12,375 FT. LBS/CU. FT. (D-698)
HIGH = 56,200 FT.LBS./CU.FT.(D-1557)

# APPENDIX C

# ENVIRONMENTAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REQULATIONS | REQUIREMENTS | PERMIT REQUIRED |
|---|---|---|
| National Environmental Policy Act of 1969 (NEPA) 42 U.S.C.A. SS 4231 et. seq. (1973)<br><br>Executive Order 11514 as Amended by Executive Order 11991 (Secs. 2(g) and 3(h), Protection and Enhance ment of Environmental Quality, May 24, 1977.<br><br>DOE Compliance with the National Environmental Policy Act, Federal Register Vol. 43 No. 35, 10 CFR Parts 208, 711, 1021. Guidelines on Preparation of Environmental Impact Statements, 40 CFR Part 1500, May 2, 1973. Implementation of NEPA by DOE: Fed. Reg. March 28, 1980 - Vol. 45, No. 62 p. 20694. | Impact Study Requirements. Comprehensive environmental evaluations must be prepared for all federal actions significantly affecting the environment. Primary and secondary impacts of projects on all environmental media must be analyzed and mitigative methods developed. Pursuant to NEPA, the Council on Environmental Quality has published regulations for preparation of environmental impact statements.<br><br>The Department of Energy (DOE) has adopted its own environmetal impact assessments (EIA) of proposed DOE actions to ensure that environmental values are considered as early as possible in the decision making process, and to provide the basis for determining whether an environmental impact statement (EIS) should be prepared. The DOE guidelines for the preparation of EIS's: programmatic, project specific, and site specific. The programmatic EIS addresses the environmental impacts of a broad research and development program. The project specific EIS evaluate the impact of the particualar DOE project to be carried out at a specific site, for example, the construction adn operation of a demonstration project. Site specific EIS's require more detailed information identifying facility impacts on an immediate site.<br><br>Specific requirements call for description of the proposed and existing environment, description and analysis of potential environmental impact, summary of unavoidable adverse impact, summary of irreversible and irretrievable commitment of resources, evauation of the relationship of the proposed action to land use plans, policies and controls, discussion of the relationship between short term uses of | |

| LAWS/ REGULATIONS | REQUIREMENTS | PERMIT REQUIRED |
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| | the environment and the maintenance and enhancement of long term productivity as well as a rigorous exploration and factual evaluation of the environmental impacts of the full range of reasonable available alternative to the proposed action. At the conclusion of the EIS there should be a synthesis of the information contained in teh body of the statement and analysis of the environmental trade offs associated with the proposed action and reasonable available alter- | |
| | Any project going forward without com- NEPA, the agency and the project developer are both subject to injunction, and will, in general, not be allowed to continue until satisfactory draft and final EIS's have been properly prepared and considered by the cognizant agency in its decision making process. | |
| Federal Non-Nuclear Energy Research and Development Act of 1974, P.L. 93-577, (December 3, 1974) 42 U.S.C. 5901 (88 Stat. 1979) | Impact Study Requirement. Section 13 (a) of the Act requires that a generic water resource assesment be undertaken for each non-nuclear energy technology. As the present time two water resource assessments are being prepared for any proposed demonstrations project which may involve a significant impact on water resources. These studies must provide invormation to determine 1) if there is any water available for development, and 2) where to get the water if it is available. Section 13(a) studies must assess the effects of development on water quality. They must include associated cost estimates as well as assessments of the environmental social, and economic impacts of any change of currently utiliized water resources that may be required by the proposed facility or process. | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMIT REQUIRED |
|---|---|---|
| | of currently utilized water resourses that may be required by the proposed facility or process. | |
| Federal Clean Air Act Amendments of 1977, P.L. 95-95 (August 7, 1977), 42 U.S.C. 7401 (91 Stat. 685): Clean Air Act, extension, P.L. 93-15 (April 9 1973, 42 U.S.C. 1957b 1(87 Stat. 11): Clean Air Amendments of 1970, P.L.91-604 (December 31, 1970), 42 U.S.C. 1957b (84 Stat. 1976);<br>Air Quality Act of 1967 (also called the National Emission Standards Act), P.L. 90-148 (November 21, 1967), 42 U.S.C. 1957-1957 11 (81 Stat. 485)<br>Clean Air Act Amendments of 1965, P.L. 89-675 (October 15, 1966), 42 U.S.C. 1857 (77 Stat. 392)<br>Clean Air Act Amendments of 1965, P. L. 89-272 (October 20, 1965), 42 U.S.C. 1857 (77 Stat. 392)<br>Clean Air Act of 1963, P. L. 88-296 (December 17, 1963), 42 U.S.C. 1957-1857g (69 Stat. 322). | Ambient Criteria. EPA has promulgated National Ambient Air Quailty Standards (NAAQS) for seven criteria pollutants: sulfur dioxide ($SO_2$), particular matter (PM is also referred to as total suspended particulates), nitorgen dioxide ($NO_2$ carbon monoxide (CO), hydrocarbons (HC), lead (pb), and ozone. Primary (health related) and/or secondary (property or public welfare related) have been set for each of these pollutants. Some states have promulgated more stringent ambient air quality standards and/or additional ambient standards for pollutants not covered by NAAQS.<br><br>Emissions Requirements. Best available control technology (BACT) is required for controlling emissions from new facilities siting in Prevention of Significant Deterioration (PSD) areas. Best available retrofit technology (BART) is required for existing major stationary sources that emit air pollutants which may reasonably be anticipated to contribute to impairment of visibility in mandatory Class I areas. New sources siting in nonattainment areas must have the lowest achievable emission rate (LAER). Existing sources in nonattainment areas must use reasonable available control technology (RACT). | |
| Executive Order 11602, Providing for Administration of the Clean Air Act with Respect to Federal Contracts, Grants, or Loans (36 Federal Register 12475)<br><br>Air Quality Regulations are contained in 40 CFR generally. See specifically: National Primary and Secondary Ambient Air Quality Standards 40<br>Standards of Performance for New Stationary Sources 40 CFR 60<br>National Emissions Standards for Hazardous Pollutants 40 CFR 61<br>Review of New Sources and Modifications 40 CFR 51.18 | EPA has promulgated New Source Performance Standards (NSPS) for a number of categories of stationary air pollution sources. NSPS require performance at least as good as that which could be obtained by using the best technological system of continuous emission reduction. The NSPS specify emission limitations for a new source and apply to sources constructed or modified after publication of the NSPAS. EPA has not pormulgated any Federal NSPS for Federal NSPS for oil shale production and refining although it has promulgated NSPS for petroleum refineries and petroleum storage and transfer facilities (greater than 300,000 barrels. The data base for Federal NSPS for oil shale are being developed by the Industrial | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMIT REQUIRED |
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| Significant Deterioration of Air Quality 40 CFR 52.18 (superceded by Section 127 of the 1977 Clean Air Act) Ambient Air Monitoring Reference and Equivalent Methods 40 CFR 53 Emissions Offset EPA Interpretative Regulations, 41 Federal Register 55524-30, December 21, 1976. | and Environmental Research Lab (IERL). When the data base is complete it will be used by the Office of Air Quality Planning and Standards (OAQPS) for oil shale. The entire process will take about five years. In the meantime, however, EPA will be developing a guidance document for the oil shale industry. This should be completed by December 1980. | |
| | Emissions standards also have been promulgated for four hazardous air pollutants: beryllium, asbestos, mercury, and vinyl chloride under EPA/s National Emissions Standards for Hazardous Air Pollutants (NESHAPS) Program. EPA is presently considering arsenic for designation as a hazardous air pollutant. Mercury and arsenic for designation as a hazardous air pollutant. Mercury and arsenic are byproducts of oil shale activities. | |
| | Permit Requirements. Stationary source dischargers are subject to EPA's new source review process. Under this process, new sources are reviewed to determine if NSPS are applicable and whether the source shall be locating in a nonattainment or Prevention of Significant Deterioration (PSD) area. Depending on the site location, a nonattainment or Prevention of Significant Deterioration (PSD) area. Depending on the site location, a nonattainment or PSD permit (collectively called preconstruction review permits) is required. | X |
| | Resource Classification and Protection. The Act establishes a four tiered classification system for improving and protecting air quality. These four categories are Class I, Class II, Class III, and nonattainment. Areas with air quality that is cleaner than the NAAQS require are designated as Prevention of Significant Deterioration (PSD) areas and fall into one of the first three categories. The following ceilings are established designating the maximum allowable increases for $SO_2$ and PM over a designated baseline in the PSD areas; | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMIT REQUIRED |
|---|---|---|

| POLLUTANT | MAXIMUM ALLOWABLE INCREASE ($\mu g/m^3$) Class I | Class II | Class III |
|---|---|---|---|
| Particulate Matter: | | | |
| Annual Geometric Mean | 5 | 19 | 37 |
| twenty-four hour max. | 10 | 37 | 75 |
| Sulfur Dioxide | | | |
| Annual arithmetic mean | 2 | 20 | 40 |
| Twenty-four hour max. | 5 | 91 | 182 |
| Three-hour maximum | 25 | 512 | 700 |

Comment period for new PSD PSD regs. ended Feb. 29, 1980.

EPA was required to promulgate PSD regulations for CO, HC, NO, AND OX by August 1979. To date, regulations have not been proposed. PSD requiremnts apply to all major emitting facilities; 1) which are listed among this Act's 28 stationary categories and which emit, or have the potential to emit, 100 tons or more per year or more of any air pollutant and 2) any other source with the potential to emit 250 tons per year or more of any air pollutant. EPA also is required to promulgate regulations aimed at preventing any future (and remedying any esisting) impairment results from man-made pollution. Visibility regulations will contain emissions limits, compliance schedules, a long-term strategy and other necessary measures. These regulations apply to major emitting facilities falling under any of the 28 stationary source categories which have the potential to emit 250 tons or more per year of any pollutant which may reasonably be anticipated to contribute to impairment of visibility.

Areas with air quality which violate NAAQS are designated as nonattainment areas. Nonattainment status, however, is assigned only for that pollutant which violates the Federal ambient standard. Because the ambient standars are violated, restrictions are placed on the introduction of new sources emitting the nonattainment pollutants. New and modified sources introduced into nonattainment areas before July 1, 1979 were permitted only if EPA's 1976 emissions offset interpretive regulations are satisfied. These regulations allow introduction of

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | new sources in nonattainment areas only when more than offsetting emission reductions are secured on a case-by case basis prior to the new facility's startup date. On and after July 1, 1979, new and modified sources may be permitted in nonattainment areas in States having EPA approved State Implementation Plans (SIPS).<br><br>Financial and Economic Controls. If a source is not in compliance by July 1, 1979, the Act requires that noncompliance penalty fees be collected by the State and/or EPA. Penalty fees are are calculated on the basis fo costs a non-complying source avoids by delaying compliance. In short, penalty fees reflect financial savings realized by the source as a result of noncompliance with the law.<br><br>Monitoring and Reporting Requirements. Beginning in August 1978, air quality monitoring will be required as part of the permit process. For construction of new facilities and modification of existing facilities, operators are required to submit one year of baseline monitoring data as part of the permit application. Supporting data also must be summitted which includes specific evaluation of PSD or nonattainment area status of the new operation. Periodic reporting to appropriate State or Federal agencies is required according to provisions in approved SIP's. | |
| Federal Clean Water Act of 1977, H.R. 3199 and S. 1952, P.L. (95-217 (Decebber 27, 1977), 33 U.S.C. 1251 (9 Stat. 1566);<br>Federal Water Pollution Control Act Amendments of 1976, P.L. 94-558 (October 19,1976), 33 U.S.C. 1293 (90 Stat. 2639) | Ambient Criteria. EPA has published guidelines for water quality standards. These guidelines are not binding. Each state, however, is required to promulgate its own ambient water quality recommended by EPA are contained in EPA's <u>Quality Criteria for Water</u> document published under Section 304(a) of the Act. | |
| Federal Water Pollution Control Act, as amended 33 U.S.C.S. 1251 et seq. (Supp. 1976);<br>Federal Water Pollution Control Act, Amendments of 1972, P.L. 92-500 (October 18, 1972), 33 U.S.C. 1151 (70 Stat. 498; 84 Stat. 91);<br>Federal Water Pollution Control Act, | Effluent Limitations. EPA has promulgated uniform effluent limitations which apply to industries irrespective of different water quality conditions that exist from state to state. None, however, have been promulgated for oil shale activities. As a result state agencies and/or the regional EPA apply effuent limitations on a case-by-case basis. Effulent limits may vary from state to | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| extension P.L. 92-240 (March 1, 1972), 33 U.S.C. 1155 (80 Stat. 1247; 84 Stat. 111.113;85 Stat.379); Federal Water Pollution Control Act, extension P.O. 92-50 (July 9, 1971), 33 U.S.C. 1155, 1157 1158 (85 Stat. 124); Federal Water Pollution Control Act, extension P.L. 92-137 (October 13, 1971), 33 U.S.C. 1156 (85 Stat. 379); Federal Water Pollution Control Act, amendments P.L. 91-224 (April 3, 1970), 33 U.S.C. 466 (84 Stat. 91); Clean Water Restoration Act of 1966, P.L. 89-753 (November 3, 1966), 33 U.S.C. 466a *80 Stat. 1246) Water Quality Act of 1965, P.L. 89-234 (Oct. 2, 1965), 5 U.S.C. 623 (70 Stat. 498); Federal Water Pollution Control Act Amendments of 1961, P.L. 87-88 (July 20, 1961), 33 U.S.C. 466a-466q Stat. 204); | state or from water body to water body for those industries which EPA has not established uniform effulent limitations. Currently (as of July 1, 1977), all industries are required to apply best practicable control technology. By July 1, 1984 best conventional pollutant control technology (BCPT) must be applied by industry to control conventional pollutants (i.e. suspended solids, biological oxygen demand etc.). BCPT will normally be less than BAT. Nonvonventional pollutants (i.e. nontoxic organic, thermal or chemical pollutants such as bismuth, sulfur, etc.) must be controlled by BAT within three years after effluent limitations are established but in no case later than July 1, 1987. Toxic pollutants are subject to BAT economically achievable no later than July 1, 1984. The 1984 deadline for toxic substances applies to those toxic pollutants for which EPA is now formulating effluent standards. Present standards prohibit the discharge of a harmful quantity of any toxic sub- (75 stance as designated by EPA. Of the 271 substances on the toxic substances list, at least twelve will be discharged by the retorting of oil shale. These substances are ammonia, arsenic, chlorine, chromium, cobalt, copper, mercury, nickel, phenols, selenium, sulfates and zinc. The Act provides for additions and deletions to EPA's toxics list. | |
| Water Pollution Control Act Amendments of 1956, P.L. 660 (July 9, 1956), 31 U.S.C. 529 (70 Stat. 498); Water Pollution Control Act, extension P.L. 82-579 (July 17, 1952), 33 U.S.C. 466 (62 Stat. 1159) Water Pollution Control Act, P.L. 80-845 (June 30,1948) Chapter 758-2d Session; Rivers and Harbors Act of 1899 (also called the Refuse Act), 33 U.S.C. 401 (1970). | Operational Controls. Operators are required to comply with best management practices (BMP's) for controling toxic and nonpoint source pollution. EPA draft policy indicates that water quality management agencies will be required to establish and implement BMP's for all activities which generate nonpoint source pollution. BMP's will be developed on a category-by category basis (e.g., mining, construction, etc.), consider site specific conditions, and focus on prevention of nonpoint source pollution. BMP's will include such operational controls as sediment runoff potential, to specify corrective measures and to schedule construction activities to minimize adverse impacts. Plans and specifications may be required for erosion and control structures. | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIRMENTS | PERMITS REQUIRED |
|---|---|---|
| Water Quality regulations are contained in 40 CFR generally. See specifically:<br>Water Quality Standards, 40 CFR 120<br>Effluent Guidelines and Standards, 40 CFR 129<br>Toxic Pollutant Effluent Standards, 40 CFR 129<br>National Pollutant Discharge Elimination Systems, 40 CFR 125<br>Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR 136 | Permit Requirements. National Pollutant Discharge Elimination System (NPDES) permits are required for all point sources discharging into navigable surface waters. NPDES permits may be used to control nonpoint source pollution. BMP requirements may also be included in NPDES permits. States must certify compliance with Section 303 (Water Quality Standards) before a Federal license or permit can be issued. Operators are also required to obtain dredge and fill permits (also called 404 or wetland permits) from the U.S. Army Corps of Engineers for discharge of refuse, dredged and fill material into navigable waters. The Corps of Engineers may issue general permits for a category of activities where minimal adverse environmental impacts are expected. All Congressionally authorized projects (100% Federally funded) may be exempted from dredge and fill permits. However, in order to be eligible for the exemption, the Federal agency sponsoring the project must submit an EIS to Congress prior to authorization or appropriation of project funds. EPA has given the authority for the NPDES permit program to the State of Colorado.<br><br>Resource Classification and Protection. All surface waters are classified according to their existing condition. Surface waters classified as "effluent limited" include those in which water quality standards are now being met or there is reasonable assurance that such a standard will be met by application of Federal effluent guidelines. Surface waters classified as "water quality limited" include those in which the existing condition of the water precludes attainment of water quality standards even if all point sources provided the levels of treatment required under Federal guidelines. Siting in areas associated with water quality limited waters is likely to be more difficult. In addition to effluent and water quality limited waters classifications, EPA has adopted a nondegradation policy for surface waters. This policy states that waters whose existing quality is better than the established standards, as of the date on which such standards become effective, must be maintained at their existing high quality.<br><br>Financial and Economic Controls. In the event that oil or hazardous spills occur, the respon- | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| | sible operator may be forced to pay expenses related to the destruction or rehabilitation of natural resources resulting from the spill. Under this provision of the Act, the President is authorized to assess a liability of up to $50 million for a spill, but in no case less than $8 million. A noncompliance penalty fee similar to that provision contained in the Clean Air ACt was introduced by the Senate but did not make it into the final bill. It is likely that this provision will be introduced again. | |
| | Monitoring and Reporting Requirements. Monitoring, sampling, and reporting requirements are specified on a case-by-case basis by those agencies administering NPDES permits. However, some uniform requirements have been established for dischargers. Operators of facilities that discharge toxic pollutants or that discharge greater than 50,000 gallons per day (major dischargers) are required to sample and record on a daily basis, submit monthly data summaries, and report quarterly. Minor dischargers (discharging no toxic substances and less than 50,000 gallons of wastewater per day) are required to sample monthly and report semi-annually or annually according to permit requirements. All dischargers are required to retain copies of monitoring reports for at least three years, unless involved in any type of litigation in which case the reports must be retained until litigation is resolved. All analytical methods must be employed according to Federal standards. | |
| Federal Safe Drinking Water Act, P.L. 93-523 (December 16, 1974), 42 U.S.C 300f (88 Stat. 166); | Drinking Water Standards. National interim primary (health related) drinking water regulations have been promulgated for ten inorganic chemicals, six organic pesticides, microbiological contaminants and turbidity. Secondary (public) welfare related regulations have not been seen yet. These will apply to such characteristics as odor, color, etc. | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| Draft EPA State Underground Injection Control Program Regulations, September 23, 1977 (corrected Octover 14, 1977). Final regulation are expected to be promulgated in 1980. National Interim Primary Drinking Water Regulations, 40 CFR Review of Projects Affecting Sole Source Aquifers, 40 CFR 149 UIC is part of the Consolidated permitting scheme of May 19, 1980. | Permit Requirements. For in situ oil shale retorting "Underground Injection Control" (UIC) permits must be obtained from EPA or the appropriate state agency which has been delegated permit authority. Permits are required for injection of any fluid (including gases) into subsurface formations containing aquifers which are potential drinking water sources. A site review is required for all facilities. This review, conducted by EPA or the state, is designed to ensure that construction will result in contamination of aquifers providing the sole or principal drinking water source for the site area. Groundwater impacts must be assessed for siting of all facilities.<br><br>Operational Controls. Regulations require that underground injection control wells be constructed so that there is no potential of contaminating underground drinking water sources. To prevent leakage and contamination casing and cementing programs must be developed for each well located in aquifers that are potential drinking water sources.<br><br>Resource Classification and Protection. Underground injection is prohibited in all groundwater formations classified by EPA as "sole source aquifers." At the present time only two aquifers have been designated as such. They are the Edwards Underground Reservoir in the San Antonio, Texas, and the Spokane Valley Rathdrum Prairie Aquifer in Idaho and Washington. Permit and regulatory requirements apply to all aquifers classified as "potential drinking water sources." A potential drinking water source is defined as any aquifer containing up to 10,000 mg/l of dissolved solids. For areas where aquifers have already been subject to underground injection operations only those aquifers containing less than 3,000 mg/l of dissolved solids are provided regulatory protection. Exceptions | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| | to this are those aquifers which have a history of injection control requirements and which will not endanger drinking water sources through continued operation. Permitting and regulatory requirements do not apply to those aquifers which satisfy the dissolved solids criteria for drinking water sources but which are so contaminated by other pollutants that they are beyond the scope of the Act.<br><br>Monitoring and Reporting Requirements. Preliminary testing is required to determine the dissolved solids content of groundwater where injection is to occur. Monthly injection reports detailing volume and pressure measurements must be maintained. These monthly reports must be summarized and submitted on a quarterly basis to EPA or the appropriate state agency. | |
| Federal Toxic Substances Act pf 1976, P.L. 94-469 (October 11, 1976), 15 U.S.C. 2601 (90 Stat. 2003). | Monitoring and Reporting Requirements. EPA may require sampling, characterization, testing, monitoring and reporting requirements for toxic substances from off-gases and liquid effluents produced from oil shale processing. The following criteria are used in determining whether reporting is requird. Reporting is not required if the chemical substance is produced for R&D purposes in quantities less than 1,000 lbs. annually. Reporting is not required if the chemical substance is a byproduct but not one used for commercial purposes. If the chemical substance is a by-product used for commercial purposes, then it is voluntarily subject to reporting requirements. Reporting is also required if the chemical substance is a byproduct which may have commercial uses including 1) soil-enrichment 2) landfill 3) waste disposal 4) fuel burning and 5) extraction of component chemical substances. | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Federal Resources Conservation and Recovery Act of 1976, P.L. 94-580 (October 21, 1976) 42 U.S.C. 6901 (90 Stat. 2795) Solid Waste Disposal Act, extension, P.L. 93-14 (April 9, 1973) 42 U.S.C. 3259 (87 Stat. 11); Resource Recovery Act of 1970, P.L. 91-512 (October 26, 1970), 42 U.S.C. 3251 (79 Stat. 19, 1980. 997). | Applicability. EPA guidelines for management of nonhazardous solid wastes are mandatory requirements for Federal activities. In fact, under the Act, Federal facilities and solid waste disposal sites must comply with all Federal, state, interstate, and local requirements. Non-Federal actions are not subject to EPA non-hazardous solid waste management guidelines except where states adopt these guidelines. All solid wastes (including mining wastes classified as hazardous are subject to Federal regulation. EPA has not yet developed a working definition for hazardous wastes and as a result it is not certain whether spent shale will fall under this classification. RCRA Hazardous Waste Management System Regs. Fed. Reg. May 19, 1980. | |
| | Permit Requirements. EPA draft criteria for solid waste landfill forbid new disposal sites in wetlands and prohibit expansion of existing sites unless an NPDES permit has been obtained. Permits must also be obtained for treatment, storage, and disposal of solid wastes. | X* |
| | Operational Controls. The Act requires that EPA conduct a study in conjunction with the Department of Interior to determine the best controls and management practices for disposing of mining wastes in an environmentally acceptable manner. In conjunction with this, EPA also is required to develop operational and performance criteria for landfill disposal. These are to be incorporated into guidelines and regulations promulgated by EPA for management of mining wastes. Oil shale operations conducted on Federal lands must comply with EPA solid waste management guidelines. EPA guidelines and regulations shall establish operating practices, measures for processing surface and subsurface waters from leachates and runoff, safety practices methods for protecting aesthetics, as well as controls for protecting ambient air quality. The guidelines and | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | regulations also will include minimum information for use in deciding the appropriate location, design, and construction of facilities associated with solid waste management practices including the consideration of regional, geographic, demographic, and climatic factors. | |
| | Monitoring and Reporting Requirements. These requirements still are being developed. | |
| Federal Noise Control Act of 1972, P.L. 92-574 (October 27, 1972) 49 U.S.C. 1301 (86 Stat. 1234)<br><br>Noise Emission Standards Construction Equipment, 40 CFR 204 Transportation Equipment Noise Emission Controls, 40 CFR 205 | Ambient Criteria. Although EPA lacks authority under the Act to establish ambient standards for noise levels in the general environmentm it has identified ambient noise levels which should not be exceeded if public health and welfare is to be protected. The EPA identified levels for protection of the general population with an adequate margin of safety against activity interference is a "Day-Night sound level" (Ldn) of 55 dB (decibels). EPA's noise abatement objectives are to reduce environmental (non-occupational) noise exposure of the population to an Ldn value of no more than 75 dB as soon as possible. As a longer term objective, environmental noise exposures are to be reduced to Ldn of 65 dB or less. The EPA objectives may be adopted and legislated by state and local authorities. | |
| | Emission Requirements. EPA has promulgated national emission standards for a number of noise sources. Some of these standards apply to sources used in the conduct of oil shale activities. These include noise emission standards for new medium and heavy trucks and portable air compressors. EPA has proposed standards for bulldozers and loaders and soon will be proposing standards for other pieces of equipment (such as rock drills) associated with the construction, operation, and transportation aspects of oil shale development. | |

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| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Federal Endangered Species Act of 1973, 16 U.S.C.A. 1531 et. seq. (1974) (87 Stat. 884)<br><br>Regulations Governing Activities Involving Endangered and Threatened Wildlife and Plants 50 CFR Part 17, July 1, 1977; Interagency Cooperation Regulations-Endangered Species Act of 1973, 50 CFR Part 402, January 4, 1978. | Resource Classification and Protection. The Endangered Species Act protects designated endangered and threatened species of plants and animals. Species classified as endangered or threatened are placed on a list which is updated periodically. Federal protection is provided to those species (and their habitats) placed on the list. Section 7 of the Act requires that all Federal agencies unsure that their projects and other actions do not jeopardize the continued existance of endangered and threatened species or result in the destruction or modification of habitat critical to the survival of the species. This requirement is placed on all Federal actions including private actions on private land where Federal funding is involved. Federal agencies must also consult with the Fish and Wildlife Service to ensure protection. Section 9 applies to all Federal and non-Federal actions. This provision makes it unlawful for any person to take, destroy, harm, harass, transport, sell or possess any endangered species. Protection afforded under the provisions of this law may require that a project be prohibited, modified, or moved. | |
| Bald Eagle Act, P.L. 92-535 (October 23, 1972) 16 U.S.C. 668 (86 Stat. 1064);<br><br>Bald Eagle Act, P.L. 870884, (October 24, 1962), (76 Stat. 1246); Bald Eagle Act, P.L. 86-70, (June 25, 1959), (73 Stat. 143); Bald Eagle Act of 1940, (June 8, 1940), 16 U.S.C. 668-668d, (54 Stat. 250). | Resource Classification and Protection. This Act protection of the bald eagle (the national emblem) and the golden eagle by prohibiting except under certain conditions the taking, destruction, harm, harassment, transportation, sale or possession of such birds. The 1972 amendments increased penalties for violating provisions of the Act and its regulations and strengthened other enforcement measures. The bald eagle is provided furhter protection under the Endangered Species Act. In all but five states, the bald eagle is designated as endangered. The additional protection provided under the Endangered Species Act prohibits destructon or modification of habitat essential to survival of the bald eagel. The Bald Eagle protects only the bird and its nest. | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Federal Fish and Wildlife Coordination Act of 1958, 16 U.S.C.A. 661 ct seq. (1974) | Interagency Requirements. All Federal agencies are required to consult with U.S. Fish and Wildlife Service, the National Marine Fisheries Services (weltlands, coastal areas, etc.) as well as state wildlife offices, regarding the potential impacts of fish and wildlife resources of all projects that result in the modification of water resources. Modification includes, but is not limited, to actions involving diversion, channelization, alteration, pollution, and withdrawal of water resources. This consultation and review process may result in project approval, denial, or modification. | |
| Review of Fish and Wildlife Aspects of Proposals in or Affecting Navigable Waters, Federal Register Vol 40 No. 231 December 1, 1975 | | |
| Fish and Wildlife Service Oil and Gas Guidelines for Exploration and Develop Activities in Territories and In- in Territories and Inland Navigable Waters and Wetlands, Federal Register, Vol 40 No. 231 December 1, 1975 | Applicability. Requirements of this Act apply to all Federal agencies, and all applicants seeking Federal permits and licenses for projects that result in modification of water resources which in turn impact fish and wildlife resources. Projects receiving Federal funding are not subject to the Act's statutory requirements unless Federal permits/licenses are involved or unless the activity is undertaken by a Federal agency. | |
| Fish and Wildlife Service Oil and Gas Guidelines for Exploration and Development Activities in Territories and Inland Navigable Water and Wetlands, Federal Register, Vol. 40 No. 231, December 1, 1975. | | |
| Federal Archeological and Historic Preservation Act of 1976, P.L. 94-422, September 28, 1976; Preservation of Historic and Archeological Data Act of 1974 (88 Stat. 174; National Historic Preservation Act of 1966, U.S.C.A. 470 et seq. 1974 (80 Stat. 915); | Resource Classification and Protection. Historical and archeological sites placed on, or eligible to be placed on the Register of Historic Places are provided protection under the Act and regulations. These provisions ma require that a project be modified, moved, or the properties salvaged. Non-Federal actions are not subject to the requirements of this act. However, private actions on private properties that destroy or otherwise adversely impact designated historical or archeological sites are subject to certain | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | tax penalties (e.g. elimination of deductions for demolition costs or accelerated depreciation). | |
| Historic Sites, Buildings, and Antiqduties Act of 1935 (16 U.S.C.A. 461-467, 1974) 49 Stat. 915; Antiquities Act of 1906, 16 U.S.C.A 431 (1974).<br><br>Procedures for the Protection of Historic and Cultural Properties, 36 CFR 800 (1974); Executive Order 11593, Protection and Enlistment of the Cultural Environment (1971). | Interagency Requirements. Federal agencies or any actions involving Federal funding or permitting are subject to provisions set forth in this Act. Federal agencies are required to consult with the Advisory Council on Historic Preservation and allow the Council to comment when such actions threaten historic or archeological sites. The Federal agency must consult with the appropriate State Historic Preservation Officer (SHPO) In addition, procedures mandate that the interested Federal agency, the SHPO, and the Advisory Council all reach a written agreement detailing measures that must be taken to mitigate any adverse effects expected to result from the conduct of the action. | |
| Federal Wild and Scenic Rivers Act, 16 U.S.C.A. 1274 et seq. P.L. 90-542, October 2, 1968; amended by P.L. 92-560, October 24, 1972; P.L. 93-279, May 10, 1974; P.L. 93-621, January 3, 1975; P.L. 94-199, December 31, 1975, P.L. 94-486, October, 12, 1976. | Resource Classification and Protection. The Wild and Scenic Rivers Act protects designated river segments with exceptional natural, scenic, recreational and other qualities worthy of preservation. River segments may be designated in three categories (wild, scenic, and recreational) represented by three levels of protection. Protection may require that a project be prohibited, mod ified, or moved.<br><br>Interagency Requirements. Federal agencies are required to advise the Secretary of Interior or the Secretary of Agriculture of any proposed projects that might impact designated wild and scenic rivers. If the governing Department (Interior or Agriculture) determines that a project will have an adverse impact on any wild and scenic rivers, then the secretary of that governing Department is authorized to prohibit construction or continuation of the project. | |
| Federal Occupational Safety and Health Act of 1970, P.L. 91-596 (December 29, 1970) 43 U.S.C. 1331 (84 Stat. 1590);<br><br>OSHA Safety and Health | Ambient Criteria. The Occupational Safety and Health Administration (OSHA) has set standards limiting the concentration of various toxic materials to which an employee may be subjected during an 8-hour period (weighted exposure average). Over 400 potential toxic gases and vapors are listed by OSHA. The American Conference of Governmental Industrial | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| Standards for General Industry, 29 CFR 1910. | Hygenists has developed "Threshold Limit Values for Chemical Substances in Workroom Air." Hydrogen sulfide ($H_2S$) is one of these chemicals that is most likely to be present above the threshold limit value (TLV) in some portion of the oil shale facilities. | |

The following maximum exposure levels for ambient noise levels also have been established:

Permissable Noise Exposures

| Duration per day, hours of exposure | Sould level, dBA slow response |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1-1/2 | 102 |
| 1 | 105 |
| 1/2 | 110 |
| 1/2 or less | 115 |

Operational Controls. To control air contaminants, appropriate ventilation systems must be installed, personal protective equipment must be used, and operational procedures and engineering controls must be implemented. Accumulation of dust on floors or ledges outside of an abrasive-blasting enclosure is not permitted. Dust spills must be cleaned up promptly. When employees are subjected to noise levels exceeding those listed above, feasible management or engineering controls must be implemented. If such controls fail to reduce sound levels within the levels listed above, personal protective equipment must be provided and used to reduce sound within those levels.

The principle parts of the Act and its attendant regulations pertain to walking and working surfaces, means of agress, powered platforms and manlifts, health and environmental control, hazardous materials, personal protective equipment, medical and first aid, fire protection, compressed gas and equipment, materials handling and

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | storage, machinery and machinery guarding, hand held equipment, electrical equipment, and welding, cutting, and brazing equipment. Plant layout is usually based on material flow of labor however, when hazardous exposures exist, the interrelationships of activities must be considered to ensure safe and healthy work places. | |
| | Monitoring and Reporting Requirements. Health monitoring, medical examinations, or other tests must be conducted for employees subjected to hazardous exposures. Accurate records must be maintains and periodic reports made on work related deaths, injuries, and illness other than minor injuries. | |
| | Records must also be maintains on employee exposures to potentially toxic materials or harmful physical agents. Monitoring or measuring employee exposure to toxic materials or harmful agents is required at such locations and intervals and in such a manner as may be necessary for protection of employees. | |
| Federal Metal and Nonmetallic Mine Safety Act, P.L. 95-164 42 U.S.C. 2011 (80 Stat. 772);<br><br>Health and Safety Standards-Metal and Non-Metallic Open Pit Mines, Revised July 1, 1976 | Ambient Criteria. Threshold limit values for exposure to airborne contaminants have been adopted as established by the American Conference of Governmental Industrial Hygienists. Exposure to airborne contaminants is not to exceed these values except for reasonable periods where adequate controls have not been developed and where workers are protected by appropriate respiratory protective equipment. Air in all active working areas must contain at least 19.5 volume percent oxygen. | |
| 30 CFR 55;<br>Health and Safety Standards-Metal and Non-Metallic Underground Mines, Revised July 1, 1976, 30 CFR 57; Notification, Investigation, Reports and Records of Accidents, | Maximum exposure levels for ambient noise levels also have been established. No worker is permitted an exposure to noise in excess of that specified in the table below. No exposure shall exceed 15 dBA. Impact or impulsive noises are not to exceed 140 dB, peak sound pressure level.<br><br>Permissible Noise Exposures | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Injuries, and Occupational Illnesses in Metal and Non-Metal Mines. Revised July 1, 1976, 30 CFR 58. | (see below) | |

| Duration per day, hours of exposure | Sound level, dBA Slow response |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1-1/2 | 102 |
| 1 | 105 |
| 1/2 | 110 |
| 1/2 or less | 115 |

Operational Controls. Mandatory operational controls, management practices, and engineering design specifications have been established to protect miner's safety and health during underground and surface mining operations. These include specific requirements for air quality ventilation, noise levels, handling and storage of explosive and other materials, gassy mines, fire prevention and control, travelways and escapeways, personal protection, safety programs, ground control, etc.

To prevent and reduce exposure to oil shale dust and other airborne contaminants associated with oil shale mining, control measures must be implemented. Fugitive dust should be controlled by wetting down haulage roads, crushers, and other sources, unless dust is controlled adequately by other methods. Holes must be collared and drilled wet, or other efficient dust control measures must be used when drilling non-water- and water-soluble materials. Other harmful airborne contaminants must be controlled by prevention or contamination, removal with exhaust ventilation, or dilution with uncontaminated air. Main fans are required for underground mining. For deep oil shale mines classified as gassy mines, more stringent control measures and sophisticated equipment are required for diluting the methane to reduce the potential of methane explosions. Retort off gases must be separated and isolated from main ventilation air streams and then transported to the surface

## FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | through separate systems. If these gases are not used for heating purposes, then control technologies such as scrubbers must be applied. | |
| | Monitoring and Reporting Requirements. Dust, gas, mist and fume surveys must be conducted as frequently as necessary to determine the adequacy of control measures. Injuries, accidents, and illnesses must be recorded and maintained by all metal and nonmetal mines. Employment reports must be submitted quarterly to MSHA and the Bureau of Mines. A Federal identification number must be issued for the mining operation. | |
| Federal Coal Leasing Act Amendments of 1975, P.L. 94-377 (August 4, 1976) 30 U.S.C. 181 (90 Stat. 1083) to Amend the Mineral Leasing Act of 1920, "an Act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on public domain"; Mineral Leasing Act Revision of 1960, P.L. 86-705 (September 2, 1960), 30 U.S.C. 226 (74 Stat. 781); Mineral Leasing Act Amendments, | Permit Requirements. Proper leases must be obtained from the Department of Interior and leasing requirements satisfied in order to develop oil shale on Federal lands. Leases must contain provisions aimed at ensuring 1) diligent development, operation, and production, 2) safety and welfare of employees, 3) prevention of undue waste, and 4) prevention and mitigation of adverse environmental impacts.<br><br>Planning Requirements. Lease terms under DOI's prototype oil shale leasing program require the submission of a detailed development plan (DDP) and prior to that, completion of an environmental baseline study. The DDP must include a schedule of operations, a detailed description of the procedures designed to meet the environmental criteria and controls incorporated in the lease, and provisions for diligent and orderly development of the oil shale deposits. | |
| 30 U.S.C. 241; Mineral Leasing Act of 1920, P.L. 146 (February 25, 1920)<br>Surface Exploration, Mining, and Reclamation of Lands, Regulations, 43 CFR 23. | Financial and Economic Controls. Lesses are required to post a performance bond. Bond is forfeited if lease requirements are not satisfied. Authority for lease cancellation also is provided under the Act where lease require ments are not satisfied. | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
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| Federal Land Policy and Management Act, P.L. 94-579 (October 21, 1976) 43 U.S.C. 1701 (90 Stat. 2743) | Resource Classification and Protection. Under this Act, the Secretary of Interior is directed to take any action to prevent unnecessary or undue degradation of public lands. It is by this authority, that land reclamation and environmental protection provisions are included in the Department of Interior's oil shale leasing program. | |
| Executive Order 11752, "Prevention, Control, and Abatement of Envirmental Pollution at Federal facilities," December 17, 1973 | Under this Presidential directive all Federal facilities are required to comply with State and local substantive standards for prevention, control, and abatement of environmental pollution. However, it does not require Federal facilities to comply with state or local administrative procedures. | |
| Colorado Water Quality Control Act, CRS 1973, Title 25, Aritcle 8, as amended through July, 1975.<br><br>Water Quality Standards and Stream Classifications, effective June 19, 1974.<br>Individual Sewage Disposal Systems Act, CRS 1973, Title 25, Article 10, as amended through August 15, 1975. | Ambient Criteria. Statewide ambient water quality criteria have been promulgated for sludge constituents, floating debris, scum, toxic or harmful substances wastewater residues, oil, greased radioactivity and salinity. Additional criteria have been developed for different water body classifications. These must meet statewide criteria and the criteria which have been developed for the specific water body classification. Additional criteria for the specific water body classifcation. Additional criteria for streams may include coliform, dissolved oxygen, pH, temperature and turbidity. | |
| Construction Grant Priority System, effective September 15, 1975.<br>Guidelines for Control of Water Pollution from Mine Drainage, adopted Nov. 10, 1970. | Effluent Limitations. Effluent limits vary according to water body classifications. None have been specifically established for oil shale. | |
| Regs, for the Control of Water Pollution from Feedlots, effective August 1, 1974.<br>Regs. for Effluent Limitations, effective August 21, 1975. | Permit Requirements. Dischargers must obtain waste discharge permits from the Water Quality Control Division. These are granted under the NPDES program. | |
| Regs. for the State Discharge Permit System, effective January 31, 1975.<br>Amendments to the Regulations for the State Discharge Permit System, effective Feb. 7, 1978. | Underground injection of any material must be permitted by the State. Federal UIC regulations, when promulgated, will be incorporated into the permit program. | |
| Rules for Subsurface Diposal Systems, | Monitoring and Reporting Requirements. Oper- | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| effective Oct. 1, 1977.<br>Reg. for Effluent Limitations: effective Aug. 21, 1975.<br>Rules for Obtaining Consideration of State Financial Assistance for Public Sewage Treatment Works Construction, adopted Jan. 15, 1974.<br>Standards for the Discharge of Wastes effective January 15, 1973.<br>Water Quality Standards for Colorado effective July 20, 1978. | ators of discharging facilities are required to monitor, sample discharges, and periodically submit reports as well as provide other reasonable available information requested by the Division.<br><br>Resource Classification and Protection. A four-tiered stream classification system has been adopted by Colorado. Streams are classified as $A_1$, $A_2$, $B_1$, or $B_2$ with Class A generally having the most stringent standards. | |
| Colorado Open Mining Land Reclamation Act of 1973 C.R.S. 1973, 34-32-301 et. seq., Vol. 14 Natural Resources I.<br><br>Rules and Regulations of the Colorado Mines Land Reclamation Board, May 1977. | Permit Requirements. Operators proposing to engage in a new mining operation must first obtain a mining land reclamation permit from the board. This permit pertains to all operations of the facility associated with the mining operation. "Permits for Regular Operations" are required for a mining operation affecting ten acres of more, or extracting 70,000 tons or more of mineral, overburden, or combination thereof. "Permits for Limited Impact Operations" are required for mining operations affecting less than ten acres and extracting less than 70,000 tons of the same. A "Notice of Intent to Continue Mining Operations" must be filed annually by the operator on the anniversary date of permit issuance.<br><br>Planning Requirements. A reclamation plan must be submitted with permit applications and renewals. Each phase of reclamation must be completed within five years of phase commencement.<br><br>Financial and Economic Controls. Operators must post bond prior to mining operations. This will be kept until reclamtion is completed.<br><br>Operational Controls. Detailed reclamation performance standards have been established by the board for grading, topsoiling, hydrology and water quality, safety and protection of wildlife as well as revegetation. Separation and segregation of topsil is required. | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Colorado Solide Waste Disposal Sites and Facilities Act, C.R.S. 1963, Chapter 36, Article 23, as amend through 1974 Now C.R.S. 1973 30-20-101 through 30-20-115 | Permit Requirements. A Certificate of Disignation" must be obtained prior to the disposal of oil shale process residue. | X |
| | Planning Requirements. An "Operational Plan" for placing into operation the design for the disposal site and facility is required. | |
| Solid Waste Disposal Sites and Facilities Regulations, effective April 1, 1972. Guidelines and Criteria for Review of Solid Waste Disposal Facilities for Water Quality Control Site Approval effective November 21, 1976. | Operational Controls. Minimum Standards have been established for solid waste disposal sites and ficilities. Engineering design criteria are specified for location, access routes, compaction and filing, as well as final surface grading and cover prior to closure. Management practices and operational controls must be applied to minimize nuisance conditions, aesthetic degradation, air pollution, as well as surface and subsurface water pollution. | |
| | Monitoring and Reporting Requirements. Colorado has set forth no monitoring requirements for solid waste disposal sites except where a water table exists within 7.0 feet of the bottom of the disposal site. Under these circumstances a monitoring well for groundwater sampling must be provided. | |
| Colorado Noise Abatement Law, C.R.S. 1963, Chapter 66, Article 35 Now C.R.S. 1973, Article 25, Article 12 effective July 1, 1973. | Ambient Criteria. Colorado has established statewide maximum permissable noise levels for various time periods and areas. Activitivies impacted by this regulation must be conducted so that noise produced is not objectionable due to intermittance beat frequency, or shrillness. See below. | |

| | 7 a.m.- 7 p.m. | 7 p.m. - 7 a.m. |
|---|---|---|
| Commercial | 60 dBA | 55dBA |
| Light Industrial | 70 dBA | 65dBA |
| Industrial | 80 dBA | 75 dBA |

Emmissions Limitations. Local officials are given authority under the Act to adopt more restrictive noise emission standards. Emissions to Colorado noise emission standards include: 1) activities subject to Federal noise control laws and 2) construction projects, which are subject to the maximum noise levels for industrial zones during construction.

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| Colorado Nongame and Endangered Species Conservation Act L. 73 p. 665, 1; C.R.S. 1963, 62-18-1 | Resource Classification and Protection. The Act prohibits (except where authorized) the destruction, removal, processing, and/or selling of endangered species residing in the state. Colorado protects wildlife listed on both the Federal and State list of rare, threatened, or endangered species. Mammals classified as endangered include the gray wolf, grizzly bear, black-footed ferret, wolverine, river otter, and lynx. Endangered or threatened birds in Colorado include the American peregrine falcon, greater prairie chicken, prairie sharptailed grouse, whooping crane, greater sandhill crane, white pelican, lesser prairie chicken, and southern bald eagle. | |
| Colorado Air Quality Act of 1979 | Ambient Criteria. Ambient air quality standards have been promulgated for $SO_2$, TSR, $NO_2$, HC, CO, Ozone and $P_b$. All standards are identical to Federal ambient air quality criteria. | |
| Air Pollution Control Comm. (APCC) Regs., Common Provision Regs., as amended through January 6, 1975;<br>APCC Reg. No.1, Emission Control Regs. for Particulates, Smokes, and Sulfur Oxides, revised March 1, 1976;<br>Amendments to Regulation No. 1, | Emissions Requirements. Emissions standards are set for $SO_2$, TSP, $NO_2$, HC, CO, Pb, odor, fugitive dust, and opacity. Emissions standards vary according to the type of source, its size, and location. Colorado is the only state that has promulgated emissions standards for oil shale activities. The Colorado new source emission standards as applied to the oil shale industry are as follows: | |
| Sulfur Dioxide Emission Regulations, new subsection 6(a) through (f) effective October 27, 1977; APCC Reg. No. 2, Odor Emission Regs., effective April 20, 1971;<br>APCC Reg. No. 3, Reg. Governing Air Contaminant Emission Notice, Emission Permit, and Fees for Direct Sources, revised through APCC Reg. No. 4, Emission Control Regs. for Existing Wigwam Waste Burners, effective August 1, 1972;<br>APCC Reg. No. 5, Emission Control Regs. for Existing Alfalfa Dehydration Plants, effective December 17, 1975; | o Production of Oil Shale. Sources producing less than 1000 barrels per day of shale oil are exempt. Larger sources are limited to a total of 0.3 pounds of $SO_2$ emissions per barrel of oil processed. This limit applies to the sum of all sulfur dioxide emissions from a given production facility per barrel of oil processed.<br>o Refining of Oil Produced from Shale. Sources processing less than 1000 barrels per day are exempt. Larger sources are limited to a total of 0.3 pounds of $SO_2$ per barrel of oil processed. This limit applies to the sum of all sulfur dioxide emissions from a given production facility per barrel of oil processed. | |

FEDERAL LAWS AND REGULATIONS AFFECTING THE PROPOSED ACTION

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| APCC Reg. No. 6, Standards of Performance of New Stationary Sources, effective April 5, 1975;<br>APCC Reg. No. 7, Reg. to Control the Emission of Hydrocarbon Vapors, effective April 5, 1975;<br>Amendments to Reg. No. 7, Revision of the APCC Regulation to Control the Emission of Hydrocarbon Vapors, effective Oct. 27, 1977;<br>APCC Reg. No. 8 to Control the Emissions Chemical Substances and Physical Agents. effective April 5, 1975;<br>APCC Reg. No. 9, The Control of Automotive Air Pollution Through the Encouragement of Public Transportation and Motor Vehicle Restraints, effective January 30, 1976;<br>Ambient Air Standards, effective December 17, 1970 as revised through December 17, 1975;<br>Repeal and Reenactment of the Sulfur Dioxide ($SO_2$) Ambient Air Standards for the State of Colorado, effective Octiver 27, 1977;<br>Statements of Policy by the Air Pollution Control Comm., current through Feb. 26, 1976. | Permit Requirements. A permit for "Authority to Construct" and a "Permit to Operate an Air an Air Pollution Source" must be filed with the Department of Health. An "Air Contaminant Notice" must be filed prior to emission of contaminants or increased emissions from any facility, process, or activity. A "Permit to Operate" must be obtained before any new source of air contamination is allowed to operate.<br>Monitoring and Reporting Requirements. The Department may require monitoring, recording and reporting of emissions data as well as the conduct of performance tests for emissions sources.<br><br>Resource Classification and Protection. Colorado also has developed its own prevention of significant deterioration (PSD) program. | |
| | Fish classifed as endangered or threatened trout, Colorado River squawfish, humpback chub, bonytail chub, razorback sucker Arkansas River speckled chub, Arkansas darter, central johnny darter, plains orangethroat darter, Colorado River cutthroat, and the Rio Grande cutthroat. | |
| Title 33, Wildlife Management | The State must conduct a site study to determine the impact of any proposed action on wildlife. If Federal endangered species are located or spotted in the area, the DOI Division of Fish and wildlife must be consulted. | |

| LAWS/REGULATIONS | REQUIREMENTS | PERMITS REQUIRED |
|---|---|---|
| | Permit Requirements. Endangered species may not be removed, captured, or destroyed unless done so pursuant to a permit issued by the Division of Wildlife and, where possible, by or under the supervision of an agent of the Division. | |
| Colorado Historical and Archeological Preservation Act House Bill 1041, 1974, Title 24, Article 65.1 1973, as amended; especially 24-65.1-104(6) and 24-65.1-202(3), C.R.S. 1973<br><br>Colorado Historic Places Act of 1975, C.R.S. 1973, section 24-80. 1-101-108. Colorado State Antiquities Act of 1973. 1976 cumulative Supplement, pages 1-4. | Resource Classification and Protection. Properties classified as historical or archeological and placed on the state and National Register of Historic Places. The National Register (February 7, 1978, Vol. 43 No. 26 Part II) includes about 200 properties, 62 of which are located in Denver County and the rest of which are distributed throughout the State. However, the State and National Registers do not include all potential existing archeological and historical sites. Consequiently, the development of public lands must be evaluated through "on-the-ground surveys".<br><br>Permit Requirements. The state historical society is responsible for issuing permits for the investigating, excavation, gathering or removal from the natural state of any historical, prehistorical or archaeological resources within the state. | |

# APPENDIX D

## CONSULTATIONS WITH FISH AND WILDLIFE SERVICE

## AND THE STATE HISTORIC PRESERVATION OFFICER

U. S. Department of Energy
Laramie Energy Technology Center
P.O. Box 3395, University Station
Laramie, Wyoming 82071

August 12, 1980

Mr. Robert Jacobson
U.S. Fish and Wildlife Services
Federal Building, Room 1311
125 South State Street
Salt Lake City, Utah 84138

Dear Mr. Jacobson:

The U. S. Department of Energy is preparing an Environmental Impact Statement for construction and operation of a full-size retort module on the Anvil Points Oil Shale Facility near Rifle, Colorado.

We would like to request your input as to the availability of the area for use in relation to endangered species and critical habitat. Attached is a map which shows the location of the proposed action. Your assistance in this matter will be appreciated. I may be reached by calling collect at 307-721-2251.

Sincerely,

Larry W. Harrington

Larry W. Harrington, Coordinator
Environment and Conservation

Attachment
as stated

U. S. Department of Energy
Laramie Energy Technology Center
P.O. Box 3395, University Station
Laramie, Wyoming 82071

August 12, 1980

Colorado State Historic Preservation Officer
Historical Society of Colorado
1300 Broadway
Denver, Colorado 80203

Dear Sir:

The U. S. Department of Energy is preparing an Environmental Impact Statement for construction and operation of a full-size retort module at the Anvil Points Oil Shale Facility near Rifle, Colorado.

We would like to request your input as to the availability of the area for use in relation to possible harm to areas of significant scientific, prehistoric, historic or archeological value. Some study has been done in the area. Attached are a map of the area to be disturbed and a survey that was done by the University of Colorado. Your assistance and guidance to us will be greatly appreciated. I may be reached by calling collect at 307-721-2251.

Sincerely,

Larry W. Harrington, Coordinator
Environment and Conservation

Attachment
as stated