OR-030-7-20

ENVIRONMENTAL ASSESSMENT RECORD FOR PROPOSED GEOTHERMAL AND OIL AND GAS LEASING IN THE OREGON CANYON AREA

Vale District

Oregon

U.S. Department of the Interior

Bureau of Land Management

AUG 1977

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
P. O. Box 700
Vale, Oregon 97918

IN REPLY REFE
1791

September 28, 1977

Dear

Enclosed for your review is the Environmental Assessment Record (EAR) for non-competitive geothermal and oil and gas leasing in the Oregon Canyon area of southeastern Oregon.

Any comments you may have will be appreciated. Your comments along with the data in the EAR will help us to make a decision regarding the geothermal and oil and gas leasing programs in the Oregon Canyon area.

It must be determined whether any lease applications will be denied, or if mitigating measures other than those recommended in the EAR will be needed.

After reviewing the information in the EAR and comments from local, State and other Federal agencies and from the public, a recommendation to the State Director will be made suggesting that an Environmental Impact Statement be prepared should circumstances so warrant. If the State Director concurs, he will, in turn, so recommend to the Director, BLM, who will ultimately make the final decision.

Should you have any questions, or desire a meeting with BLM personnel on the geothermal or oil and gas lease applications, please contact the undersigned official.

Sincerely yours,

Fearl M Parker

Fearl M. Parker
District Manager

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

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INTRODUCTION

There has been some interest in exploration for geothermal energy and for oil and gas resources in the 1.0 million-acre Oregon Canyon area situated north and west of the McDermitt, Nevada community. To date, there has been a single application for geothermal leases and four for oil and gas leases (Fig. 1). The geothermal lease is located in T.40S., R.42E., W.M., and covers 2,480 acres while the oil and gas leases are situated in T.38S., R.43E., and T.39S., R.43E., W.M. and cover 9,900.73 acres. Because the area in the Oregon Canyon area is relatively uniform in nature, it was decided to prepare a single environmental assessment record (EAR) for the area outlined in Figure 1.

The following EAR is written to include all land belonging to the Federal government within the Oregon Canyon area and those private lands within the area on which the Federal government owns the mineral estate.

The lands applied for in geothermal or oil and gas leasing are not in a Known Geothermal Resource Area (KGRA) or a Known Geologic Structure (KGS) respectively, and therefore fall under non-competitive leasing procedures.

Non-competitive geothermal or oil and gas leases will be awarded to qualified applicants following receipt and evaluation of the required operating plans. Once the lease is issued, the lessee will be required to submit plans of operation which must be approved prior to entry upon the lands for any purpose other than casual use. Another environmental assessment, covering that specific plan of operation, will be made before the proposed operation plan is approved.

I. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVE

THE PROPOSED ACTION

The proposed action involving the issuance of Federal geothermal or oil and gas leases is to provide for exploration and, if commercial reserves are discovered, an orderly development of geothermal or of oil and gas resources.

Federal Regulations

The proposed action involves the leasing, with special stipulations and controls, of Federally-owned geothermal and oil and gas resources for exploration and development. Geothermal leasing for exploration and development is pursuant to the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001-1025) while oil and gas leasing is pursuant to the Act of February 25, 1920 (41 Stat. 437; 30 U.S.C. 181 et seq.) as amended and supplemented including the amendatory act of August 8, 1946 (60 Stat. 950; 30 U.S.C., sec. 181 et seq.) and the act of September 2, 1960 (74 Stat. 781; 30 U.S.C., sec. 181 et seq.). Pertinent regulations are found in the Code of Federal Regulations (CFR), Public Lands: Interior, Title 43, Part 3100 (oil and gas leasing) and Part 3200 (geothermal resource leasing). Copies of 43 CFR are available at all U.S. Bureau of Land Management (BLM) offices.

The BLM administers Federal laws and regulations pertaining to mineral resources on lands under its primary jurisdiction (Public Lands), Federal lands withdrawn from other agencies, acquired Federal lands, and Federal mineral resources on private lands. The BLM, in consultation with the U.S. Geological Survey (USGS) determines whether and the conditions under which Federal geothermal or oil and gas leases will be issued, monitors the various phases of resource development, and through standard and site specific stipulations formulated during the leasing process, develops measures for environmental protection. If the lands being considered for leasing are withdrawn for another Federal agency, that agency is involved in determining whether the land will be leased.

After leases are issued on lands administered by the BLM, the USGS administers geothermal or oil and gas operations on the leases through the office of the appropriate supervisor. The survey is responsible for maintaining engineering, geologic, geophysical, economic, environmental, and other technical expertise needed to assure compliance with applicable laws, regulations, and objectives of the Department of the Interior. The BLM and

USGS responsibilities for administration of geothermal or oil and gas operations on Federal leases are described in Secretarial Order 2948 and the implementing working agreement (Appendix A).

State of Oregon Regulations on Oil and Gas Operations

The State or Oregon is an associate member of the Interstate Oil Compact Commission and has adopted many of the policies and model rules suggested by this group of state regulating agencies. State rules require bonding, blow-out prevention equipment, controlled disposal of brines, and the cementing and casing of wells. State law also sets well spacing limits and provides for the protection of correlative rights of landowners. In 1961 the Legislature passed a unitization law which defines the conditions for forming field-wide operating units, provides for settlements between working interests and allows compulsory unitization when 75% of the royalty ownership favors unit operations.

State regulatory authority is vested in the Department of Geology and Mineral Industries which issues drilling permits, approves casing programs, inspects blow-out prevention equipment, witnesses abandonment plugging, and collects well records. In the event of a discovery, the rules of the department require uniform development and regular reporting of storage and production. Stipulations added to the drilling permit at the request of the State Department of Environmental Quality require compliance with state air and water quality laws.

A site certificate from the Energy Facility Siting Council is required if an oil or gas discovery results in development of a pipeline six inches in diameter and five miles in length. This certificate is a binding agreement between the State of Oregon and the applicant authorizing the applicant to construct a pipeline on an approved site. It incorporates all conditions imposed by the state on the applicant and all warranties given by the applicant to the state. From the time an application for a pipeline is received, the Siting Council is required to recommend or reject the certificate within twelve months.

Before drilling permits are issued, the applications are reviewed by the Department of Environmental Quality, Water Resource Department, Fish and Wildlife Commission, and the Department of Land Conservation and Development.

A summary of these requlations may be found in Appendix B.

Lands in the EAR Area

There is a total of 1,038,873 acres in the Oregon Canyon EAR area. Of this total, 936,958 acres are administered by the BLM; 800 acres are in other Federal withdrawals (Federal Power Commission - FPC); 17,429 acres are administered by the Ft. McDermitt Indian Reservation and the Bureau of Indian Affairs (BIA), U.S. Department of the Interior; 42,310 acres are state-owned; and 41,376 acres are in private ownership. Approximately 22,300 acres lie in Humboldt County, Nevada while the bulk of the land is situated in southwestern Malheur County, Oregon.

Most of the land to which the Federal government has title also includes ownership of the mineral estate. Figure 2 shows the mineral estate of the EAR area. Additional information may be obtained at the BLM's Vale (Oregon) District Office or the Oregon State Office, Portland.

DESCRIPTION OF GEOTHERMAL AND OIL AND GAS RESOURCES AND EXPLORATION AND DEVELOPMENTAL ACTIVITIES

The following narrative describes geothermal and oil and gas resources and summarizes the exploratory and developmental activities associated with each resource required to bring about commercial production.

Geothermal Resources

Geothermal Energy - The following description of geothermal energy resources follows that of George Nielson (1976).

Geothermal energy, a unique resource, in its broadest sense is the natural heat contained in and continuously flowing from the earth. Today it is proving to be a viable source of energy for the generation of electricity and space heating.

Physically, it is quite impractical to collect all of the natural heat flow from the earth and convert it to electricity with 100 percent efficiency and so it is clear that natural heat flow from the interior of the earth is not a significant energy source. Rather, because the earth is an extremely poor conductor of heat, much heat is stored within its depths. Temperature generally increases with depth in the earth. The average rate of increase in the United States is 1.6^{o}F per hundred feet of depth, or 27^{o}C per kilometer. Consider the rock which lies at a depth of 2 to 3 miles below the surface depths which can be reached by the drill bit quite readily. The average temperature of the rock at these depths is 280^{o}F. The heat capacity of rock--its capacity for storing energy--is almost 1 calorie per cubic centimeter for each degree C of temperature. If we were to utilize the heat stored in the first 3 miles of the earth's surface, rocks above 100^{o}C, we would have enough energy to meet our present electrical demands for over

100,000 years. This well illustrates the tremendous potential of the geothermal resource. On the other hand, there are many technological problems to be solved.

At the present time, electricity from geothermal heat cannot be produced with other energy sources unless there is a high-grade concentration of energy, in a form commonly called a "geothermal reservoir." Surprisingly, the location and characteristics of geothermal reservoirs are rather poorly known, and this is the primary cause for the uncertainty about the potential for the occurrence of economically viable geothermal systems.

Workers in the field speculate that there are four essentially different types of high grade geothermal reservoirs that may be exploitable: the hyperthermal systems, the geopressured systems, the molten rock systems and the high heat flow or hot, dry rock systems.

1. Hyperthermal Systems - The geothermal systems which are being used around the world today have extremely high temperatures, in the range from 500^{o} to $600^{o}F$, at relatively shallow depths, and so are called hyperthermal systems. All occur in rocks with a high water content. This water serves as a heat exchange medium which flows freely into boreholes and carries the heat to the surface and to turbines with few technical difficulties. The pressure of the overlying rocks and water keeps the water in the reservoir in the liquid state, even when the temperature is far above the atmospheric boiling point. However, the waters may boil in the reservoir and enter the borehole as steam under pressure, as occurs at The Geysers in California and Lardarello, Italy or it may enter the borehole as a boiling mixture of water and steam, as at Wairaki in New Zealand and at Cerro Prieto, in Mexico. In the latter case, the water must be separated from the steam at the surface and be rejected.

   Most researchers believe that the heat source for a hyperthermal system is molten rock which has been intruded at shallow depths in the earth's crust. Many of the known hyperthermal systems occur at the edge of continental plates along belts of volcanic activity, as in New Zealand, the Phillippines, Japan, El Salvador, and Chile. Other major fields, such as The Geysers and Lardarello, do not occur in close association with volcanic activity. It might be hypothesized that these fields lie over major reservoirs of molten rock in the earth's crust. Another possibility in these two areas is that water-laden rocks such as shale have been thrust deep into the earth by faulting and folding, and that heat has driven water or steam back to surface rocks along permeable channels. In either case, large quantities of heat have been transported to shallow depths by mass transport, either by molten rock or by hot water, thus bypassing the thermally insulating properties of rocks in general.

2. Geopressured Systems - Another type of geothermal reservoir may occur in areas where sediments are being deposited rapidly, as along the Gulf Coast of Texas and Louisiana. Normally in areas of less than rapid sedimentation, rocks become lithified and support the weight of overlying sediments without undue compaction. In such a sequence of rocks, one may measure the pressure of the fluids contained in the pore spaces of the rock and find that it is the same as though one had an open column of water; that is, the pressure on the water in the rocks is only hydrostatic. In rapidly sedimenting systems, the rock may not become lithified rapidly enough to support the pressure from above. The rock at depth is then compressed, at the expense of the pore space. In order to reduce pore space, water must be forced out of the rock, and this results in a pore pressure greater than hydrostatic. In extreme cases, the pressure on the pore water at depth represents the weight of both the overlying water and solids, so that the pressure amounts to 2.0 to 2.2 times the hydrostatic pressure. Such rocks are said to be "geopressured". Dehydration of montmorillonite, which comprises 60 to 80 percent of clay deposited in the northern Gulf basin, occurs at depths where temperature exceeds 80^{o}C and is generally completed at depths where temperature exceeds 120^{o}C. This process converts intracrystalline and bound water to free pore water. The volume produced is roughly equivalent to half the volume of montmorillonite so altered. The water produced is fresh and often contains substantial quantities of methane gas, an additional source of energy. If a hole is drilled into a permeable zone in a geopressured section, great volumes of water will flow to the surface. This is often a catastrophic event when an oil well is drilled into a geopressured zone unexpectedly.

   A geopressured zone can be considered to be a geothermal system if it lies at 15,000 to 20,000 feet depth, where the temperature is 300^{o} to 400^{o}F even without any abnormally high heat flow being present. Electric power can be generated both by letting some of the water flash to steam to operate a turbine, by using the excess pressure of the flowing water to turn a water wheel, and utilization of the entrained methane.

3. Molten Rock Systems - Some researchers feel that molten rock would be the ideal source of geothermal energy, in view of its

high heat content and high temperature. Cooling a mass of molten rock from a temperature of several thousand degrees F to 100°F would produce about 10 times the heat calculated in the earlier example for normal heat flow, and because of the higher temperature, the efficiency of converting heat to electricity could be improved significantly. A cubic mile of molten rock could supply electrical energy to the entire United States for a period of about 200 days, at the current rate of consumption. However, the extent of our resources of molten rock is poorly known, with the lava lakes at Kilauea Volcano in Hawaii being the only known occurrences of molten rock in the United States. Volcanologists estimate that the annual production of newly molten rock in the crust over the whole earth is only two cubic miles, which is not an impressive quantity in terms of electrical power production. Moreover, the technology required for handling molten rock may not be easily available. As a consequence, it appears unlikely that molten rock will serve as a significant source of geothermal energy in the near future.

4. Hot, Dry Rock Systems - The average temperature gradient in the United States is 1.6°F per hundred feet. However, the gradient is less in some areas and more in other areas. These values of gradient might be thought of as representing some statistical distribution with a median value and a standard deviation. Temperature measurements compiled for thousands of oil wells suggest the standard deviation is $\pm$ 30% of the median value. This would mean that over one-third of the area of the United States, the temperature gradient is more than 2.1°F per 100 feet, over 8 percent of the country the gradient is greater than 2.7°F per 100 feet over 2 percent of the country the gradient is greater than 3.5°F per 100 feet, and over 1% of the country the gradient is more than 4.6° per 100 feet. This last one percent of area, which amounts to 36,000 square miles, could be considered to be a hot, dry rock resource, in that the temperature at 10,000 feet depth would be above 530°F. The recoverable heat and electricity that could be obtained would be 3 to 4 times greater than in the case of average heat flow discussed earlier, and thus the cost per unit would be lower by the same factor.

   One approach to recovery of heat from such rocks would be to drill two holes and circulate a heat exchange fluid from one well to the other to extract the heat from the rock. In order to have efficient heat exchange between the rock and the fluid, a large contact area must be provided. Research is currently being carried on by the Los Alamos (New Mexico) Scientific Laboratory to develop techniques for creating a large fracture system, perhaps a mile in diameter, through which the heat exchange fluid can be circulated before it enters the production well.

Orderly development of geothermal energy would depend on the discovery of a number of high grade hyperthermal systems, which can be developed in today's energy market at a considerable profit. In a few years' time, as other energy sources become more expensive, and as geothermal technology becomes more credible and cost effective, the more expensive but more abundant geopressured and hot dry rock systems could become economically competitive. In this scenario, it is quite possible that the rate of geothermal power production could reach 400,000 megawatts in three or four decades.

Development of Geothermal Resources - Development and production of geothermal resources involves six phases: exploration, test drilling, production testing, field development, powerline construction and full-scale operations. Each successive step is dependent upon successful results in the previous phase. Because of limited knowledge of the occurrence, location and properties of geothermal resources as related to both energy and by-product water and mineral materials, it is not possible in this assessment to specifically predict the success or failure of the interest area or to make a categorized prediction about the program as a whole.

The following narrative describes the general processes involved in the six phases of geothermal development.

1. Exploration - The exploration of geothermal areas is designed to locate and define commercial geothermal reservoirs and to evaluate the impact of possible geothermal development upon the environment, including development of surface and subsurface facilities and various land uses. Principal exploration activities include topographic and geologic mapping, geologic field examinations, ground and spring temperature surveys, geochemical studies, geophysical surveys and shallow drilling for the purpose of sampling shallow ground waters, temperature measurement and subsurface rock sampling. These exploration activities are surface oriented investigations which include:

   - Geochemical surveys in which soil, water and vegetative samples are obtained and analyzed for their chemical content.

   - Stratigraphic, lithologic and structural mapping in which geological survey crews examine rock outcrops and topography in an area and make deductions about the subsurface geology.

- Micro gas surveys in which air samples are obtained from various points within a given area.

- Reconnaissance surveys in which surface features and natural phenomena are examined without disturbing the land.

- Shallow drilling of holes as great as 500 feet deep to obtain data on heat flow.

Generally these surveys make use of existing roads and trails. Occassionally, new roads, clearings, etc., may be required in areas lacking roads or trails.

2. Test Drilling - Locations for the drilling of test wells are selected on the basis of preliminary exploration work, an approved exploration plan and other data. Test wells provide subsurface geologic data, locate potential productive zones within the geothermal reservoir, help delineate the reservoir limits and aid in determining the physical and chemical properties of the reservoir and reservoir fluids.

Test wells may vary, depending on the geological conditions and the objectives, from boreholes with diameter of about 4 to 24 inches and in depth from a few hundred to several thousand feet, with the deepest in the 5,000 to 10,000 foot range. The equipment and the control measures for drilling, sampling and completion have to be appropriate to specific situations. Where the principal objective is to outline prospective areas by collecting data on thermal gradients or geologic structure and steam producing zones will not be penetrated, small diameter boreholes may be put down by small or medium sized drill rigs to depths of about 2,000 feet. For test wells intended to investigate potential reservoirs with large diameter and deeper boreholes, the current drilling equipment, technology and methods are similar to those used in oil and gas operations.

The test drilling equipment used often is a truck mounted drilling rig. A truck mounted air compressor is usually used if the drilling is done with air; or a water tank truck if the drilling is done with water. In some cases a drilling rig with a conventional substructure is used. The drill site (or pad) generally involves an area of less than an acre which may be cleared of vegetation and graded to a flat surface. The drilling rig, mud pumps, mud tanks, generators, drill pipe rack, tool house, etc., are usually located on the drill pad. Other facilities, such as storage tanks for water and fuel may be located on the drill pad or in close proximity to the pad. A reserve pit of approximately 1,000 square feet and 6 to 8 feet deep is dug to contain waste fluids during drilling operations. Where larger and/or deep holes are to be drilled, larger equipment is required. It may be necessary to construct a heavy duty road that can support the drilling rig and other equipment that must be moved to the location. The largest individual truck anticipated will weigh approximately 90,000 pounds. The larger drill rig and associated equipment and material will occupy a larger site, often 400' x 200' and sumps may be as large as 3,600 square feet.

3. Production Testing - Production testing is the transitional phase between exploration and potential development and production of a geothermal reservoir. When a well has penetrated a potentially productive geothermal zone, drilling ceases and the well is tested over a period of time to permit periodic cleaning and to determine the flow rate, composition and temperature of fluids and gasses, recharge characteristics, pressures, compressibility and other physical properties of the reservoir fluids. Testing requires that the maximum production rate of the well be established by various controlled production rates over sufficient time to establish the hydrodynamic properties and/or boundary characteristics of the reservoir. This process involves venting of the well to the atmosphere with accompanying vapor release and noise.

   Testing in a water-dominated system requires construction or enlargement of a sump to contain test fluids, unless the fluids can be reinjected or are pure enough to be discharged into natural drainages without degrading the quality of local surface or ground water. In the event that exploratory drilling and production testing indicates that a geothermal field has economic potential for power development, a commitment must be obtained from a customer electric utility to warrant further development. This would be a major decision point in the development and production of the geothermal resource of a given area. Additional permits would be required for construction of industrial facilities and for road and powerline rights-of-way on Federal land beyond the lease site.

4. Field Development - Favorable exploration, test drilling and production testing programs will probably lead to the drilling of a number of additional wells to develop a field. Access roads will be improved to give permanent service.

   Limited service and living quarters will be constructed if required and adequate water sources and sewage facilities will be provided.

   The development of a large field can continue for many years as new wells and additional power generating units are developed.

The drilling for geothermal fluids will continue to include test wells and intensive production testing as the limits of the field are probed. In these wells, uncertainties as to the depth of the producing zone and type of fluids to be encountered will be less than in the initial prospecting stages. Much of this drilling will take place between proven wells under more predictable conditions.

If the geothermal fluids and gasses contain substances that are found to be detrimental if discharged at the surface, the contaminating substances must either be removed, neutralized, or reinjected into the appropriate subsurface reservoir. If no harmful materials are present, or if these materials can be economically removed, it is possible that fresh water may be a by-product of energy production at a geothermal plant. Conservation and utilization of such demineralized water will be required where such production is economically feasible.

To the extent that wells produce geothermal fluids, it also may be necessary to carry out an injection well program in close coordination with the production wells. The technique of injecting liquids deep within the earth has been in use for many years in the petroleum industry. Indeed this is one of the basic methods of secondary recovery and maintenance of proper reservoir pressures. Adaptation of these techniques to reinject geothermal fluids may require some slight modifications, but should be well within the realm of existing technology.

5. Power plant and powerline construction - Power generation and transmission facilities will be constructed in stages to establish the most efficient size for the project in relation to the associated geothermal reservoir. Under present technology, above ground insulated pipes are used to transport the steam from the well to the power plant because of pronounced thermal pipeline expansion and contraction during operation. An underground pipe system is not economically feasible owing to service and equipment requirements.

   Since geothermal fluids and steam can be transported only a distance of about one mile due to pressure and temperature loss factors, power plant installations will be relatively small, probably not exceeding 100 megawatts at individual sites. A typical power plant at The Geysers consists of two turbine generators housed in a single building with an adjoining structure housing cooling towers. Geyser units 3 and 4 are housed in a building 140 x 34 feet and 30 feet high. Adjoining is a cooling tower consisting of three 36 x 66 feet shells. Surface steam lines of 10 to 30 inches, fiberglass and asbestos insulated pipe with characteristic large U-shaped expansion loops, connect the wells to the power plant. The greatest distance of any connected well currently is 1,200 feet in a straight line. Each plant is served by several producing wells at spacings of about 40 acres per well. Thus, in the producing area, the terrain is laced with exposed steam pipes radiating out from the power plants which in turn are connected together with high voltage transmission lines.

6. Full Scale Production - During the operation period, activities primarily will consist of the operation and maintenance of the power plant and related facilities and the drilling, redrilling, and work-over of geothermal wells to maintain production capacity. Electrical energy generation will be at its maximum during this stage. Overall activity will be considerably reduced over that required during field development and the construction of power generation, power transmission, and related facilities. The adverse environmental effects of geothermal development may decline as the field enters full-scale production. If proper environmental measures have been fully implemented during the construction phase, vegetation will begin to cover exposed soils where conditions are conducive to plant growth and drainage and soil erosion measures will control run-off to minimize both on and off site damage. The physical disturbances and activities associated with construction will have ended. A state-of-use equilibrium will be reached which will be conducive to broader multiple land uses, including wildlife habitat, grazing, and agriculture. The Larderello Field in Italy, for example, is in an area of intensive agricultural development. Within the confines of this geothermal field, there are many farms, vineyards, and orchards adjacent to producing wells, pipelines and power plants.

Non-Power Uses of Geothermal Energy - It is entirely possible that, if geothermal sources are discovered, they will not have a temperature high enough to permit generation of electric power. Figure 3 shows the approximate required temperature of geothermal fluids for various commercial purposes. Even if geothermal heat is discovered that is high enough to permit electric power generation, there is a real possibility of downstream uses of the geothermal fluid even after some heat had been extracted in power production. Agricultural, food processing, soil warming, and space heating are all uses that can be done with the geothermal fluids that are discharged from a power plant.

Should these lower temperature uses occur, they would differ from the electric power generation development described above in the following respects:

(1) Actions up through the field development stage would be very similar to those described above except that the number of holes drilled and their depth would probably be less since the volume and temperature requirements of the geothermal fluid would be less. There is a possibility that even more holes would be drilled, though to a lesser depth, because lower temperature fluids are more likely to be found over a larger area than the high temperature fluids required for power generation. This is not likely, however, because the market for space heating and agricultural uses is limited respectively by population and available water.

(2) Pipelines would still have to be constructed, but again, the number of pipelines would probably be fewer.

(3) Plants could be of similar size for food processing and greenhouses but would be much smaller for space heating uses.

(4) No power lines would be constructed so no extensive rights-of-way through the area would be necessary.

Geothermal Resources in Oregon - Potential uses of geothermal resources are varied, and in most cases, are of local in nature. Commercial geothermal development, primarily for electrical power generation, in the United States to date is limited, existing only at The Geysers in California, and these only since almost 1960. In contract, geothermal developments have existed in Italy since about 1900.

Geothermal resources are used for space heating in Klamath Falls, Oregon. The Oregon Institute of Technology and a few commercial establishments use heat from geothermal resources. The city of Klamath Falls uses this energy to melt snow off of a steep, heavily traveled street. Geothermal heat is also locally used to heat a greenhouse and a few homes at Vale, Oregon.

Oil and Gas Resources

Phases of Implementation - Petroleum operations progress through five phases: (1) preliminary investigations, (2) exploratory drilling, (3) development, (4) production, and (5) abandonment (Figure 4).

Unlike geothermal resources, the geologic nature of petroleum deposits and their formation are well known. Detailed information on these resources may be obtained from any textbook on general or petroleum geology. Basically, petroleum and natural gas may be found in commercial quantities from sedimentary geologic formations with the following characteristics:

(1) An adequate source of petroleum-generating material in the form of abundant marine (and occassionally nonmarine) animal and plant life.

(2) The presence of reservoir rocks in which important amounts of oil and gas can accumulate and from which they can be made to flow to wells for production at satisfactory rates.

(3) Suitable structural or stratigraphic traps that provide a means of localizing and entrapping the oil or gas in the reservoir rocks. Whether these three characteristics are found in a combination that will provide commercial production of petroleum in Oregon has yet to be determined.

Several phases may occur simultaneously in an area. One company may drill an exploratory well on a lease while another company conducts preliminary investigations on adjacent areas. However, if only one company is interested in the area, normally only one phase of the operation will take place at a time.

Exploratory wells are drilled on a small percentage of the area covered by preliminary investigations.

1. Phase I: Preliminary Investigations - Preliminary investigations often preceeds the issuance of a lease. They are described in this section to provide an overview of the entire range of oil and gas operations.

   Preliminary investigations begin with an office review of geological and technical data available for the region. In many oil and gas producing regions, an office analysis may develop enough information to proceed with drilling without conducting additional preliminary investigations. However, the office analysis may indicate only a broad prospective area, and further preliminary investigations may be required.

   Preliminary investigations are made from the air and on the ground.

   Airborne investigations involve the use of small aircraft and helicopters to conduct visual reconnaissance, photographic, and geophysical surveys. These may be followed by on-ground geological and geophysical surveys which involve either casual or intensive use of the land. Casual uses generally do not disturb the surface. Intensive uses include operations which require clearing of new access trails, movement of heavy equipment, or other actions which can result in substantial surface disturbance.

Geological surveys normally are a casual use. Rock outcrops and topography are examined to determine the structural attitude and age of surface formations, and geologic maps are prepared. In many areas, rock outcrops have been mapped and sufficient information obtained to enable the geologist to recommend a drilling location without conducting additional surface exploration work. However, when surface structures are not present or do not provide conclusive indications of subsurface structures, geophysical investigations may be needed to outline structures where oil or gas may be trapped.

Geochemical and soil-gas surveys involve casual use of the land. In geochemical surveys, the chemical contents of water, soil or vegetative samples are analyzed for the presence of oil or gas. In soil-gas surveys, soil samples are analyzed to determine whether minute traces of gas have excaped to the surface from petroleum reservoirs.

In geophysical surveys, subsurface formations are evaluated by analyzing properties such as gravity, electrical conductivity, magnetic susceptibility and structural attitude. The seismic survey is one of the most commonly used geophysical methods. It is an intensive use method and involves the use of heavy truck-mounted equipment. Other geophysical methods, such as temperature, gravity, magnetic and radiation surveys, usually are confined to existing roads and trails.

In seismic surveys, a shock wave is sent into the subsurface and the time required for the wave to travel to and return from a subsurface horizon is recorded. A map of the subsurface can be drawn from an analysis of the differences in the time it takes the wave to be reflected back to the surface from the various rock formations.

Explosive, thumper or vibrator methods are used to produce the shock wave.

In the explosive method, shot holes are drilled to a depth of 50 to 200 feet. Four to twelve holes are drilled per mile of line. The holes are loaded with 5 to 50 pounds of explosives and detonated. The same hole may be reloaded and shot several times to find the depth and explosive charge returning the best reflection or refraction signal.

The thumper and vibrator methods pound or vibrate the earth to create a shock wave. Less than 50 square feet of surface area is required to operate the equipment at each test site. If there is brush or loose rock in the area, it may be removed to provide a more solid base for the test.

The sensors and energy source are typically located along straight seismic lines laid out on a 1 to 2 mile grid. Existing road systems are used where available. Lines may be cleared of vegetation and loose rocks to improve access for the trucks. Each mile of line cleared to a width of 8¼ feet utilizes one acre of land.

2. Phase II: Exploratory Drilling - This phase does not begin until a lease has been acquired by the operator. In areas where preliminary investigations are favorable and information warrants further exploration, exploratory drilling may be conducted. More precise data on the geologic structure are obtained by stratigraphic tests. The presence of suspected oil and gas deposits may be confirmed by exploratory drilling of deep holes.

   (a) Stratigraphic Tests. Stratigraphic test holes are drilled 100 to 500 feet deep to locate geologic indicators. The holes are usually drilled with truck-mounted equipment and disturb a relatively small area. Stratigraphic holes in areas of shallow high pressure zones are cased. The roads and trails constructed for access to the test sites are temporary and involves minimal construction. The drill site occupies approximately 900 square feet and is sometimes placed in the center of new or existing trails.

   (b) Exploratory Wells. Exploratory wells are deeper tests requiring larger drilling rigs with support facilities, and may disturb a larger surface area than stratigraphic tests. Required facilities include roads, drill pads, mud pits and--in some cases--camps and airports.

   Both the stratigraphic tests and exploratory wells require a permit to drill issued by the appropriate Geological Survey District Engineer. The State of Oregon also regulates exploratory drilling and associated activities and facilities.

   Nationwide, one out of every seven exploratory wells drilled in 1974 was finished as a producer. However, only one in 59 resulted in the discovery of significant recoverable reserves (more than one million barrels of oil or six billion cubic feet of gas). Of the 200 or so wells drilled in Oregon, none has been financially successful.

   After a drilling site has been selected, a heavy-duty road is built to move the drilling rig and other equipment to the location. The roads are not designed for permanent access.

The well site occupies about an acre and is cleared of all vegetation and graded nearly flat. Depending on the soil in the area, the well site or drill pad and roads may or may not be graveled. The drilling rig, mud pumps, mud pit, generators, pipe rack, and tool house are located on the drill pad. Other facilities such as storage tanks for water and fuel may be located on or nearby the drill pad. Water trucks are used when pipeline installations or water wells are not practical.

A water supply is required for mixing drilling mud, cleaning equipment, cooling engines, and other uses. A pipeline may be laid several miles to a pump installed at a stream or to a water well.

The drilling mud is maintained at a specific weight and viscosity to cool the bit, reduce the drag of the drill pipe on the sides of the well bore, seal off any porous formation, contain formation fluids to prevent a blowout or loss of drilling fluid, and bring the drill cuttings to the surface for disposal. Various additives are used in maintaining the drill mud at the appropriate viscosity and weight. Some of the more rarely used additives are caustic, toxic, or acidic in nature. Others are simply weight additives and fluid loss additives.

A well completion requires installation of steel casing between the surface casing and the pay zone. The casing is selectively cemented to improve stability and to protect specific zones. The drilling rig and most of the support equipment are usually moved from the well site after the casing is cemented.

Storage tanks are required to hold oil produced from an exploratory well. A separator may be required to separate the soil and gas. If water is produced with the oil, a treater may be needed. The gas separated from the oil may be burned off as waste during the initial stage of development of an oil field.

If gas is discovered, the operator is allowed to flare only enough gas for a short period of time to determine the well's capabilities. The well is then shut-in until a gas line is constructed.

The completion of several exploratory wells as commercial producers usually marks the beginning of the development phase.

3. Phase III: Development - Oil field developmental steps are outlined below:

(a) Well Spacing Pattern. A well spacing pattern must be established before development drilling begins to determine the spacing unit assigned to each well.

If a well spacing pattern has not been previously established for the area, the operator proposes a spacing pattern to the state regulatory agency and to USGS for approval pursuant to the Oil and Gas Operating Regulations, 30 CFR 221. Information considered by USGS in establishment of a well spacing pattern includes data obtained from the discovery well on the porosity, permeability, pressure, lithology and depth of formations in the reservoir; data on well producing rates and type of production (predominantly oil or predominantly gas) and the effects of the proposed well spacing pattern on the economics of recovery.

Most spacing patterns established at the present time for Federal leases are from 10 to 40 acres per well for oil production and units of 160, 320, or 640 acres per well for gas production.

(b) Drilling Procedures. Procedures used in drilling development wells are about the same as those used for a wildcat well, except that there usually is less subsurface sampling, testing and evaluation.

(c) Surface Use. Facilities required for development drilling may include access roads; well sites; flowlines; storage tank batteries; facilities to separate oil, gas, and water; and injection wells for salt water disposal. In some instances, gas injection wells for either fuel conservation for future production or maintaining stable reservoir pressure may be used. In remote locations, camps and air strips may be required.

Access roads usually are better planned, located and constructed than roads built during the drilling of wildcat wells.

When an oil field is developed on a spacing pattern of 40 acres per well, the wells are ¼ of a mile from each other. If a section (1 square mile) is developed with 16 wells, at least 4 miles of access roads are built, and approximately 4 to 6 miles of flowlines are installed between the wells and the tank batteries.

Surface uses in a gas field will be significantly less than in an oil field because gas wells usually are drilled on 160-acre per well or larger spacing units. A 160-acre per well spacing pattern requires four wells per section and approximately 2 miles of access roads and pipelines. Separation and storage facilities are not required for gas production unless the production is rich in liquids, or condensate. It may be sold without spearation and the purchaser may separate the liquids at a central processing point far removed from the lease.

4. Phase IV: Production - Oil and gas field facilities are shown in Figure 5 and are outlined below:

(a) Well Facilities

(1) Oil Fields. Pressures in some petroleum reservoirs are great enough to force oil to the surface. The result is a flowing well. However, most oil wells in the United States require the use of some means of artificial lift to bring the oil to the surface. Pumping and a technique known as "gas lift" are the two methods of artificial lift used at present. Flowing wells and wells with gas lift facilities require a minimum of equipment at the surface and produce little or no sound. All pump systems require more surface equipment and create more noise than flowing wells and gas lift facilities.

(aa) Flowing Wells. The surface equipment at the head of a flowing well may be limited to a series of valves, or "Christmas tree" and a fenced service area ranging from 15 x 15 to 50 x 50 feet around the wellhead and Christmas tree.

(bb) Artificial Lifts.

(i) Pumping. Over 90 percent of the oil wells in the United States in 1971 were on artificial lift, and most of the artificial lift wells used sucker rod pumps. Other pumps commonly used on oil wells are hydraulic and centrifugal pumps.

All of the pump systems require some surface equipment and fuel or electric power lines. All generate some noise, ranging from almost none for electric motors to high noise levels for single cylinder gas engines.

(ii) Gas lift. Gas lift is used in some oil fields where low cost, high pressure natural gas is available and where pressure in the petroleum reservoir is sufficient to force the petroleum part of the way up the well. The addition of gas lowers the specific gravity of the petroleum so that it flows to the surface. The system is quiet and uses little ground. However, it will be used less in the future as supplies of high pressure natural gas decline.

(2) Gas Fields. Most gas wells produce by normal flow and do not require pumping. Surface use at a flowing as well usually is limited to a 20 x 20 foot fenced area. If water enters a gas well and chokes off the gas flow, a pump may be installed to pump off the column of water.

(b) Flowlines. Crude oil usually is transferred from the wells to a central collection point, or storage tank battery, before it is transported from the lease. Natural gas is often sold at the wellhead and transported directly off the lease. If processing is required to remove liquid hydrocarbons or water, however, the gas may be transferred to a central collection point prior to sale.

Oil and gas are transferred from the wells to central collection points in flowlines. The flowlines usually are 3 or 4-inch diameter steel pipes. They may be buried, installed on the surface, or elevated. Natural and man-made corrosive liquids, groundwater and salt concentrations and electric currents can corrode buried steel pipe. Several protective measures have been developed. They include coating the steel pipes with paint, plastic, cement, felt wrapping and bitumen; feeding controlled electric currents to the metal flowlines; burying masses of metal and attaching them metallically to the metal flowlines and substituting nonmetal pipe for steel.

(c) Separating, Treating, and Storage Facilities. If the fluids produced at the well contain gas and water, the oil, gas and water are separated before the oil is stored in the tank battery. The batteries usually contain at least two tanks and usually are located on or near the lease.

Small leases may contain only one tank battery; large leases may contain several, with each battery containing separating, treating and storage facilities.

(d) Disposal of Produced Water. After water is separated from oil at the tank battery, it is disposed of under USGS supervision. Although most produced waters are brackish to highly saline, some produced waters are fresh enough for beneficial surface use. Ranchers and farmers in some cases have filed prior rights claims on oilfield water so they can use it for agricultural purposes.

(e) Methods of Increasing Petroleum Recovery. Oil cannot be produced unless forces within the petroleum reservoir are great enough to drive the oil to the well bore. Primary production occurs when energy in the reservoir is sufficient to drive the oil to the well. When natural energy sources are inadequate, secondary production methods involving gas or liquid injection may be used to supplement the natural forces.

In water flooding, the most commonly employed form of secondary recovery, water is injected into the reservoir to drive additional oil to the producing wells. On the average, a successful waterflood will increase recovery by roughly 10 to 100 percent.

Saline water is disposed as required by USGS Notice NTL-2B, mainly in evaporation pits or by subsurface injection. Evaporation pits are used mainly in arid regions where evaporation rates are high.

The USGS may require that evaporation pits be lined with an impervious material and be inspected periodically to insure that the lining is maintained. Concrete, asphalt, plastic, bentonite and epoxy resins are used for pit linings.

Because salt water seldom issues from heater-treaters or gun barrels completely free from oil, oil skimmer pits are installed between the separating facilities and the evaporation pits, when surface disposal is used.

When salt water is disposed of underground, it usually is introduced into a subsurface horizon containing water of equal or poorer quality. It may be injected into the producing zone from which it came or into other producing zones. In some cases, this stimulates oil production. In other cases, it could reduce the field's productivity and may be prohibited by state regulation or mutual agreement of the operators.

In some fields, dry holes or depleted producing wells are equipped for salt water disposal; but occasionally new wells are drilled for disposal purposes. Cement is squeezed between the casing and sides of the well to prevent the salt water from migrating up or down from the injection zone and into other formations. The salt water is generally injected down the well through tubing.

Depending upon the porosity, permeability and pressure of the disposal zone, the salt water may be injected without pressure.

If pressure is required, an injection pump is used to force the salt water into the disposal zone.

Other secondary techniques for improving oil recovery have been tested, including miscible flooding (injecting chemical compounds with water) fire flooding (starting a controlled fire in the reservoir) and steam flooding (injecting steam into the reservoir). Some of the techniques have been used for tertiary recovery after a water flood.

Natural gas also is injected into some oil reservoirs during primary recovery as a pressure maintenance program.

(f) Land Required for Oil and Gas Producing Facilities. The land uses for all facilities in a developed field may range from 22.4 acres per square mile with a 20-acre per well spacing pattern, to 2.4 acres per mile with a 640-acre per well spacing pattern.

Less land is usually used in gas fields than in oil fields because gas production often does not require storage on the lease.

(g) Employment. The number of people required to operate an oil or gas field varies with the characteristics of the production and the number of leaseholds in the field. If the wells flow without pumping, one employee in a large, modern field can control production of about 25 wells. When wells are pumped, one employee in a large modern field can control production on 10 to 20 wells. If oil storage tanks are manually gauged and sampled, one employee can service approximately 25 tanks. If automatic gauging and sampling devices have been installed, one person can service the equivalent of 100 - 150 tanks. In a large, modern field, one five-man maintenance crew can service up to 50 wells.

5. Phase V: Abandonment - Field abandonment considers wells and equipment from two phases - exploration and development and from production.

(a) Exploratory and Development Wells. Dry wells normally are plugged before the drilling rig is removed. This allows the operator to use the drilling rig to plug the hole and avoid bringing in other plugging equipment. The operator must obtain permission from the USGS district engineer to plug the well.

Well plugging requirements vary with the characteristics of the rock formations, subsurface water and the well. Generally, however, the hole is filled with heavy drilling mud to the bottom of the cemented casing. A cement plug is installed in the bottom of the casing, the casing is filled with heavy mud and a cement cap is installed on top of the well. In uncultivated areas, a pipe may be installed as a monument, giving location and name of the well. In croplands, the casing is cut off and capped below plow depth, and no monument is installed. Plugging requirements provide for protection of aquifers and known oil and gas producing formations by placement of additional cement plugs.

After the plugging is finished, the drilling rig is removed and the surface, including the reserve mud pit, is restored to its original condition, insofar as possible and according to requirements of the surface management agency. The operator's report of abandonment is approved by the USGS after the surface management agency approves actual surface cleanup and restoral.

(b) Production and Injection Wells, and Related Facilities. Before a lessee abandons a former producing well, he must demonstrate its unsuitability for further profitable production to the USGS district engineer. A copy of the operator's notice of intention to plug and abandon is transmitted to the surface management agency to obtain the agency's recommendations on surface restoration.

In some cases, wells are plugged as soon as they are depleted. In some cases, depleted wells are not plugged immediately, but are allowed to stand idle for possible later use in a secondary recovery program.

Truck-mounted equipment is used to plug former producing wells. In addition to the measures required for a dry hole, plugging of a depleted producing well includes the installation of a cement plug in the perforated section in the former producing zone and -- if casing is salvaged -- a cement plug is put across the casing stub. In cultivated areas, the cement pumpjack foundations are removed or buried below plow depth. In areas where removal or burial would cause more surface damage than the foundations, they are left at the site.

When an entire lease is abandoned, the separators, heater-treaters, tanks and other processing and handling equipment are removed and the surface restored. Flowlines and injection lines installed on the surface are removed, but buried lines usually are left in place. The operator's bond with the Federal Government is not terminated until the surface management agency has approved surface restorations, the USGS has approved subsequent reports of abandonment and royalties due the Federal Government have been received.

Summary of Oil and Gas Leasing and Exploration in Eastern Oregon - Oregon has had several periods of oil and gas exploration. Small speculative ventures based on little, if any, geologic studies were initiated mainly on private land from 1900-1940. From 1940-1962, the exploration was more intense and professional, with many deep expensive test holes. At the close of World War II, large oil companies did extensive geologic studies. A third period of serious on-shore activity began in 1975, led by the major oil companies.

Between 1902 and 1920, 40 holes were drilled in Oregon by wildcatting groups whose total estimated expenditure was about three million dollars. Of the 40 holes, 25 were located in eastern Oregon, but most were shallow, with the deepest well of the period extending to a depth of 4,360 feet. Figure 6 shows locations of drilling sites in Malheur County and Table 1 summarizes the results of the activity. The Ontario Cooperative Oil and Gas Company well near the town of Ontario in Malheur County was one of the most significant tests of the period. The well blew out when gas and sand was encountered at 2,200 feet. The large flow was shortlived and after a few days, only a small amount of gas remained. This explains why 18 of the 25 hiles drilled in eastern Oregon during this period were concentrated in northern Malheur County.

From 1920 to 1940, 45 holes were drilled in Oregon with a total estimated expenditure of $512 million. Most of this effort was west of the Cascades. About 15 holes were drilled in eastern Oregon, mostly in the southern parts of Klamath and Lake Counties and northern parts of Malheur and Harney Counties, but were mostly shallow by present standards.

Large oil companies began exploring in Oregon at the close of World War II and continued their efforts in eastern Oregon. In 1954, El Paso Natural Gas Company drilled the deepest hole in the western Snake River Basin to 7,470 feet. The unsuccessful hole was about eight miles west of Vale. In 1958 Sunray Midcontinental Oil Company and Standard Oil of California operators drilled a well southeast of Prineville in which gas was found in Cretaceous marine sediments. Since the gas occurred in a bed with mainly shales, no test were made. By 1963, most of the large oil companies terminated their on-shore efforts in Oregon and turned to the more interesting off-shore explorations which ran from 1960 to 1967. The total estimated on-shore expenditures in Oregon for the period 1941-65 was about $14.3 million, most of which was spent west of the Cascades.

In 1970, Texaco became interested in the Paleozoic-Mesozoic marine beds of central Oregon, and leased over 200,000 acres of Federal, state and private lands in Crook and Grant Counties near the location of two encouraging holes drilled in 1955 and 1958. Most of this lease acreage was on Federal land.

In 1971 three significant events occurred. The first, Texaco drilled a 7,998 foot hole in the center of its lease block (then about 250,000 acres covering about 400 square miles), but no commercial discovery was made and the hole subsequently plugged and abandoned. The second, two major oil companies also moved into the area when Standard Oil of California and Amoco applied for Federal leases on significant acreage in eastern Oregon. And the third, the BLM responded to environmental pressures and stopped additional leasing in Oregon.

No holes were drilled during 1972. Standard Oil delayed the start of a wildcat hole in the remote southeastern corner of the state (southern Malheur County) to the following year. Standard's 1973, 8,414 foot hole on a federal lease was unsuccessful and subsequently plugged and abandoned. As a result of this hole, Standard gave up its interest in southern Malheur County. No holes have been drilled nor have new oil leases been issued since 1971.

Altogether, only 12 deep holes have been drilled up to the present, most of which were on Federal land. Texaco and Standard are currently the major Federal leaseholders in eastern Oregon, and together, hold about 172,000 acres. The State of Oregon has issued leases covering 8,484 acres in eastern Oregon. Estimated expenditures of over $1.5 million were made by oil and gas leaseholders in eastern Oregon, primarily for exploration.

In spite of the approximately 30 dry holes drilled in northern Malheur County, the drill spacing is still quite low when compared to other "wildcat" areas that have subsequently entered production. It is altogether probable that geothermal test drilling will compliment and encourage renewed oil and gas exploration.

To date, there are no producing oil or gas wells in Oregon, either on dry land or on the continental shelf.

ALTERNATIVE TO THE PROPOSED ACTION

The proposed action involves the leasing, with standard and site specific stipulations and controls, of Federally-owned geothermal and oil and gas resources for exploration and development in the Oregon Canyon EAR area. This document will analyze the impacts of exploration and the various phases of resource developments upon the different components of the non-living and living environment and upon human and cultural resources.

There is only one alternative to this action: Do not lease any of the Federal land in the EAR area for geothermal or oil and gas purposes.

"No leasing" would involve an administrative decision by the BLM not to lease any of the Public Land for geothermal or oil and gas purposes. Little discussion of this alternative is needed since use of the Public Lands would remain the same as present and there would be no impacts upon human resources.

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

The following narrative describes the non-living environment, the living environment, ecological interrelationships, human resources and values, sociological characteristics, and regulatory structures.

NON-LIVING OR ABIOTIC ENVIRONMENT

The non-living, or physical, or abiotic environment provides the backdrop for all living activities. This includes the climate, topography, soils, air, water and geologic structure. Changes in any of these elements can alter the qualitative and quantitative characteristics of the flora and fauna and modify ecological relationships between the existing species of a given area.

Climate

Climatic data for the EAR area is scanty; the north McDermitt recording weather station is situated in R.43E., T.36S., W.M., in the northern half of the EAR area, north and east of Battle Mountain and a second station is situated near the McDermitt, Nevada community. Rainfall and temperature data from these two stations is summarized in Table 2.

Temperature - Mean annual temperature is nearly 48.4°F with July the warmest month at 70°F and December and January the coolest with 31.2 and 30.4° respectively. Known extremes have been near -50°F and 110°F.

Precipitation - Mean annual precipitation ranges from about 8 inches (20cm) at the lowest elevations to about 22 inches (56 cm) in the more mountainous portions of the EAR area (Huxel, et al, 1966). The adiabatic cooling of easterly moving air masses as they ascend the western mountain slopes causes condensation and loss of moisture. As this air descends the eastern slopes, it is adiabatically warmed and thus able to retain the remainder of its moisture. Thus the area receiving the most precipitation would be the Trout Creek Mountains in the western part of the EAR area. Most of the runoff from these mountains drains into the Alvord Lake Basin, although a substantial amount drains toward the Quinn River. Precipitation on the valley floor is the lowest in the area due to the process described above. On the east side of the valley, precipitation increases with elevation although much of the moisture in the air has been lost. Beyond the ridge east of the valley, precipitation decreases gradually with corresponding decreases in elevation. Estimates of the annual precipitation for each side of the valley are presented in Table 3. Precipitation data presented in Table 2, though not representative of the entire area, probably represent an average for the Owyhee Uplands (Figure 7). Snowfall, as measured at the northern station averaged 15.0 inches (38cm) for the years 1957, 1959, and 1960. Again, snowfall figures for the mountainous areas to the west would probably be considerably higher. Most of the runoff within the EAR area is generated by snowmelt during late winter to early summer.

Snow accumulates to depths as great as four to five feet in the area with deeper areas of drift, but these have not been measured. Snowdrifts may persist well into the summer months in the highest elevations. Vegetation, such as big sagebrush (*Artemisia tridentata*), snowberry (*Symphoricorpos* spp.), and quaking aspen (*Populus tremuloides*), are typical of north slopes where snowdrifts are common.

The spring rainfall-temperature pattern is favorable for plant growth during May and June. Likewise, the high temperatures and low precipitation of July through October is favorable for grass curing and drying, especially in the lower elevations.

Humidity - Relative humidity is low, especially during the months of July and August. Evaporation rates are high due to high temperatures and low humidity.

Air Movement - Prevailing winds are from the west with high, gusty winds of 25-35 mph in the spring and gentle breezes during the summer. The former are responsible for depleting soil moisture. Air inversion is rare. During the winter and spring, there are periods of fog, usually in the valleys, but this frequently burns off by mid-day.

Growing Season - The growing season - or frost-free period - is generally between 90 and 107 days. This period, longer in the northern and shorter in the southern portions due to elevation differences, strongly influences the species and number of plants in the EAR mainly to forage crops due to the short and unpredictable growing season.

Air - The entire area has air of high quality. There are no industries within or adjacent to the area which contribute to air pollution. McDermitt is the only population center near the area. Its small size and relatively isolated setting, limits the pollution potential from this source. Heavy equipment used by the McDermitt Cinnabar Mine south of McDermitt or other regional mining activity do not significantly constitute an air pollution hazard.

Topography

The EAR area covers two geographic zones: The Owyhee Uplands and the Basin Range (Figure 7). It also straddles the boundary between two major river basins, the Owyhee River basin and the Quinn River basin, and also includes a portion of the topographically closed Alvord Lake Basin (Fig. 8). Altitudes within the EAR area range from 7,920 feet (2,400m) along the east rim of Oregon Canyon to 4,300 feet (1,303m) just north of McDermitt. Structurally, the area consists of a north-south trending trough surrounded on the west, north and east by uplifted Tertiary volcanic rocks.

The eastern portion of the EAR area is characterized by rolling plateaus with numerous deep-cut canyons. The western portion, separated from the eastern by the Battle Mountain and Blue Mountain Ranges and by the McDermitt Valley, is characterized by small fault-block mountains and mesas deep-cut by numerous canyons.

Drainages in the northeastern half of the EAR area run primarily north into Owyhee River Basin while most of those in much of the remaining part of the area run south towards the Quinn River in Nevada. A few streams in the northwest corner flow into the Whitehorse Desert of the Alvord Lake Basin where they disappear into the ground. Most of the streeams in the EAR area are intermittent, at least along portions of their courses. Many are characterized by deep, scattered, sheltered pools during the dry summer months.

Topography does have some effect upon resource management in the EAR area, especially on livestock grazing in the western half. Some areas are too steep to be used by livestock, however, these areas may be used by various wildlife species. Elevational differences have some influence on livestock and wildlife movement patterns, chiefly due to the effects of elevation and climate on plant productivity.

Soils

The data presented in Table 4 was compiled from a study conducted in 1969 by the Oregon State Water Resources Board (Lovell, et al., 1969). The soil type unit designation in the Table refers to the map issued by Lovell, et al., (1969) and summarizes on slope, land use, drainage classification, runoff, permeability, water-holding capacity, root zones, shrink-swell potential, workability, erosion hazard, flooding potential, soil limitations, irrigation suitability, temperature limitations, and hydrologic groups are presented.

Water

Surface Water - About 50% of the study area lies within the Owyhee River basin which drains northward into the Snake River. The

Owyhee River basin, according to Robison (1968), is comprised of three subdivisions, the Upper and Lower Owyhee subdivisions and the Crooked Creek subdivision. Of the area within the EAR boundaries included in the Owyhee basin, the southeastern portion (section 1a in Figure 2) is part of the Upper Owyhee subdivision. Antelope Creek and its many ephemeral tributaries such as Trial Creek, Field Creek and Pole Creek drain most of this area, flowing northeasterly into the Owyhee River. Several small ephemeral creeks drain the eastern rim of this area and an unnamed perennial creek flowing just north of Antelope Flat drains the southernmost portion of the area, forming the headwaters of the west fork of the Little Owyhee River. Streamflow data for this area is limited to crest-stage recorders which record only maximum streamflows and gage heights over a given period. Table 5 shows annual maximum discharges for several streams within the subject area for the years 1971-75.

Tertiary basalt flows trending northeasterly divide the Upper Owyhee River subdivision from the Crooked Creek subdivision (Walker & Repenning, 1965). Rattlesnake Creek and Battle Creek drain the area east of Battle Mountain and west of the drainage divide. Crooked Creek, with its headwaters on the northeastern side of Blue Mountain drains the Plateau north of Blue Mountain Pass as well. Annual crest-stage records for Crooked Creek, recorded at a station just south of Basque are included in Table 5. Numerous ephemeral tributaries to Crooked Creek drain the area northwest of Blue Mountain.

Southwest of the Owyhee River basin lies the northern end of the Quinn River basin. Once a part of Lake Lahontan during the Pleistocene epoch, with well preserved shoreline features evident at and below an elevation of 4,380 ft. (1335m) (Huxel et al., 1966), the Quinn River Valley extends southward into Nevada for 70 miles (113km). The northern end, referred to as the Oregon Canyon subarea in this report, is drained primarily by Oregon Canyon Creek and Jackson Creek. McDermitt Creek drains an old caldera southwest of the Oregon Canyon subarea. Oregon Canyon Creek initially flows northward out of Oregon Canyon, before reversing its course and flowing southward over the alluvium of the valley floor to the Quinn River. Jackson Creek drains much of the north and east sides of the valley, although its flow is not sustained all year long. Many other ephemeral streams drain the valley margins, although most of them are completely absorbed by the alluvium before reaching Oregon Canyon Creek, which is also usually dry during late summer and early fall. Huxel, et al., (1966) estimate the average annual runoff from the west side of the Quinn River Valley in Oregon to be about 4,600 acre-feet ($5.7 \times 10^6 m^3$) and that from the east side to be about 8,400 acre-feet ($10.4 \times 10^6 m^3$). These figures do not include the runoff carried by McDermitt Creek. Partial records from three gaging stations, two on tributaries to Jackson Creek and one on a tributary to McDermitt Creek, are included in Table 5.

That portion of the EAR study area lying within the Alvord Lake basin is composed of Tertiary lava flows which slope to the northwest. It is dissected by several ephemeral streams to the north and one major perennial system to the south, Whitehorse Creek and its tributaries. No streamflow data is available for this area. It is part of an internally drained basin wherein all streamflow that is not evaporated percolates through the alluvium to the ground-water reservoir. There may, however, be some flow of ground water from the Alvord Lake basin to the Owyhee basin. Data to support this speculation does not exist.

Sediment loads are greatest during spring runoff when rainfall and the contributions from melting snow are the greatest. Silt loads drop significantly, however, as the dry part of the season advances. The USGS estimates that the sediment production in the EAR area to be in excess of 151,000 cu. yds. annually.

Surface water in the area is generally of high quality except in the vicinity of sources which supply drinking water to wildlife and livestock.

Ground-Water - Aquifers within the EAR boundaries are of two types, the unconsolidated alluvium of the valley fill and the fractured and jointed Tertiary volcanic rocks of the uplands. Within the Owyhee River basin, there are several springs issuing from basalt flows, principally along the southwestern edge of the Owyhee Uplands. These springs are recharged primarily by snowmelt, but no flow data is available. The volcanic rocks underlying the uplands of the Owyhee River and Alvord Lake basins within the EAR area are of moderate to good permeability, although water levels are deep and thus few wells have been drilled (Robison, 1968). Water levels for two wells drilled in basalt of the Owyhee uplands, one within the EAR boundary (no. 1) and one north of the EAR area (no. 2), are presented in Table 6. There are no large bodies of alluvium within either the Owyhee River basin or Alvord Lake basin portions of the EAR area.

A large ground-water reservoir exists within the valley fill at the north end of the Quinn River valley, referred to herein as the Oregon Canyon subarea. Huxel et al., (1966) estimate that within the first 100 ft. (30m) of saturated alluvium, the amount of water in storage within the Oregon Canyon subarea is about 1,300,000 acre-feet ($1.56 \times 10^9 m^3$). Where the depth to water is less than 100 ft. (30m, see Figure 9), the amount of water within the first 100 ft. (30m) of saturated sediments would be about 810,000 acre-feet ($9.99 \times 10^8 m^3$). Huxel, et al. (1966) also estimate the surface inflow across the bedrock-alluvium contact into the Oregon Canyon subarea to be about 13,000 acre-feet ($1.6 \times 10^7 m^3$) per year and subsurface inflow from adjacent bedrock to be about 1,000 acre-feet

($1.2 \times 10^6 m^3$). This leaves an annual net gain to the valley-fill reservoir of 3,000 acre-feet or $3.7 \times 10^6 m^3$). Subsurface movement of ground-water out of the Oregon Canyon subarea is very minor since the hydraulic gradient is nearly zero. The distribution of phreatophytes, obtain their water directly from the shallow water table, is shown in Figure 9. Very little data on ground water quality in the EAR area is available. Table 6 presents data for two wells and one hot springs. Even though the water from the hot springs is relatively soft, it is not well suited for irrigation due to high sodium content.

Geology

The following narrative on the geologic section was developed by Kenneth Rock, Office of the Geothermal Supervisor, USGS, Menlo Park, California.

The EAR study area occure in two distinct provinces. The Owyhee Upland, which encompasses most of the area, includes most of Malheur County, the northeast corner of Harney County, and extends into adjacent parts of Idaho and Nevada (Figure 7). The western portion of the study area, in part, is in the Basin and Range province. It consists of fault-block mountains and downdropped basins with interior drainage. This is in marked contrast to the Owyhee Upland, where few basins have interior drainage and runoff is to the Snake River to the northeast. Extensions of the block faulted mountains of the Basin and Range Province become smaller and less defined as they extend into the Owyhee Upland. Additionally, the established drainage patterns and more mature topography distinguish the Owyhee Upland from the geologically younger plains regions both to the west and east (Concoran, 1969).

Structure - The oldest exposed rocks in the Owyhee Upland are of Miocene age. They consist of tuffaceous sediments and thick sections of basalt and rhyolite flows. Total thickness varies between basins, but maximum thickness if estimated at 1,800-2,100 m (6,000-7,000 ft.) (Concoran, 1969). Overlying the Miocene units is a series of Plio-Pleistocene sedimentary tuffs, basaltic lavas, and welded ash-flow tuffs (Figure 10). Generally, the lava sheets are thinner and more widespread than those of the Miocene.

The part of the Basin and Range province included in the area of EAR coverage is dissected by two prominent sets of faults: one striking N. 20-40 E. and the other N. 20-35 W. (Figure 10). Displacements of large magnitude on some of these faults have resulted in north-trending grabens bounded by high mountains. These mountains ranges, including the Trout Creek Mountains and the northern extension of the Santa Rosa Range, represent tilted fault blocks, or horsts, resulting from relative uplift along the normal faults.

The Quinn River Valley, which lies between these mountain ranges, is a north-trending structural trough which extends southward into Nevada. Lake Lahontan occupied the valley area during Pleistocene time (Russell, (1885), and reached a maximum elevation of 1,335 m (4,380 ft.). Shoreline features are prominent at and below this altitude. Quaternary alluvium now fills the central part of the valley.

Fine-grained tuffaceous sedimentary rocks are found along the margins of the Quinn River Valley. They represent floodplain or shallow lake deposits. Conglomerate layers are found in some places. These tertiary rocks, shown as "Tts" on Figure 10, also contain abundant middle to late Miocene mammalian fossils. In addition, the canyon walls near the northeasternmost part of the EAR area (near the forks of the Little Owyhee River) contain sparse vertebrate fossils of possible early Pliocene age. They occur in the sedimentary rocks (Tts) which disconformably overlie widespread rhyodacite flows (Ttr).

West of the valley, in the southwest corner of the EAR study area, is a Miocene collapse structure known as McDermitt caldera. It is oval shaped with a diameter of 45 km (28 miles) in a northerly direction and 35 km (22 miles) in an easterly direction. Only the northern part of this caldera is included in the EAR study area. The Tertiary volcanic rocks in the McDermitt area consist of early Miocene basalt and andesite flows as well as late Miocene rhyolite ash-flow tuffs associated with the McDermitt caldera (Rytuba, 1976).

Volcanic activity began in the early Miocene with the eruption of andesite and basalt flows from fissure vents. These flows rest unconformably on Cretaceous granitic rocks and range in age from 24 to 18 million years. About 18 million years ago, volcanic activity became dominantly felsic and explosive with the eruption of a large volume of ash-flow tuffs (Rytuba, 1976). These tuffs are exposed within the north and south rims of the caldera and consist of three cooling units. Each eruptive event was climaxed by the collapse of the magma-chamber roof.

An acurate fault zone located along the Trout Creek scarp was first recognized by Walker and Repenning (1965) as a portion of the caldera. The eastern caldera margin has been modified by Basin and Range faulting. Its projection extends along the western side of the Quinn River Valley (Fig. 10). The western margin of the caldera is defined by several coalescing rhyolite domes which were emplaced along a north-trending fault zone. Near the caldera margins, coarse conglomerate and talus deposits derived from the caldera walls (Tst) interfinger with the fine-grained lake sediments.

Geological Hazards - Several geologic hazards could adversely affect man's activities in the EAR study area. Of particular concern are landslides, earthquakes, and flash flooding. Probably the most serious of these natural events is landsliding. Landslides in the region appear to be associated with incompetent tuffaceous beds. The characteristic reverse rotation causes the development of hummocky topography, which locally has permitted the formation of small ponds. Tuffaceous sediments are shown on the geologic map as "Tts" and "Ttr". The hazard would, no doubt, be greatest in areas of steep topography. Thus, it is apparent that detailed geologic mapping should be undertaken to evaluate landslide potential wherever ground conditions are unknown.

Although situated between two states (California and Washington) that have had many violent earthquakes, Oregon is noticeably less active seismically. During the available historical reocrd (since 1841), 34 earth quakes of intensity V, Modified Mercalli Scale, or greater have had epicenters within Oregon or near its borders (Von Hake, 1976). Only 13 of these had an intensity above V. Figure 11 taken from the USGS Earthquake Information Bulletin, May-June 1976, is a plot of the historical earthquakes in Oregon of intensity V or greater. Although more detailed information is not available, the figure also shows that the EAR study area is in Zone 2 where "moderate damage can be expected."

It is important to remember that a portion of the EAR area of coverage is included in the Basin and Range Province, an active rift zone. Thus, the faults probably all have potential for movement, and appropriate measures should be taken in dealing with them. It is possible that many minor earthquakes have gone unnoticed because of the area's remoteness, low population, and lack of funding for studies or instrumentation.

The part of Oregon considered in this study typically has low annual precipitation. A good portion of it occurs, however, in short, but locally intense thunderstorms. Consequently, the drainage paths of even small, ephemeral streams should be avoided, where possible. This is essentially true, in narrow, so-called "hourglass" canyons.

Other possible geologic hazards are volcanism, and subsidence. These are common to most geothermal areas. Sufficient data are not available to realistically evaluate either of these hazards, although there are some mitigating measures for subsidence. Volcanism has not occurred in the area during historic times, and its likelihood of recurrence is sufficiently remote so as not to be a factor in considering the location of resource development facilities. It should be added that geothermal or oil and gas drilling will not affect volcanic activity.

Economic Geology - Aside from sand and gravel, the only significant mineral production in the EAR area has been mercury. However, there has been considerable interest in other resources, including geothermal energy and oil and gas. Interest in such resources as mercury and uranium has declined, but may increase in the future. The following narrative describes the current status of these resources.

1. Minerals

a. Sand and gravel - There are widespread occurrences of sand and gravel within the EAR area, especially the central portion. These are believed to be late Tertiary, Pleistocene and Recent stream and terrace gravels. Although widespread, the alluvial blanket is not continuous and is characterized by many small isolated deposits, especially in the terrace gravels. U.S. Highway 95, which extends north from McDermitt, has at least six areas that contain rock and gravel suitable for road construction and maintenance (Figure 2). These areas have been used in the past as gravel sources by the Oregon State Highway Department, Malheur County and the Jordan Valley Road Department. They should remain available for gravel extraction to satisfy traditional uses and for possible construction associated with geothermal or oil and gas resource development.

b. Cryptocrystalline quartz and petrified wood - The south western portion of the EAR area has a number of occurrences of petrified wood and such cryptocrystalline quartz varieties as chert, agate, thundereggs, etc. These materials are sought by many local and out-of-state collectors. There are a number of rock and mineral shops mostly within a 250-mile radius, that draw from these areas for their materials. However, the majority of collection is by recreationists. Their use would probably not be adversely affected by either geothermal or oil and gas activities. In the event of full-scale resource development, those areas closed for safety reasons may be replaced by new areas uncovered during construction.

c. Mercury - There are three claims for mercury mining northwest of McDermitt. There has been no known production of this element on these claims, and even though the geological setting is favorable, it is believed that the claims are speculation.

There are two producing mines in the EAR area, the Bretz and the Opalite. These mines have produced but little since the mid-40's, but they have a combined production of 22,143 flasks (1 flask = 76 lbs.) during the years 1927-41 (Yates, 1942). This should be compared to the U.S. production of 1,200 flasks during 1974 (Sisselman, 1974).

d. Potassium and sodium - Sodium resource developers have shown interest in lands lying to the north of McDermitt. However, no leases have been applied for and no production has been reported.

e. Construction materials - Cinders, riprap material and building stone are present in the area, but in unknown amounts.

2. Geothermal Resources

Large areas of Malheur County have been designated as valuable for geothermal resource development by the USGS. This designation is based primarily on the large areas of Pleistocene and Recent volcanic deposits, extinct volcanoes, and the numerous exposed and near-surface warm springs in the county. Such formations raises the hope that the magma source is large, still very hot, reasonably shallow, and overlain by suitable porous and water-saturated reservoir rock. As a result of these expectations, large areas of the county, including sizeable portions of the EAR area, are under non-competitive geothermal lease application.

3. Oil and Gas

There has been some oil and gas leasing activity in the area where several thousand acres are under application for leasing. Although the EAR area has been designated as valuable for oil and gas by the USGS there is no current drilling in the area. The most recent test well, situated in the Blue Mountains and drilled to a depth of 8,414 feet, proved to be unsuccessful (Figure 6, Table 1). Likewise, several wells which have been drilled in the northern part of Malheur County have been unsuccessful. To date, there is not a single producing well in all of Oregon.

4. Water

Surface water resources consist of numerous small streams, chiefly the Little Owyhee, which are intermittent along parts or all of their respective courses. There are no large lakes or reservoirs in the area; impoundments in the EAR area are characterized by small reservoirs, usually less than two acre-feet and are designed for livestock.

Scattered wells tapping ground water sources supplement surface water supplies. Eight wells in the area supply a total of approximately 105 gallons per minute (gpm) with a range of 5-40 gpm per well. One well dried up following completion.

More data pertaining to water supplies has been presented above under the heading: "Water".

LIVING OR BIOTIC ENVIRONMENT

The living - or biotic - environment consists of both plants and animals, and includes both wild and domesticated species of each. The human environment is also a component to be considered under this category.

Vegetation

The vegetation of the EAR area is considered to consist of two desert vegetative communities within the sagebrush formation: the sagebrush association and the shadscale formation (Oosting, 1948). These two plant communities are also known as the sagebrush steppe and the saltbrush-greasewood group (Küchler, 1964). The former association covers most of the EAR area but its exact limits are difficult to determine because of broad zones of intergradation with the latter in the northwestern and southern margins of the area.

The sagebrush association is characterized by such dominants as the big sagebrush, *Artemisia tridentata*, and bluebunch wheatgrass, *Agropyron spicatum*. Idaho fescue, *Festuca idahoensis*, are considered to be a codominant with *A. spicatum* on north slopes by many authorities, has been reduced to the role of a subdominant due to many years of overgrazing by livestock. Other components include *Artemisia arbuscula*, arrowleaf balsamroot, *Balsamorrhiza sagittata*; buckwheats, *Eriogonium spp.*; lupines, *Lupine spp.*; Indian ricegrass, *Oryzopsis hymenoides*; Sandberg's bluegrass, *Poa secunda*; phlox, *Phlox* spp.; squirreltail, *Sitanion hysterix*; and numerous other species. Higher elevations may be characterized by stands of curleyleaf mountain mahogany, *Cercocarpus ledifolius*.

The second community, the shadscale formation, is best developed in the EAR area along the southern and northwestern margins. Dominant species include shadscale, *Artiplex confertifolia* and greasewood, *Sarcobatus vermiculatus*. Other species include bud sagebrush, *Artemisia spinescens*; winterfat, *Eurotia lanata*; spiny hopsage, *Grayia spinosa*; bromes, *Bromus* spp.; Indian ricegrass; squirreltail; rabbitbrush, *Chrysothamnus* spp.; and horsebrush, *Tetradymia canescens*. The more mesic exposures support small populations of antelope bitterbrush, *Purshia tridentata*; curleyleaf mountain mahogany; and associated perennial bunchgrass species, especially Idaho fescue and bluebunch wheatgrass (Culver, 1964).

Isolated pockets of riparian, or streamside, vegetation which is naturally isolated or has been protected from livestock grazing by fencing or other measures is characterized by cattails, *Typha latifolia*; willows, *Salix* spp.; and poplars, *Populus* spp.; and numerous forms of sedges, herbs, shrubs, mosses and small numbers of algae.

The general topography of the EAR area provides a wide variety of small vegetative assemblages which differ qualitatively and quantitatively from those described above, chiefly among subdominant species. These variations may be due to differences of exposures to solar radiation, landslope, elevation, and the presence or absence of water. Generally, the more arid -or xeric - habitats often support spiny or thin leaved species which the more mesic areas are characterized by species of broader leaves and by greater species diversity.

Large expanses in the EAR area which are accessible to domestic livestock grazing have been subjected to considerable abusive vegetative utilization during the late 1800s and the early 1900s. This use reduced Idaho fescue to the role of a subdominant over most of the area and converted large portions of the bluebunch wheatgrass understory to one of less desirable annual grasses and forbs and increased big sagebrush in the shrub overstory. The more flammable annual species, especially cheatgrass, Bromus tectorum, facilitate frequent wildlifes to further alter the vegetative community toward sub-climax or seral vegetation. As a result of the Vale Range Rehabilitation Project which began in 1962, several large areas within the EAR areas have been subjected to land treatment and intensive management practices. Land treatment practices included plowing and seeding introduced grass or spraying with herbicide for brush eradication. These areas are depicted in Figure 12 and are summarized on Table 7 along with range improvement projects. Most seeded areas now consist chiefly of a crested wheatgrass, Agropyron cristatum, with varying amounts of bluebunch wheatgrass and Sandberg's bluegrass with scattered big sagebrush and rabbitbrush. Sagebrush in treated areas is not as dense as in untreated areas and the grasses are representative of untreated areas of good condition.

Other vegetation found throughout the area include mosses which are found on undisturbed litter under sagebrush and lichens which grow on exposed surfaces of most rock.

For additional information on the flora of the EAR area, especially the Owyhee Uplands, the reader is referred to Culver (1964).

There are currently seven species of rare, threatened and endangered plant species which may be within a close proximity of the EAR area. These include the following:

1. Allium robinsonii - known from Malheur County, found on widely disjunct sites.

2. Eriogonum ochrocephalum ssp. calcareum, a wild buckwheat - known for Baker, Lake and Malheur Counties; a regional endemic.

3. Lomatium minus, a desert parsley - known from the scablands of eastern Oregon, found on widely disjunct sites.

4. Pediocactus simpsonii var. robustior, a hedgehog cactus - found in the Wallowas and from Malheur and Harney Counties; rare or threatened in Oregon, status in other states unknown or more abundant.

5. Penstemon seorsus - known from Crook, Malheur, and Harney Counties; a regional endemic.

6. Polygonum heterosepalum, a knotweed - known from western Harney and eastern Malheur Counties; a regional endemic.

7. Rhysopterus plurijugus, a corkseed - known from Malheur and Harney Counties; a regional endemic.

Nos. 1, 3 and 7 are on the Smithsonian Institution Report.

Wildlife

The large area of southeastern Oregon encompassed by the EAR area has a large variety of wildlife habitat areas. Most significant are the uplands lying northwest of McDermitt, Nevada. This upland drains to the north into the Whitehorse Desert area and encompasses the Oregon Canyon Mountains and some of the foothills of the Trout Creek Mountains. Of principal importance in this area is the Alvord cutthroat trout, Salmo clarki alvordensis, which has been isolated from other subspecies for approximately 10,000 years following the disappearance of ancient Whitehorse Lake. This fish now occurs in Big Whitehorse Creek and its tributary streams: Little Whitehorse, Willow, Antelope and Twelve Mile Creeks. The latter two streams were stocked with trout from Big Whitehorse Creek during the 1970s (Figure 12).

Big game that utilize this environmentally sensitive area include mule deer, Odocoileus hemionus and pronghorn antelope, Antilocarpa americana. The area is one of the outstanding mule deer hunting areas of southeastern Oregon. Many of these deer winter in the foothill areas especially to the northeast in the Blue Mountain area. Upland game birds include sage grouse or sage hen, Centrocercus urophasianus; chukar partridge, Alectoris graeca; and California quail, Lophortyx californica. The area outlined on the wildlife habitat map (Figure 13) made a portion of this analysis record that is shown as environmentally sensitive area should not be leased for geothermal or oil and gas exploration purposes. The reason being that the high elevations and fragil nature of the wildlife habitat in the area could be easily disrupted by excessive human disturbance or disturbance of the vegetative cover.

Mule deer also occur throughout the EAR area in limited numbers. Principal concentrations occur in the rougher topography, especially the breaks of Battle Mountain, and the Rattlesnake and Louse Canyon areas. Pronghorn antelope summer range comprises a good portion of the high plateau area in the southeastern portion of the EAR area. This area also contains significant populations of sagehen.

The fisheries resource is limited to the previously mentioned Alvord trout area to McDermitt Creek along the Nevada border and to the headwaters of Louse Canyon and a number of livestock ponds which are annually stocked with rainbow trout by the Oregon Department of Fish and Wildlife. These areas are delineated on the wildlife habitat map.

The inventory of non-game wildlife species has recently been initiated. One significant species is the kit fox, Vulpes velox which has been recorded from the northwestern portion of the EAR area. This record represents the northernmost extension of the range for this species.

Bird life in the EAR area is abundant and vaired especially in the deep canyons which traverse the area and in areas of well-developed riparian vegetation. If importance are numerous forms of songbirds characteristic of the upland and riparian habitats and raptors inhabiting the numerous canyons.

The collared lizard, Crotaphytus collaris and the leopard lizard, C. wislizeni, known to occur in the EAR area, are on the endangered plant and animal list for Oregon. However, none of these forms are on either the state or federal list of threatened or endangered species at the present time.

If additional information about the wildlife of the EAR area is desired, incomplete checklists of mammals, birds, reptiles and amphibians may be obtained from the BLM District Office, Vale, Oregon.

Livestock

Grazing by domesitc cattle occurs throughout the EAR area. One community allotment and eight individual allotments (and a part of a ninth), and some Federal range fenced in with private range are within the area. Some limited sheep trailing use is also made in the assessment area. The recognized grazing seasons in the allotments generally extend from April 1 through November 15, however, grazing use on private rangeland and Federal range fenced in with it may occur any month of the year. Authorized grazing use on Federal lands is administered under Sec. 3 of the Taylor Grazing Act (43 U.S.C. 315, 315a, 315h, 315n). To facilitate management of licensed livestock and to improve range conditions, a large expenditure of public funds has been made for range improvements in the area. A large acreage of seeding, many miles of fence and numerous stock water developments have been constructed over the past 30 years. Table 7 summarizes the various types of range projects and Figure 12 shows the locations of treatment areas in the EAR area. A summary of the grazing allotments and authorized use is presented in Table 8. There are 879,423 acres in the allotments covering Federal lands and Federal lands fenced in along with private lands. These lands support 19 operations representing over 80 thousand Animal Unit Months (AUMs) of grazing use.

The range of a wild horse herd of 1,605 individuals extends into the western margin of the EAR area (personal communications, Jerry Wilcox, Vale BLM District Office).

Ecological Interrelationships

Hydrologic Cycle - The hydrologic cycle is depicted in Figures 14 and 15 for the entire environment and the grassland habitat. The sun supplies the heat energy and this, together with the force of gravity, keeps the water moving from the earth to the atmosphere as evaporation and transpiration, and from the atmosphere to the earth as condensation and precipitation. Stream flow and ground water movement complete the cycle. While there is no identifiable point of beginning or ending, the oceans are generally considered to be the major source, the atmosphere as the transportation vehicle and the land as the user. Within the total system water is neither lost nor gained but the amount available for use may fluctuate widely seasonally and geographically with supplies ranging from too much to too little. Water quality impacts resulting from man's use of lands, natural resources, and water supplies complicate problems of maintaining balance with mans needs within capabilities and limitations of this natural system.

Of the many factors which contribute to the physical environment of an ecosystem - the movement of water into, through, and eventually out of the system - is a major stimulus in the functioning of the system. This cycling of water in an ecosystem essentially consists of precipitation inputs, run-off inputs, and a series of intermediate processes influencing the magnitude of the precipitation/run-off relationship. These include interruption, infiltration, percolation, evapo-transpiration, surface run-off, and storage at various levels within the system. The hydrologic cycle may be combined into a conceptual model of watershed behavior as shown in Figure 14.

The ecosystem in which the geothermal interest area is included - the Cold Desert Ecosystem - is characterized by low percipitation input from year to year. Evapo-transpiration is great. The net result is that little soil moisture is available when the weather is warm enough for the vegetation to use the moisture effectively. This reduces the potential for production among all living components in the Cold Desert.

Energy Flow - Energy flows through the ecosystem, it does not cycle. The components of the energy flow consist generally of abiotic inputs, producers, consumers, and decomposers as shown in Figure 16. For example, grasses (producers) capture energy from the sun by photosynthesis and utilize soil nutrients, water, etc. to produce usable organic substances. Herbivorous and carnivorous animals (consumers) feed on plants and other animals to acquire energy. Bacteria, fungi, and some kinds of animals (decomposers) derive energy in the process of decomposition of dead organisms. Energy is continuously being utilized (used by each group of organisms or lost) and new energy is being acquired from solar radiation.

In the Cold Desert Ecosystem solar radiation is high, but due to other climatic factors such as limited precipitation and sparce vegetative cover, little solar energy is captured by the plants and used. Therefore, the production capacity of the desert is greatly reduced and the food chain shortened.

Nutrient Cycle - Certain elements such as nitrogen, oxygen, phosphorous and potassium are essential for the maintenance of life on the planet Earth. These elements, and many others as well, continuously circulate through the environment as components of various complex substances following fixed patterns or cycles and in the process are made available as nutrients to plants (producers) and to animals and man (consumers). For example, nitrogen is recycled from plants to the atmosphere and back in a complicated process whereby organic material is converted into inorganic ammonia, nitrites, and nitrate by successive armies of micro-organisms (decomposers). Nitrates, if not looped back through plants or stored in the soil, are denitrified, and the nitrogen is returned to the atmosphere as gas where it again becomes available to nitrogen fixing plants, thus, completing the cycle.

The nutrient cycle occurs slowly in the cold desert ecosystem as large quantities of nutrients are tied up in shrubby plants that have a slow rate of decomposition.

It is questionable whether the nutrient cycle is in balance on the lands within the boundaries of the EAR. Livestock grazing intensities vary on these lands from moderate to heavy. Steep topography and lack of water limit or occlude grazing altogether.

Livestock grazing accounts for a significant amount of the nutrients being removed from the area. Rodents also consume a significant amount of vegetation. Rodents, in turn, are preyed upon by coyotes and predaceous birds.

Coyotes are trapped in winter, primarily for their pelts. High fur prices have intensified this effort. They are also hunted for sport.

The predators do not remain within the boundaries of the area. The amount of nutrient loss resulting from rodent predation and the subsequent loss of predators is unknown. It is estimated that this loss is insignificant.

Succession - The stage of plant succession of the area has regressed considerably from where it was before the advent of white men in the region. Through historical uncontrolled grazing, most of the perennial grasses favored by cattle have been eliminated and less desirable grasses and brush have replaced them. Much of the area is capable of producing a much denser stand of perennial grass and forbs; however, natural upward successional trends are slow due to low rainfall, poor and immature soils and harvesting activities carried on by rodents and livestock.

In an attempt to improve range and watershed conditions, areas with deeper and more mature soils have been revegetated through seeding of crested wheatgrass, Agropyron cristatus, an introduced perennial grass. This has created a patchwork of artificially induced seral communities. In areas that supported an understory of native perennial grasses, sagebrush was sprayed with herbicides to reduce brush-grass composition of these communities and speed the increase of perennial grass cover in the treated areas. Figure 12 shows the location of these land treatment areas and Table 7 presents a tabulation of range improvement projects.

Effects of Development on Vegetation In general, most natural vegetation can be replaced slowly through natural succession, or more rapidly through seeding. Surface disturbances can and will alter or destroy fragile niches in the EAR area occupied by many plant species which are unique or rare to the area. Many vegetative associations support biological communities of value to the biologist for research and to the general public for aesthetic values.

HUMAN RESOURCES AND VALUES

There are few inhabitants on Federal or private lands on which the mineral estate belongs to the Federal government within the EAR area. There are a few scattered ranches along the northwestern and south-central margins of the area. The town of McDermitt (population 200) and the nearby Ft. McDermitt Indian Reservation are situated adjacent to the southern boundary of the EAR area.

Recreational Values

There are no developed campgrounds in the EAR area. One primitive campground with a single privy constructed on BLM land by a private individual, is located at Anderson Crossing on the Little Owyhee, was inventoried for recreational potential in 1971.

There are no formally designated recreational lands in the EAR area. However, the major portion of the area meets certain criteria established in 43 CFR 2071.1 as Class II: General Outdoor Recreation areas. About 159,000 acres along the Whitehorse Creek drainage in the Alvord Lake Basin qualify for a Class III: Natural Environmental Area designation. Approximately 8,000 acres in the Antelope Creek area (Owyhee River Basin) and another 8,000 acres of the Little Owyhee Canyon qualify for the Class V: Primitive Area designation. Approximately 180 acres at the head of Antelope Creek Canyon (in the Owyhee River Basin) which includes the Dirty Shame Rock Shelter archaeological site qualifies for the Class VI: Historic and Cultural Site category.

Fishing facilities in the EAR area are generally unaccessible and limited in sport fishing potential. There is no commercial fishing. McDermitt and Oregon Canyon Creeks have relatively stable stream flows and are naturally propagated. The South Fork of the Owyhee River has a high quality smallmouth bass, Micropterus dolomieui and trout, Salmo spp., habitat but is generally unaccessible to the public. Stock of rainbow trout S. gairdneri by the Oregon Department of Fish and Wildlife has been successful in a few reservoirs in the northeastern portion of the EAR area: Little Snake, Rattlesnake No. 2, and Echave. Many intermittent streams contain sport fish, usually trout, but these are found in deeper pools.

Whitehorse and Fish Creek in the western portion of the EAR are the localities of fish habitat preservation sites (Figure 12). These sites, established by the BLM and the Oregon Department of Fish and Wildlife are habitat for the Alvord cutthroat trout, a race of S. clarki. The preservation of this race, which has run isolated from other races of this species for approximately 10,000 years, is of concern to many conservation groups and individuals.

The most important game species in the EAR area include pronghorn antelope, mule deer, sage hen and chukar partridge. Antelope and sage hen populations are stable and habitats are relatively accessible, all of which contributes to an intensive sport hunting season. Deer populations are increasing paralleling a decline in hunting effort, especially in the lower elevations. Waterfowl hunting in the area is insignificant.

The South Fork of the Owyhee River, which forms a small segment of the EAR area boundary, supports an increasing float-boating recreational sport. In 1975, there were 125 user-days for this activity.

There are scattered areas of semi-precious gemstone deposits throughout the area. Thundereggs have been found along the Quinn River and are considered to be of high quality. Occasional pieces of petrified wood have been found, but there are no known concentrations.

Off-road vehicle (ORV) activity in the area is limited because of either dangerous, rocky terrain or flat, monotonous lands and a low population density in both the EAR area and in adjacent areas. The uplands in much of the southwestern portion of the area are suitable for snowmobile use since deep snow covers rocky surface areas in winter.

Eduational and Scientific Values

The remoteness of the area from any sizeable population center offers the scientific community an excellent opportunity to study the flora and fauna of large undisturbed areas of the sagebrush steppe and the salt-bush-greasewood group of the cold desert ecosystem. Intensive surveys may reveal new species of plants and animals as well as range extensions reflecting additions to the biota of Malheur County and to the State of Oregon.

Likewise, the remoteness of the area affords considerable opportunity for basic geological survey work and mineral exploration.

Cultural Values

Historical Background - Malheur County, now recognized as one of Oregon's leading agricultural counties, was first settled by miners and stockmen in the early 1860's. Following the discovery of gold and silver in the northern part of the county and in adjacent portions of western Idaho in 1863, two large stock ranches were established in the south central part of the county and two more along the northwestern border of the EAR area. "The Ruby", a cattle and horse ranch owned and operated by "Doc" Inship, was located in the upper valley of Jordan Creek and embraced approximately 3,000 acres. About the same time, a man named McWilliams located the "Sheep Ranch" containing about 11,000 acres in the central portion of the Jordan Creek Valley. In 1869, the Whitehorse Ranch was established east of the Alvord Lake bed. Much of the area lying north-west of the EAR area was once a part of the Hervey Miller ranch, once the largest such operation in the nation.

Four important trails of pioneer days either cross the EAR or nearby lands. Hill Beachy established the short-lived Idaho Stage Company around 1865 which extended from Silver City, Idaho through Jordan Valley and Rome, Oregon to Chico, California. A spur of this line extended from Rome to Ft. McDermitt. The Oregon Central Military Road Company was granted permission by the State of Oregon to construct a road from Eugene, Oregon east to the Idaho state line. The proposed route would parallel the Idaho Stage Company along much of Indian Creek. Construction, however, was never realized. The Boise-Winnemucca Stage and Telegraph Line and the wagon road between Silver City and Ft. McDermitt, established in the 1870's and 1880's respectively, passed through the EAR area.

Jordan Valley, lying to the northeast of the EAR area, was originally known as Baxterville (or Dog Town) and was first settled permanently in 1864 by miners who turned to ranching. The town grew into a commercial center in the 1880's serving ranchers, farmers and miners. In 1889, the first of the colorful Basques arrived from Spain and soon developed large cattle and sheep ranches. The failure of Jordan Valley to obtain the county seat in 1888 following the organization of Malheur County in 1887 coupled with the consolidation of many smaller ranching operations, mine closures, and its relative geographic isolation all contributed to a gradual decline in population during the last 50 years to the present level of about 185 people. Renewed mining interests, in nearby Idaho, small housing developments, and tourism may spur a population increase in the future.

McDermitt, Nevada, which has also been known as Camp McDermitt and Ft. McDermitt, is situated on the southern margin of the EAR area. The community was established in the 1860's as a military post to protect travelers, and later settlers, from Indian attacks. It later became the center for the Ft. McDermitt Indian Reservation which once covered much of the southern part of Malheur County, but which has since been reduced to 17,427 acres in Oregon and a small area in adjacent northern Humboldt County, Nevada. The community, with a current population of approximately 200, serves the nearby reservation and nearby ranches and mines.

Historical Sites - The routes of the pioneer trails described above are not well defined (Figure 17). However, the remains of two stone buildings which may have historical significance are located in the EAR area.

The extent and importance of prehistoric archaeological sites in the EAR area are unknown since no intensive professional inventory has been made. However, one site with Indian picture writing has been found west of Horse Hill and a second site near the Dirty Shame Rock Shelter on the Antelope Creek drainage of the Owyhee River watershed has been investigated by the University of Oregon.

Since numerous sites were located in inventories completed for the BLM Vale KGRA EAR and in the area south of the Cow Creek area, the latter by David Chance in 1968, there is good probability that additional sites will be found in the EAR area (Ruebelmann, 1975).

Social Background - An analysis of population trends in Malheur County indicates that there has been a shift from rural to urban living in the last 30 years. Ontario has realized a large increase in population while the remainder of the county as a whole has not. There has been a considerable emigration from the county, especially of the 24 to 44-year age group which is coupled with an annual influx of several thousand migrant farm laborers during the summer harvest season.

An analysis of the 1970 population of Malheur County indicates that it is predominately Caucasion, 22,110 out of a total of 23,169. Of this figure, approximately 10% claim Spanish as the mother tongue (U.S. Bureau of the Census 1971 b). Japanese-Americans, most of whom live in the northern half of the county, account for about 845 people. In addition, there are 112 American Indians and 102 Negroes.

Included in the population count for Caucasions is another ethnic group which has maintained its own separate identity within the local community, the Basques. The Basques, natives of the Pyrenees region of the Bay of Biscay in northern Spain and southern France, first came to eastern Oregon in 1889, settling primarily in the region between Ontario and the Steens Mountains to the southwest where sheep raising became the main industry. Many were eventually to acquire lands and large herds. A large number of Basque families established ranches along Jordan Creek and McDermitt Valley in the southern portion of Malheur County.

The Basque way of life is rapidly disappearing. Many of the younger generation do not speak the language well or not at all. Their life-styles and values have become more Americanized. Members of the younger generations no longer restrict themselves to the agricultural pursuits of their forebears, or limit social contacts to the Basque community (Kressman and Yturri, 1938). Remaining populations of Basques may be found in Jordan Valley, west along Jordan Creek, and south along U.S. Highway 95 to McDermitt.

The populations of Spanish-speaking people in Malheur County fluctuates with the seasonal demands for farm labor. However, there are over 2,500 permanent residents living in the county year-round, the majority of which reside in the northern half. Most are American citizens, but approximately 30 percent are Mexican citizens with permanent resident visas. Many of these people speak little or no English. They continue to live in a culturally segregated environment where the Spanish language is the main form of communication.

Programs designed to promote general acceptance of the Mexican-American population have not been established. There is no program to promote continued education for the large majority who have little or no knowledge of English. Children are often kept out of school during part of the year to work in the fields. There is no enforcement of school attendance laws or any direct interest on the part of the schools to determine and certify registration of school age children.

The small population of American Indians is centered near McDermitt at the Ft. McDermitt Reservation. Small groups of Indians are scattered throughout the remainder of the county. The Indians belong to the Uto-Aztecan (Northern Paiute) family of the Aztec-Tunoan Phylum of the Great Basin Culture Area (University of Oregon, 1976). There are two sub-groups in the EAR area: the Tagu-tika and the Gwi-nidi-ba.

Social and Economic Situation - Malheur County had an estimated population of approximately 24,700 people in 1974. Most of the population is concentrated along the valleys of the Snake, Malheur and lower Owyhee Rivers. The chief towns of Ontario, Nyssa and Vale (the county seat) are situated in the agricultural area and have respective estimated populations of 7,700; 2,735; and 1,705. Nearly 33 percent of the county's population lives in Ontario. The small community of Jordan Valley, with an estimated population of 185, lies to the north of the EAR area but has since grown to approximately 300 due to increased mining activities in nearby Idaho. The community of McDermitt, lying aong the southern margin of the EAR area, has a population of about 200 due to increased mining activities to the south in Nevada.

The county economy is largely dependent on agriculture with livestock being the largest single contributor to the economy. Other agricultural products include dairying, sugar beets, potatoes, onions, corn, hay, and alfalfa. The food processing plants at Ontario and Nyssa are heavily dependent upon local agriculture. Ontario is the major trade center in Malheur County and adjacent parts of Idaho while Winnemucca, Nevada serves as a trade center for the McDermitt area.

Agricultural activities in the McDermitt area include livestock raising and the production of hay and alfalfa. The hay is produced on irrigated land and is used for winter livestock feed.

According to the 1970 census, Malheur County was the third poorest in the state, but is now estimated to be the second poorest. Nearly 4,600 people or 20% of the total population are estimated to be living at or below the poverty level.

Nearly all of the housing in the county is owner occupied; rentals in all communities are very scarse.

The principle residential-commercial center in the area is McDermitt. Available services include service stations, restaurants, motels, grocery stores, general markets and a small dirt airstrip. A rock shop and a trucking operation are located here. In addition, there are churches and a school which offers instruction through the senior high level. U.S. Bureau of Indian Affairs facilities are located on the nearby Ft. McDermitt Indian Reservation. Gaming devices (slot machines, etc.) are located in some of the commercial establishments.

The principle residental area north of the EAR area is Jordan Valley. Available services include service stations, a garage, restaurant, grocery stores, motels, general markets, and a small dirt airstrip. A mineral exploration company has facilities here, and the BLM has a fire guard station west of town. Ambulance service to Caldwell is also located here. A grade school and a high school are situated in the community and a second grade school is located nearby in Pleasant Valley, Idaho. Two new areas near Jordan Valley are being subdivided for homesites - the first is located about two miles west of Jordan Valley in the Jordan Creek bottoms and the second is on Hooker Creek, five miles north of Jordan Valley.

Arock, located about 24 miles west of Jordan Valley and north of the EAR area, consists of a few residences, an elementary school, a church, and a post office.

A motel-restaurant-garage establishment is located at Burns Junction, the point of junction for US Highway 95 and State Highway 78 about 20 miles north of the EAR area. It is also the site for the proposed Burns Junction BLM Fireguard Station.

Commercial interchange is stronger between Jordan Valley and Caldwell, Idaho and between McDermitt and Winnemucca, Nevada than between these two communities and any location in Oregon.

Increased mining activities in the Jordan Valley and McDermitt areas may increase residential construction in these communities. Such construction may be either permanent type houses and/or trailer courts. Some of these developments may be company-owned.

For more detailed information on the sociological characteristics of southern Malheur County and adjacent areas, the reader is referred to Kressman and Yturri (1938) on Basque history in Oregon and to data compiled by the U.S. Department of Labor (1970), the Grant Morgan Association (1972), and the U.S. Bureau of the Census for 1970 (1971, 1972a and b). Hanly and Lucia (1974) wrote a colorful history of the area.

ATTITUDES AND EXPECTATIONS

Local Attitudes

Interviews were conducted in the Jordan Valley and McDermitt areas to obtain public opinion pertaining to the leasing of public lands for geothermal and oil and gas resource exploration and development in the southern portion of Malheur County, Oregon. Should either or both of these resources be present in quantities and under conditions to make development economically feasible, the small communities of McDermitt, Jordan Valley and Arock would be strongly impacted. The cities of Ontario, Nyssa and Vale in Oregon; Caldwell, Nampa and Boise in Idaho; and Winnemucca in Nevada would be impacted to a lesser degree.

The attitudes and expectations concerning geothermal and oil and gas resource exploration and development in northern Malheur County can be found in reports entitled *Proposed Geothermal Leasing Environmental Analysis Record, Bully Creek Geothermal Interest Area, Vale District, Oregon* (Feb. 9, 1976); and *Environmental Assessment Record for Proposed Oil & Gas Leasing in the Vale Area* (Feb. 1977). Both reports may be purchased from or examined at the BLM District Office, Vale, Oregon.

Jordan Valley - According to the people interviewed, the people of the Jordan Valley area are basically supportive of the status quo and are slow to accept change in their community. However, if change does occur and is for the betterment of the total community, it is more readily accepted. Recent changes that have occurred in the Jordan Valley area include the City of Jordan Valley sewer and water project; a renewal of gold and silver mining in the Silver City - DeLamar area of Idaho; the relocation and development of a new solid waste site for the City of Jordan Valley; the construction of the proposed PP&L 500-KV transmission line; and school unification. The City of Jordan Valley sewer and water project was favored and well received by the majority of the people, however, because of prolonged construction and contractor problems the project became controversial and unpopular with the people. According to those interviewed, the project will be accepted when the system becomes fully operational.

The opening of DeLamar Mine has started to cause a large influx of outside people into the City of Jordan Valley. The majority of the people feel the DeLamar Mining operation is well received while a minority is opposed to its development because it rocks the status quo of the community and will create a burden on the public school system. Most people in the minority are skeptical of the mine development because they have seen similar projects start and then die within two or three years. The Malheur County plan to relocate and develop a new solid waste site north of Jordan Valley was accepted by the majority of the people. People are supportive of any program which handles solid waste in a proper and orderly manner providing it is neither too costly nor a burden to the people who it serves. The Pacific Power & Light 500-KV transmission power line is not opposed by the people or any of those interviewed, they accept it as a necessary project.

One of the most unpopular issues in Jordan Valley is school unification. It is opposed by the majority of the people interviewed. It appears the people are happy with their present system and do not want a change. Those interviewed indicated that people throughout the Jordan Valley area enjoy the use of open space in Malheur County and value its availability for public use. People like open space to carry on their recreation activities and support Federal, county and city government programs which provide for open space. Quality of open space is more important than quantity of open space.

According to people interviewed, Jordan Valley citizens support strong local government and local control of planning decisions and economic development which affect the community. They are concerned about the effects that rapid growth in population and/or development might have on the quality of life in their community. They are not opposed to agricultural or light industry development but are quick to point out

out these industries are dependent on a community work force which they do not have at the present time.

People interviewed stated, outside people who move in the community are accepted slowly. It usually takes time for people to establish themselves. Local people oppose outsiders who push themselves into community affairs too fast. People who are already in business in Jordan Valley would oppose any new or outside business which would be competitive with their business.

McDermitt - The people of McDermitt are also basically supportive of the status quo but readily accept change in their community, especially when the change is necessary or is for the betterment of the entire community. Recent changes that have occurred in the McDermitt area include the expansion of mining activity at the McDermitt Mine; installation of settling ponds in the sanitation system; improvement of the solid waste disposal site; the construction of new housing, primarily for mine personnel, south of McDermitt; and upgrading educational facilities and programs. All of these projects were well received and were given strong support of all groups.

The people of McDermitt enjoy the use of open space in Malheur and Humboldt Counties, and value its availability for public use. Open space is valued for recreational activities and Federal, State, County, and City programs which provide recreational facilities in open space receive support. The quality of open space is considered to be more important than quantity.

McDermitt citizens are concerned about the effects that rapid growth in populations and/or development might have on the quality of life in their community and therefore support local (county) government and local control of planning decisions and economic development which may affect the community. They are not opposed to increased agricultural activities or light industries, including mining, but they indicate that these activities are dependent upon a work force which they do not have.

People coming into McDermitt from the outside are generally accepted if they do not push themselves into community affairs too rapidly. Some merchants fear new competition because it may reduce their earnings.

Northern Malheur County - The general attitudes and expectations of northern Malheur County towards population growth and development and the associated problems are described in the Bully Creek and Vale area reports, cited above.

Public Attitudes Towards the BLM

According to people interviewed, public attitudes and expectations of BLM management and activities in the Vale District are very positive. The people of both Jordan Valley and McDermitt like having BLM facilities in their communities which represent a business that does not take resources from the communities but adds to the communities. All of the people interviewed in both areas support the Vale District BLM in its implementation of the multiple use concept. The general public, with some exceptions, supports BLM management in Oregon while support from Nevada residents is smewhat negative towards BLM management in that state.

There has been a change in public attitude in Oregon following the Vale Project in the 1960's. At that time, public attitudes toward BLM were considered to be negative, but the success of the Vale Project has apparently had a significant positive affect on public opinion.

A large number of persons interviewed favored the leasing of Public Lands in the EAR area for geothermal and oil and gas exploration and resource developments. Some people did not want to see a large amount of surface disturbance or a ban on grazing or other traditional land uses in the leased areas. Several people are aware of the uniqueness of the Alvord cutthroat trout, a race of *Salmo clarki*, and are not opposed to leasing and resource exploration and development in the western portion of the EAR area as long as the quality of the habitat of this fish is not reduced in any way. Those who favored leasing of Federal mineral interests were concerned about protection of existing agricultural lands, just compensation to the private surface owner, and proper reclamation of disturbed surfaces. However, those who opposed leasing the government mineral interests were opposed more for personal reasons rather than concern for protection of the land or environment. Nuisance values tend to play an important part in their opposition to leasing.

Public Attitudes and Expectations of Proposed Geothermal and Oil and Gas Exploration and Resource Development

From the information gathered in interviews for this EAR and for EAR preparation for other parts of Malheur County, both local governments and the general public are supportive of geothermal and oil and gas exploration and resource development. People generally believe that directly or indirectly their communities would benefit from geothermal or oil and gas resource development activities. There is some concern, however, as to the effects of large scale development on such community facilities as schools, water and sanitation systems, and medical services, especially in sparcely populated areas. There is also some apprehension about a "boom and bust" situation being created as similar situations have occurred in Idaho and Nevada in prior years in the mining industry.

It is believed that the general public is not technically knowledgeable in geothermal resource exploration and development and is not aware of the problems associated with geothermal steam. However, the slow pace of geothermal development on both private and Federal lands in relation to public expectations has led to a very low level of interest at the present time. Local residents tend to compare geothermal development to their experiences with oil and gas development in the area. In these instances, there has been drilling and some show of oil and gas since the early 1900's but nothing of economic significance to date (Figure 6, Table 1).

Many people believe that the integrity of scientifically and historically valuable areas and scenic areas, such as deep canyons, must be maintained in their present conditions.

LOCAL REGULATORY STRUCTURES

Local regulatory structures pertaining to the Ontario-Vale-Nyssa area of Malheur County can be found in the BLM Vale District Office in a report entitled *Environmental Analysis Record, Proposed Geothermal Leasing Vale Addition*, dated July 1975. The following narrative describes regulatory structures which pertain primarily to southern Malheur County and adjacent areas.

Southern Malheur County, Oregon

Acceptability of Land Use Planning - The following information was obtained from interviews with people in the Jordan Valley community. Data for the comments from Nyssa, Ontario and Vale may be found in the above cited EAR on the Vale Addition.

1. City Planning - The City of Jordan Valley has recently recognized that city planning is necessary. They are presently in the process of establishing and organizing a city planning commission. Because of the large influx of people moving into the community as a result of the opening of the DeLamar mine, it has forced them to recognize the need for some type of zoning and planning to have orderly growth.

   According to the people interviewed, the citizens of the City of Jordan Valley tend to look on the negative side of land use planning as a necessary nuisance but a favorable balance is beginning to emerge in the community. Those interviewed indicated they will have to rely heavily on Malheur County Planning staff for assistance in classification and describing of planning zones, permitted and conditional uses. There will be strong emphasis on local control of any land use planning and decisions.

2. County Planning - Land use planning in Malheur County is about seven years old. In general, people of Malheur County were skeptical of land use planning. They were afraid the designation assigned to their land would be different from what they wanted to use the land for. A minority of the people in the county do not see the need for land use planning and resent outside people coming into the area to tell them how to use the land. The county government tends to look upon land use planning as a nuisance. The Oregon legislature forced all counties within the state to develop land use plans. Malheur County was one of several counties in the state in which a deadline was set to develop land use plans or the state would do the planning for them. People in general favor county planning providing it is not too restrictive. The people are recognizing it is necessary and are accepting it.

Present Comprehensive Land Use Plans, Zoning Ordinances, Geothermal Ordinances and Building Codes — The following narrative describes land use plans, zoning ordinances, geothermal ordinances and building codes in force in Malheur County.

1. Comprehensive Land Use Plans - Malheur County Court adopted the Comprehensive Land Use Plan for Malheur County on December 12, 1972 (Commissioner Journal, Book R. p-479). However, the Comprehensive Land Use Plan was not actually accepted until August 15, 1973, because of an oversight in the recording of the minutes of December 12, 1972, Court's action. The Comprehensive Land Use Plan has been reviewed and accepted by the State of Oregon but is subject to further review and modification by the state to meet State or Oregon objectives. For further reference, refer to Appendix C.

2. Zoning Ordinances - On approximately June, 1973, Malheur County developed a County Zoning Ordinance which was filed on record August 17, 1973 in the public records (Micro Film Inst. 148901). The Zoning Ordinance still has to be reviewed and accpeted by the State or Oregon.

   Private lands in the EAR area fall into two zones of the County Zoning Ordinance - Exclusive Farm Use (F-1) and Rural Service Center Zoned (C-2). The latter represents a small area in the McDermitt area. Refer to Appendix D for zoning ordinances location.

   Under Exclusive Farm Use (F-1), conditional uses are permitted for mineral exploration, mining and processing. Concerning conditional uses, page 9 of Malheur County Zoning Ordinance reads as follows: "Operations conducted for exploration, mining and processing of geothermal resources as defined by subsections (4) of ORS 522-010, aggregate and other mineral resources as other subsurface resources." Therefore, geothermal exploration and development is permitted under conditional uses with the approval of the Malheur County Planner and District Attorney, any company wishing to conduct geothermal or mining exploration and development on private lands must submit their plans to the Malheur Planning Commission for approval.

Rural Service Center Zone (C-2) is designed recognizing the present existence of and to provide areas for farm centers which primarily exist to provide limited convenience goods and commercial services to residents of the surrounding rural areas. It also allows the Planning Commission to attach special conditions to certain uses, as delineated in Section 3.064 of this Ordinance, that have a potentially detrimental effect on neighboring lands.

For a detailed description of permitted and conditional uses permitted in the two zones described above, see Malheur County Zoning Ordinance: Exclusive Farm Use (F-1) P. 8-11, and Rural Service Center Zone (C-2), P. 23-25.

3. Geothermal Ordinances - Around April, 1973 Malheur County pioneered and developed Oregon's first county preliminary geothermal ordinance. On June 19, 1974 Malheur County Court adopted the Geothermal Ordinance and it was filed on record June 30, 1974 in the public records (Micro File Inst. No. 158761 - See Appendix E). The ordinance provides for issuance of permits, collection of fees, and provides penalties for violation.

4. Oil and Gas Ordinances - There are no oil and gas resource development ordinances for Malheur County. The provisions for exploration and development of "aggregate and other mineral resources as other subsurface resources" is described above for farm use lands (F-1). Plans for oil and gas resource exploration and development must be approved by the Malheur County Planning Commission for approval and bonded by the State of Oregon. There is no provision for posting a county bond.

5. Building Codes - The State of Oregon legislature passed and adopted a uniform building code act (Senate Bill 73 - Chapter 834, Oregon Law 1973) which became effective on January 1, 1974. The Act stated that all cities and counties within the State of Oregon must conform to the State building code by July 1, 1974. The Act requires all counties and cities to use a building permit system. Permits will be acquired from the county and city governments. Either the State or the County will furnish inspectors. The State Uniform Building Codes referred to are as follows: State of Oregon Structural, Mechanical, Electrical, Plumbing Specialty Codes and Fire and Life Safety Code, - effective on July 1, 1974.

Type Adequacy, Structure and Enforcement of Local Governmental Entities - There are two different schools of opinion relative to the type and adequacy of planning staff, type of governmental entities regarding the making of land use plans and planning decisions, implementing plans, and the willingness and capability to enforce the land use plans and zoning ordinances: there are those who hold to the traditional type of county and city government and believe the present governmental bodies are performing adequately and see no need for a change. On the other hand, there are those who feel a change is needed in the present local governmental structure because certain segments of the people of Malheur County are not represented and/or the local government could perform more efficiently and effectively with a different type of government structure.

They feel the county has the information available but tends not to follow through on enforcement, or, only make a token effort. Others feel the county is willing and capable of enforcing land use plans and zoning ordinances but fail to disqualify themselves in conflict of interest decisions. A minority group feels the county is doing an adequate job of enforcing the county land use plans and zoning ordinances.

As mentioned, the Malheur County Planner recognizes the enforcement of land use plans and the zoning ordinance is inadequate because of the lack of available manpower and funds.

City Government Analysis - The only Oregon community of any importance near the EAR area is Jordan Valley. The cities of Nyssa, Ontario and Vale lie about 65 miles to the north.

Jordan Valley - Jordan Valley has a mayor and a city council type of government. As previously stated, Jordan Valley is presently in the process of organizing a city planning commission. An evaluation of adequacy, structure and enforcement of the city land use planning system would be premature at this time. It would take several years to fully develop, implement and enforce land use plans and zoning ordinances.

McDermitt - The McDermitt community is unincorporated, and as such, is governed by Humboldt County Commissioners. However, such facilities as fire protection, sanitary facilities, schools, television, water supplies and police protection are locally controlled. Some of these services are partially supported by Malheur County or the State of Oregon.

In addition, a Deputy from Malheur County is quartered at McDermitt and the U.S. Bureau of Indian Affairs maintains police protection at Ft. McDermitt Reservations.

Other cities in Malheur County - The adequacy, structure, and enforcement relative to land use planning in the cities of Nyssa, Ontario and Vale, if desired, can be found in the BLM Vale District Office in an Environmental Analysis Record, Proposed Geothermal Leasing Vale Addition, July, 1975.

Need for Additional Ordinances and Land Use Planning - The majority of the people in the populated area of the county as well as the remote rural area such as Jordan Valley interviewed felt the county should definitely develop ordinances for geothermal exploration and development, or at least develop an ordinance on a limited scale to get a feel for the problems. However, a minority felt no ordinances should be developed.

Those people who are knowledgeable and involved in land use planning and development of ordinances felt very definite about developing geothermal ordinances while those who where not knowledgeable were opposed to any more ordinances.

The peoples concern spurred Malheur County's Planning Department to initiate and develop Oregon's first County Geothermal Ordinance. The Geothermal Ordinance was adopted by the Malheur County Court on June 19, 1974 (see Appendix E).

According to the Malheur County Planner and District Attorney, geothermal development is included in the present Malheur County zoning ordinance. Geothermal exploration and development is permitted under conditional uses with the approval of the Malheur County Planning Commission. Therefore, any company wishing to conduct geothermal or mining exploration and development on private lands must submit their plans to the Malheur Planning Commission for approval.

Land Use Planning, Humboldt County, Nevada

There was no planning in Humboldt County prior to 1963. In 1963, the county zones Union Township, which includes the land around Winnemucca, into different land use zones. The remainder of the land in Humboldt County, including McDermitt, was placed in the Open Use Zone (M-3). The Open Use Zone permits all uses except wrecking yards, material sites and dumps. These types of uses must be brought before the Planning Commission for action.

A General Comprehensive Land Use Plan is being developed for Humboldt County. Planning Ordinances will be developed and acted upon at the same time as the General Comprehensive Land Use Plan. The State of Nevada had set a date of July 1975 for completion of the County Comprehensive Land Use Zoning Plan. This date has not been enforced when counties have been active in developing such a plan.

III. ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVES

GEOTHERMAL RESOURCE EXPLORATION AND DEVELOPMENT

ANTICIPATED IMPACTS

General

The initial development of the geothermal resource is a step by step development with each succeeding step dependent upon successful indications in the previous step. Normally, however, field exploration, test drilling, and production testing, occur at the same time. During these stages, approximately 30 to 100 men will be required, if successful indications are received, for a period of up to a year. At this time if the field has proven successful, field development will commence. This stage may last from three to five years. During the field development and power plant con struction stages, employment may reach 150 to 250 people. One power plant for every two years is an estimated rate of construction based on 15 years of experience in The Geysers field of California. However, again using the California experience, the rate of construction within the last few years has been much slower because of problems in obtaining local and state permits as well as a host of other delays. Oregon does not seem to be greatly simplifying the permit process at present. The degree of complexity and the delay attached to such plant siting permits from the state are beyond the control of the Federal government. Likewise, a discussion of these permits is beyond the scope of this report except to point out that the rate of state and local permit issuance may well be the determining factor in the rate of any plant construction.

Most of the men employed will be temporary construction and drilling workers. If the geothermal resource proves to be large and over an extensive area, all steps in the development process may occur simultaneously over an extended period of time.

There is an estimated five year time lag between the issuance of a lease and the production of the first electric energy.

After maximum development has been attained and electric energy is produced on a regular basis, five people per 100 megawatts are normally required for operation and maintenance of the generating facilities.

Five people per 100 megawatts are also normally required for operation and maintenance of the steam field and pipelines. As wells tend to play out, new wells will be required. Approximately twenty permanent people will be required for this work.

Two hundred families moving into the area will cause an impact on the economic and social aspect of the area. Even the 30 people required for operation and maintenance will have considerable impact upon the communities of McDermitt, Arock and Jordan Valley.

The economic impact will be two-fold. With the influx of workers, a burden will be placed on the community for services and goods. The retail establishments will again feel a pinch when the workers leave.

Geothermal development requires substantial investment in drilling wells and construction of roads, pipelines, power plants, and transmission lines. All the investments result in an increased tax base for the area of development.

The drilling of wells with associated sounds from power sources such as large engines of drilling rigs running continuously, construction equipment, unloading and racking of drilling pipe, venting of compressed air and cuttings (noise and dust) during dry drilling phases, and venting of steam from wells after completion, are principal sources of noise. Excessive noise and dust levels can pose health and safety hazards to residents and visitors to the area. These excessive noises and dust particles could become annoyances to people at night as well as the daytime and could affect their attitudes and expectations of their community.

Exploration and Test Drilling

Exploratory operations may involve both airborne explorations, which do not require physical presence on the ground, or surface exploration. Surface exploration includes both casual use, which generally does not result in significant disturbance of the environment and intensive use which may result in serious disturbance of the environment to varying degrees. Intensive use can involve actions such as construction of temporary access roads or trails, clearing of vegetative cover for an exploration site, movement of heavy equipment and vehicles cross country, etc.

The soils within the EAR area are susceptible to wind erosion. As vegetative cover is destroyed or removed, airborne dust particles will increase and air quality decrease in direct ratio to loss of protective vegetation.

Road construction not only destroys vegetation but can block natural drainages unless culverts and other structures are provided.

Such impoundments gradually fill with sediments and overflow water, if in sufficient quantities, can erode the road surface; culverts, if not in sufficient size or number, can reduce the capacity of the natural channel increasing stream flow velocity, sediment loads and downstream scouring action.

Increased human activity on the land within the area increases the potential for accidental fires. The soils of the area are very susceptible to both wind and water erosion. Loss of vegetation destroyed by fire will increase soil loss.

Shallow test drilling could contaminate ground water acquifers. Construction of access roads and trails, movement of heavy equipment and vehicles across country, leveling and clearing of drill pads, and drilling will adversely affect the local landscape characterisitcs. Exploration will have a light impact on the native fauna and livestock. The impact will vary by species due to various tolerance levels of human activity. Mule deer, antelope and livestock use of the area will likely shift to adjacent areas or different parts of the pasture where human disturbance is less or absent. The several raptorial bird species may also frequent the area to a lesser extent. Vegetative disturbance and habitat disruption will be limited to actual sites of intensive exploration or road construction. The impact of this disturbance will be minimal to the local fauna and domestic livestock.

Recreational use of the Federal land will be impaired somewhat. With increased human activity chukar hunting will probably be somewhat restricted. Most of the other recreation, motorcycling, hunting small non-game mammals or predatory animals, horseback riding, and hiking will not be affected.

The environmental impacts from test drilling will be effected by the size and type of drilling equipment. Use of large drilling rigs will require road construction and or drilling pads. Removal of vegetation from two to three acres per site may result. These sites will have to be considered heavily impacted in regards to the general landscape due to the leveling of the land, pit digging and intrusion of the equipment. The road construction and actual drilling will constribute only a moderate impact to the environment considering the present landscape, i.e., existing roads and powerlines and towers. However, the cuts and fills, grading and dust will make a visual impact. Improper abandonment of field camps could contribute to degradation of the environment by trash, drilling wastes and unrestored surface disturbances. The possibility of blowouts appears somewhat greater in the test drilling stage than in the following stages. In New Zealand a large crater was formed after a blowout occurred. However, due to the heterogeneous character of the present landscape - rolling sageland and steep sided buttes, the creation of a crater would only moderately alter the overall landscape form.

Operation of gasoline powered motor vehicles used to move men and supplies and diesel powered trucks, drill rigs and construction equipment necessary for test drilling and subsequent development phases can contribute pollutants to the atmosphere. The quantity of pollutants from internal combustion engines is expected to be small in comparison to pollution from present vehicular movements over existing local roads, but vehicular movement related to geothermal activity will result in some increase in the pollution load to the local atmosphere.

Particulate matter, in quantities greater than natural windblown dust or dust generated by present vehicular movement over untreated local roads, will be added to the atmosphere as a result of geothermal related vehicular movement on untreated or unsurfaced roads and from earthmoving activity during construction of drill pads and related construction projects. Construction activity will also create temporary vegetation free sites, which will be subject to a greater degree of wind erosion than natural and undisturbed ground. Dust generated as a result of geothermal related activity will contribute to the degradation of air quality in the vicinity of the geothermal development. Quantitative measurement of the potential increase in particulates, as a result of geothermal activity have not been documented, but no serious impacts are anticipated. In addition to possible degradation of air quality, the settling of particulates on surrounding plant life may have some influence on their growth and survival.

The potential adverse environmental effects of accidental release of geothermal fluids include waste of the resource, noise nuisance, air contamination from gaseous emissions, pollution of surface and ground water resources and hazard to health and safety (bodily injury to workers, both at the initial event, which may be sudden and violent, and in subsequent control attempts).

Activities relating to test drilling increase the potential for increased sediment loads and dissolved solids in streamflow. Solid waste and bacterial pollution potential increases with increased human activities.

The consumption of such affluents as brine by livestock and cattle from standing ponds or contaminated streams can result in illness or death. Mud sumps may become lethal traps for animals that get stuck.

The impact of the test drilling operations may affect wildlife and domestic livestock at the actual site of the drilling operation. Road construction to enable the movement of heavy equipment to these sites will have a moderate impact on the habitat of the native fauna and welfare of the livestock.

The disturbance caused by man's activities and machinery operation will cause some species of animals - such as mule deer, pronghorn antelope, and certain raptorial birds - to vacate the vicinity. Most of the other animal species which inhabit the area have rather high tolerance levels of human disturbance. Livestock will move to other areas within the fenced pastures to avoid any disturbance.

Field Development

The development of a large field would continue for a period of several years as new wells and additional power generating units are developed. Since most environmental impacts are cumulative, such as water and air pollution, proper care must be exercised at each step.

The noise level for any geothermal lease area can be expected to increase as a result of the various phases of geothermal activity. Movement of trucks and other vehicles, drilling of wells, venting of steam and other associated sound sources all tend to raise the background noise level.

Production testing requires venting of the well to the atmosphere over a period of time. Venting is accompanied by vapor release and noise.

Non-condensable gases, such as carbon dioxide, methane, hydrogen, nitrogen, argon, carbon monoxide, hydrogen sulfide, radon, ammonia and vapors such as boric acid and mercury are often associated in varying amounts, with steam from geothermal sources. These gases and vapors make up less than 3 percent of the total steam fraction.

Although present in small percentages, some of the non-condensable gases and vapors may pose possible pollution and health hazards. Bleeding and venting of steam wells will introduce these gases and vapors into the atmosphere during and after the production testing phase. Of these gases, hydrogen sulfide ranks number one as the most prominent potential environmental hazard. In addition to being toxic, H_2S has a nuisance odor of rotten eggs and is detectable in concentrations as small as .025 ppm. During periods of air stagnation and air inversion conditions, H_2S could accumulate locally from a geothermal operation to a high nuisance level, and perhaps a mildly toxic level. Other gases and vapors could increase to toxic levels from geothermal operations.

Noise, gases and activities associated with production testing will reduce the suitability of the area for use by other resources. Production testing will conflict with use of the land by wildlife, livestock and recreation, at least temporarily.

Open burning of trash and wastes, including brush from land clearing operations, on geothermal leases will contribute pollutants and particulate matter to the atmosphere with resultant degradation of local air quality. Accidental brush fires will contribute to air pollution and may endanger wildlife, structures, and human life.

An additional health and safety hazard is introduced during field development. Asbestos, alone and in combination with fiberglass, is used as an insulating material around pipelines, as sheathing on cooling towers, and for various other uses during and after this phase of development. If concentrations of airborne asbestos fibers accumulated in enclosed fabricating or storage areas, the fibers could be inhaled by workers during fabrication, storage, or field installation, posing a health hazard. Asbestos is believed to be a causative agent for certain types of cancers.

As the development proceeds through test drilling and production testing, physical land modification and disturbance increases. The direct consequence of this is greater landscape deformation and greatly increased potential for wind and water erosion.

The impact on water supply during the field development phase will be similar to that from earlier activities. The potential of local water pollution by blowouts, spillages and leaks will be greater.

During the field development phase, the possibility of water pollution or possible blowouts, due to failure of casings and/or cement jobs, exists at wells that have been completed and then shut-in before finally being connected to a power plant. It is also possible during this period for a casing leak or poor cementing job to go undetected allowing steam and brine to migrate into shallow aquifers.

All species of fauna, including livestock in the area will be highly impacted during the field development stage. Habitat destruction will be complete at the specific sites of development. Disturbance from high intensity human activity will also impact the animals utilizing habitat near the sites of intensive development.

By this stage of implementation, it is felt that all but the most tolerant animal species will have been driven from the developed area. Those animals which are tolerant to human presence and activity make up approximately 35% of the fauna (excluding the insects) and by far the more populace species, e.g., the numerous species of rodents.

If field development operations are carried on during the normal grazing season, the impact on livestock in the area will be high. The livestock may crowd fences trying to vacate the area.

Nearly all of the recreational use will disappear during this and the following stage. The ORV use in the area will be displaced and concentrated elsewhere.

With the substantial increase of people and families during this stage, the demand for housing and trailer rental space, contractor services and on commercial business will be significantly increased. School enrollment will increase and the pressures on city and county government will be considerable.

Much of the work requires semi-skilled labor. As has already been demonstrated in the farm labor market, the local labor force is not adequate to meet seasonal needs; therefore, laborers will have to be imported from outside the area. Many people in the labor market may not be readily accepted by the local community. The introduction of a labor force composed of people from different backgrounds, sub-culture or lifestyles, may cause some tension.

The only known mineral values are the gravels and mercury throughout the area. Gravels are very plentiful in the area and the loss of this land to gravel production would be of little significance. Oil and gas reserves could possibly be discovered and developed in conjunction with the geothermal resources. Geothermal exploration may in fact complement oil and gas exploration.

The existence of mining claims could possibly be a legal obstacle which would have to be overcome to develop the field but this is not considered likely.

Powerplant & Powerline Construction

The venting of steam to the atmosphere can create an adverse environmental impact as described above.

The clearing and grading of the powerplant sites, construction of access roads or trails, installation of steam pipelines and powerplant construction will result in vegetative and surface disturbance. Soil disturbance and movement, disposal of vegetation and construction wastes, handling of materials, equipment and supplies, etc., will result in temporary environmental impacts such as noise, dust, surface run-off, siltation, smoke, etc. Similarly, powerline construction may involve clearing of rights-of-way, construction of temporary and permanent access routes, erection of towers and lines, etc. Potential environmental impacts involve factors such as soil movement, erosion and siltation, dust disposal of vegetative waste, etc. Where powerlines involve relatively steep slopes, the potential of environmental damage is increased.

Conflicts with recreational uses will occur because of reduced accessability or elimination of area availability due to safety problems.

Greatly increased sediment loads could result from construction activities. Not only would water quality decrease even further, but road and improvement damages due to flooding could also occur.

Construction of generation and power transmission facilities will result in the alteration of the aesthetic qualities of the area by changing the land use to an industrial development. Landscape changes will result from the removal of vegetation, from soil disturbance to accommodate roads, buildings, steam wells, pipelines and transmission lines and from the man-made structures placed upon the site. The impact will not only occur at the site but also on linear corridors occupied by power transmission lines and along steam pipelines that will lace the terrain by radiating out from the power plants.

Noise and increased human activities will result in loss of wildlife values, including both habitat and recreational use. The construction stage will likely be the period of maximum disruption to the fauna and the associated habitat of the EAR area. All but some of the most tolerant animals will probably have left the area during this time. Several of the rodents, a few of the most tolerant birds, and the majority of the insects, will likely remain within the area.

If construction operations are carried on during the normal grazing season, the disturbance will have a high impact on livestock in the area. Stock may have to be removed from the immediate area.

The size work force required during this stage will be approximately the same as the previous stage. Therefore, any stress on the community that occurred during the previous stage will likely remain the same.

There will be an impact on governmental services such as garbage pickup, new houses being built in accordance to zoning ordinances to accommodate people, health services, improvement of roads and bridges, etc. The movement of heavy construction equipment and generators, construction supplies and materials, and travel of construction workers will put a burden on the state and county roads and bridges in the county area, especially in the Jordan Valley area. If housing becomes a serious problem, workers may have to resort to living in temporary quarters or commute to the EAR area from as far away as the Jordan Valley (Oregon) or the Winnemucca (Nevada) areas, adding an additional burden to existing highways. Accident rates can be expected to increase on these roads as light vehicles and truck traffic increase. This will increase the burden on state and county law enforcement agencies.

Operations

During normal operating procedures, non-condensable gases are vented to the atmosphere during power generation from gas ejector vents on the condensers and from the cooling towers. Release of such gases can effect air quality in the vicinity of the power plant and, if noxious gases are present in sufficient concentrations, may create a health hazard to employees at the plant.

Any accidental discharge of steam, due to the rupture of pipelines or a well blow-out, will yield gases and vapors to the atmosphere.

If a gas extraction process is installed at powerplants, concentrated gases and vapors, if accidentally discharged, can increase the concentration of pollutants to the atmosphere.

Erosion from roads and the construction activities, if not properly conducted, can result in added siltation of aquatic habitat within the area of project influence. The siltation will be most severe during construction phases, although some might extend into the operational stages.

If sump ponds or other impoundments are required during development, or operation phases, the possibility of embankment failure exists. If retaining walls should rupture, soil erosion and contamination will result. Water quality may also be impacted through the addition of toxic chemicals as well as increased sediment loads to the Owyhee River and other drainages. Removal of large quantities of subsurface fluids can result in subsidence.

If deep injection wells are used, possible contamination of ground water aquifers can occur. Extensive experience in fluid injection in the petroleum industry indicates this will not be a problem.

If corrosive fluids are produced by the wells, the equipment for handling such fluids, or inside surfaces of such equipment, must be made of suitable corrosion-resistant materials. This would be normal design practice to assure reasonable life for the equipment; it also is necessary to prevent leaks and spills which can result in contamination of surface waters.

There is a broad range of potential adverse and beneficial effects on water resources which may result from full-scale operations. Environmentally significant alternations can occur in the ground water and surface hydrologic regimes and in the availability of water suitable for human, agricultural and industrial needs as a result of injection or waste disposal operations. Such impacts could be felt both on the immediate leasehold and adjacent lands as well as over a much larger area. For example, a decrease in stream flow through water withdrawal for geothermal activities could adversely affect a drainage basin for a distance of many miles downstream or even an entire drainage basin. Conversely, the use of electric power from a geothermal field for a desalination water project or the by-production of fresh water may beneficially serve a community in an outlying region or in the area adjacent to the geothermal operation.

The ground water regime in the general area of a geothermal field may be altered if appropriate protection and control procedures are not employed. Fresh-water aquifers are situated above geothermal reservoirs. If the geothermal reservoir contains hot mineralized or saline water, tapping the geothermal strata can result in contamination of the fresh water aquifer if one horizon is not kept isolated from the other by properly cementing the casing of either production or re-injection wells. Beginning with the early stages of a project, suitable data must be accumulated and thoroughly analyzed, to determine what steps must be taken to prevent or minimize alteration of the local ground-water regime.

Experience in petroleum production indicates that marked changes in reservoir pressure, whether due to pressure reduction from fluid extraction, or to pressure increase due to injection, may in certain types of reservoirs, especially in faulted or fractured rocks, result in instability leading to seismic activity. Such instability due to production alone has been documented in the Wilmington Oil Field of California (Poland and Davis, 1969) while instability caused by injection was documented at the Baldwin Hills Oil Field of California (Hamilton and Meehan, 1970) and in Colorado (Healy, et al., 1970). The role of fluid-pressure changes in initiating seismic activity is not well known but a causative relation has been established in many areas. In general, such earthquakes have not been damaging, but the potential for major seismic action cannot be ruled out. The injection of fluids along a fault zone may indeed result in a series of minor quakes but it may serve to release the stored up energy and prevent a major quake. This technique is a major area of study in California and proponents of controlled fluid injection along faults is growing rapidly.

Subsidence of the ground surface over and around a geothermal reservoir can result from the withdrawal of large volumes of fluids (Poland and Davis, 1969; Hunt, 1970). Subsidence would reach a maximum rate during full-scale operations unless replacement fluid is returned to the reservoir. In some instances it may be practical to re-inject the geothermal fluids after utilizing most of their heat. Studies would be required prior to approval of operating plans and operation would have to be monitored to determine the subsidence potential and its probable consequences.

Drilling and fluid production will involve the same considerations during full-scale operations as during the testing and earlier production operations, including prevention of blowouts, sealing of wells and providing for control of fluid flow from a well. Steam not containing noxious gas concentrations generally can be exhausted to the atmosphere without causing significant environmental damage if noise is kept at a moderate level. Condensing such steam can result in greater heat recovery and even augment fresh-water supplies.

Full development of a geothermal field (as with drilling, production testing, field development and powerplant and powerline construction) can have varied impacts upon fish and wildlife. Most of the impacts will occur on or adjacent to, the power generation plant sites and areas occupied by related facilities. There can also be impacts upon fish and wildlife from improper handling of geothermal fluids. As a geothermal field proceeds through the stages of powerplant, road, transmission line and any by-product facilities construction and operation, the loss of wildlife values, which began in the test drilling and production testing stages, will vary by nature of activity. The impacts of exploration, development and construction generally will tend to be of a temporary nature during the period of such activity. Impacts associated with the operational phase will continue during the life of the plant, but even here some wildlife will accept such environmental intrusion without serious consequences. Impacts can include both wildlife habitat and usage. The fauna will surely differ from that prior to initial exploration. Certain species may be favored more than others by habitat change. Existing public access will be restricted to reduce hazards to the public or to protect plant facilities with an accompanying reduction of hunting and other recreational opportunity on these lands. Power distribution lines located in flyways or over nesting and feeding sites may cause some mortality of waterfowl, eagles, hawks and other birds from collision and/or electrocution.

The by-product potential of some goethermal developments is expected to be of commercial interest. Heat may be extracted from geothermal fluids for purposes other than power generation, thereby increasing the overall thermal use efficiency and precluding the need for providing alternative sources for an equivalent energy source. It also may be feasible to extract valuable chemicals and potable water from the brines produced. Such by-products can represent positive, beneficial environmental influences. Safeguards must be employed so that waste streams from by-product plants do not contaminate or adversely affect the environment, for example, by contributing to air or water pollution.

The operation and maintenance stage will have little impact on livestock if proper access structures are available under the pipelines. The livestock will soon become acquainted with the activity and structures and accept them as part of the environment.

As construction personnel are replaced by maintenance and operating personnel, the demand on governmental services, schools, housing, commercial businesses, hospitals, and health services will decrease. People of the county will be receiving benefits from the development through perhaps lower taxes as a result of the increased tax base on geothermal development facilities. The increase of available electrical power may increase industrial growth in the area.

Adverse affects on the landscape will decline during this stage since there is less disturbance from equipment and people.

No areas of slope instability have been specifically identified within the area. Soil type Units 30, 31, 41, 56, 76, and S76, however, are known to contain components of montmorillonite clay. These soils types are scattered throughout the EAR area. Strata with a significant montmorillonite content may be prone to slumping or mass wasting on exposed slopes and cuts where subjected to repeated cycles of wetting and drying.

Cuts into the toes of slopes should be avoided.

MITIGATING MEASURES

Very rigid and explicit drilling and casing requirements are set forth in Geothermal Resources Operational Order No. 2 of the Conservation Division of the U.S. Geological Survey. All drilling programs are subject to the approval of both the U.S. Geological Survey and the Bureau of Land Management.

Mitigation of potential environmental problems and impacts stemming from geothermal exploration and development activity can be accomplished through enforcement of applicable federal, state and local laws and regulations, geothermal exploration and leasing regulations, geothermal operating regulations, Geothermal Resources Operational (GRO) Orders, lease and land use permit stipulations, and application of existing and developing technologies. Although the number of geothermal installations in the world is small, a great amount of technical and operational information has been gained from them. Certain technologies, such as drilling methods and handling of high pressure fluids, have been directly transferred with appropriate modification, from the petroleum industry to the geothermal industry. Our knowledge of environmental causes, effects and remedial or preventive measures specifically relating to geothermal development ranges from adequate to limited. Some environmental impacts are known and can be prevented; some impacts can be anticipated and adequate environmental protection can be planned; some impacts can only be hypothesized so contingencies included the general regulations may provide a means for corrective action in the event these impacts become reality. If unacceptable environmental factors exist which cannot be corrected, development or operation would not be permitted.

If a significant geothermal resource is discovered, e.g., one involving two or more power generating plants, it is probable that development will occur over a period of years. This probable prolonged development period tends to be a mitigating measure in itself in that problems discovered in initial operations may be solved and taken care of in succeeding operations. If problems develop which cannot be satisfactorily solved, the regulations provide for the shutdown of operations until such time as acceptable corrective action is taken.

Exploration

Section 3209.2 of the Geothermal Regulations provides that no exploration operations will be conducted on public lands except pursuant to the terms of a Notice of Intent which has been approved by the authorized officer. Section 3209.1-1 sets forth the requirements for filing such a notice. Special provisions relative to the particular area involved will be included as appropriate to assure adequate environmental protection in connection with such exploratory operations.

Monitoring

Monitoring will be conducted for all potential impacts related to exploration, development and production of geothermal resources.

Such impacts include noise, air quality, water quality, radioactivity, erosion, fish and wildlife and land subsidence.

Monitoring of noise, and air quality, which are readily identified and associated with specific activity on an individual lease, will be the responsibility of the lessee, under the supervision of the U.S. Geological Survey and will be required as a stipulation in the lease or through Geothermal Resources Operational (GRO) Orders.

Monitoring of changes in water quality, sediment yield, fish and wildlife values, erosion and land subsidence will be the responsibility of the lessee under the supervision of the U.S. Geological Survey (Refer to 30 CFR Parts 270 and 271, 43 CFR Part 3200, and Secretary Order 2948).

Land Resources

The term applies to those surface oriented activities and operations affecting the surface such as aesthetic values, erosion control, and land stability problems.

Section 3204.1 (f) of the Geothermal Regulations requires that aesthetics be taken into account in the planning, design, and construction of roads, pipelines and facilities. Careful planning, design, and supervision of operations should lessen the undesirable impact of such operations. The overall impact will be lessened if operations can be conducted out of sight of main public access routes. Facilities should be blended into the background as much as possible to minimize the contrast with the natural setting. Powerplant buildings should be designed with minimum profiles. Facilities and pipelines should be camouflaged by proper selection of paint color. Roads should be constructed to minimum necessary width and as much as practical following the natural contour.

All of the public land in the EAR area is managed under the multiple use concept involving such uses as recreation and grazing. The principal measures assuring multiple use of the surface are contained in Section 3204.1 (b) of the Geothermal Regulations which assure public access to leased land and limits restrictions on access by the lessee to those consistent with health and safety requirements. Lands in the vicinity of wells, pipelines and powerplants must be restricted from hunting and general access in the interest of safety. Fencing will be required at hazardous locations.

The chances of seismic action originating from geothermal development cannot be estimated. However, it is also possible that reinjection of fluids especially along fault zones may result in a series of minor quakes which serve to release the stored up energy thus preventing a major quake. As stated previously, this technique is a major area of study in California.

Livestock grazing and geothermal operations should co-exist satisfactorily with proper planning as required under Section 3200.0-8 (b). Examples of actions which can be considered to insure minimum impacts on grazing include:

1. Harassment of livestock will not be permitted.
2. During the field development and construction stages, livestock may have to be removed to insure their safety and welfare.
3. Construct pipelines so as to prevent a drift fence effect.
4. Provide a suitable number of pipeline crossing areas and cattleguards.

Cultural Values

A professional archeological inventory will be completed to assure identification of all known or possible cultural sites. 43 CFR 3204.1 states that "the lessee shall conduct activities on discovered, known, or suspected archeological, paleontological, or historical sites in accordance with lease terms or specific instruction." For more detailed language, refer to Special Stipulation (d) for provisions to protect archeological and historical values.

Erosion Control

Section 3204.1(c)(4) of the Geothermal Regulations requires minimum disturbance to vegetation and natural drainage. The lessee will be required to employ adequate conservation practices on the leased land. Compliance will also alleviate potential downstream impacts from increased sediment load. Stream sedimentation may also be regulated by state water quality authorities. Mitigating measures include reseeding of disturbed areas, dust and erosion control on roads, well sites, and construction areas, and sound engineering practices in construction of roads, drill pads and structures. Examples of mitigating measures which will lessen environmental damage are:

1. Road and trail construction shall not block drainage systems or water courses. Culverts or other suitable crossings installed on drainages and the road drained or water barred as necessary to prevent erosion.
2. The slope of cut banks and fill slopes shall not exceed 1.5:1.
3. Down spouts should be provided where culvert drains may cause fill cutting and accelerated erosion.

4. All roads planned for permanent or long duration use should be adequately paved or gravelled to control erosion.
5. All access roads and trails, drill pads, etc., will be rehabilitated as soon as possible after abandonment.
6. All disturbed areas should be re-vegetated for adequate soil protection. Native species will be used when possible.
7. Top soil from disturbed areas other than these used for permanent construction shall be stockpiled for use in reclaiming the sites.
8. Sufficient buffer strips of natural vegetation should be left between disturbed soil and drainage bottoms to aid in preventing sediments from moving into watercourses.
9. Harmful chemicals should be removed from all sumps and ponds. Upon abandonment, sumps and ponds should be filled and revegetated.
10. All rehabilitation measures should be directed toward restoring the area to as near natural condition as possible.
11. Vehicle travel shall be restricted to roads as much as possible in order to minimize soil disturbance.

Other Land Use Factors

Waste disposal will be regulated as prescribed by Section 3204.1(a). Mitigating measures which will lessen environmental impacts are:

1. Comply with applicable Federal, state and local sanitary and waste disposal regulations.
2. Remove all garbage waste and foreign debris from the area.
3. Any human solid waste will be disposed of through chemical or gas fired toilet facilities on drilling site(s). Suitable sanitary facilities should be provided in power generating plants and other permanent installations. Neither surface nor subsurface water are to be contaminated.

The lessee will be required to have a permit for a tram road across Federal land not under lease for access to his leased land.

Air Quality

General provisions for prevention of air pollution and related employee health and safety are included in Sections 3204.1(c)(3), 3204.1(c)(5), and 3210.2-1 of the Geothermal Regulations. Examples of mitigating measures which will lessen environmental damage are:

1. Keep new road construction to a minimum.
2. Limit site disturbance in pad and building construction to the smallest area necessary for satisfactory development and use.
3. Gravel or pave all access roads and trails receiving heavy use.
4. Gravel or pave all power generating sites.
5. Control dust, when air drilling by whatever means necessary.
6. Although not related to dust, require workers to wear protective devices when working with asbestos and fiberglass to prevent breathing airborne particles.

Noise

Noise due to steam ejection or expansion, drilling operations, construction activity, and other related geothermal activities may pose serious health and environmental hazards. To minimize adverse environmental effects from noise generation, the lessee should be required to:

1. Comply with Federal and state noise exposure levels established pursuant to the Occupational Safety and Health Act of 1970.
2. Install the latest muffling equipment on both wells and drilling rigs.
3. Limit drilling and production so that no geothermal wells are located closer than 0.5 miles to any populated area (10 or more dwellings with a 0.25 mile area) without written consent of 75% or more of the owners. In addition, the following minimum distances should be observed in locating a well in areas other than populated areas:

    a. Outer boundary of parcel - 100 feet.
    b. Public roads - 100 feet
    c. Residences or other development - 500 feet.

Gas & Vapors

The venting of steam to the atmosphere can create an adverse environmental impact if the steam contains significant amounts of noxious gases. To protect environmental values, the lessee should be required to:

1. Comply with national and state primary and secondary ambient air quality standards, as well as safety and health standards when releasing gases and vapors to the atmosphere.

2. Limit emissions from venting wells or pipelines to short durations.

Burning

Burning of trash could contribute to significant air pollution. It is recommended that no burning be permitted.

To insure that wild fires do not result in environmental degradation, the lessee should make every effort to prevent, control or suppress any fire within the lease. Reports of uncontrolled fires must be immediately sent to the BLM's District Manager or his representative.

The lessee will be responsible for any fire suppression costs that are determined to result from his operations.

Water

To prevent any deterioration in quantity or quality of either surface or subsurface water, the following measures should be implemented:

1. No water is to be removed from any lake reservoir, spring or well on Public Lands without written permission of the authorized officer. Compensation will be made for water removed from any BLM well.
2. Comply with Federal and state water quality standards.
3. Waste waters will not be discharged into live streams or underground aquifers, except that waste waters may be reinjected into the producing reservoir from which it was withdrawn.
4. Toxic materials will not be released to any surface waters or to any subsurface waters that are suitable for irrigation, livestock, or human use.
5. No discharges to surface water which would result in increasing the sediment load above acceptable limits will be permitted.
6. Cementing and casing during drilling and production will be adequate to prevent contamination of fresh water aquifers.
7. Monitoring will be adequate to prevent casing leaks or cement job failure from contaminating aquifers or resulting in blowouts.

Minerals

Geothermal resource development is not expected to seriously conflict with, or have any major impacts on existing mineral deposits because the lands within the EAR area are essentially devoid of deposits with any currently significant value, except gravel, which is in abundance.

Vegetation

Since the list of rare or endangered plant species contained in this report is general in nature as are potential work sites, a field check by a qualified botanist prior to the leasing of specific areas or before resource development begins is recommended to assure the protection of these species. It is imperative that these plants be considered for special protective measures since any exploration or development within or adjacent to their habitat would negatively impact their survival.

Other migitating measures pertaining to floral elements can be found under erosion control above.

Wildlife and Wildlife Habitat

Section 3204.1(g) requires the lessee to employ such measures as deemed necessary to protect fish and wildlife resources and their habitat. Section 3204.1(i) provides that the lessee shall provide for the restoration of all disturbed lands in an approved manner. Necessary fish and wildlife protection and land restoration measures will be developed on a sensitive basis and included as special stipulations in each lease. Such stipulations should include:

1. The proper spacing of high voltage transmission lines should in itself prevent any electrocution of birds. Should local use of geothermal power involve smaller, closer spaced lines, then the specifications for power transmission lines developed with the Idaho Power Company and the Bureau of Land Management should be applied. Mr. Nelson's designs are available for examination in the Vale, Oregon BLM District Office.
2. All surplus brine and associated effluments should be reinjected into the appropriate strata to prevent the possibility of contamination of local watercourses.
3. Areas of vegetal removal and/or soil disturbance should be seeded or planted to native vegetation. Plant species not native, such as crested wheatgrass, nomad alfalfa, etc., may also be used where adapted to the sites.
4. Noise suppressing mufflers must be installed on vents to minimize the adverse effects of operational noise on wildlife.

5. No rights-of-way are to be granted on or over any lands delineated in the future for no surface occupancy.
6. Wells encountering aquifers will be cased so as to prevent the lowering or loss of these water tables into other strata.

Attitudes & Expectations, Local & Regulatory Structures & Cultural Values

Other than apprising the lessee of city and county zoning ordinances, building codes, etc., and requiring him to comply with local laws, the only method of mitigating impacts of geothermal exploration and developments on Attitudes and Expectations and Cultural Values (owners of private land and the people in general) is advising the county and city governments of the potential impacts so they in turn may advise the local citizenry. The mitigating measures required to forestall problems created by a temporary (but possible long term) influx of 30 to 200 people and families will have to be initiated and accomplished by county and city governments and by local businessmen and citizens.

Archeological and Historical Values

Provisions designed to protect archeological and historical values are given in Section 18 of the Geothermal Resource Lease.

RESIDUAL IMPACTS

Geothermal regulations, lease provisions, and General Resources Operational Orders are designed to assure that geothermal resources can be developed and utilized in an environmentally acceptable manner. In those instances where this cannot be done, development and use will not be permitted. However, virtually any human use of lands and their resources may have some degree of adverse impact. Where benefits warrant acceptance of minor impacts, such uses may be appropriate provided the adverse impacts have been adequately recognized, mitigated to the extent possible, and are not so serious as to preclude the proposed action. The following discussion summarizes the types of adverse impacts that may be unavoidable should the proposed work be implemented.

Exploration Phase

Exploratory activities will involve physical presence upon the land which may result in damages to the land and resources thereon. Exploration activities include, but are not limited to, geophysical operations, drilling of shallow temperature gradient wells, consturction of access roads or trails, and cross-country transit by foot, animals or vehicles.

Even though persons conducting exploration operations comply with all of the general and specific terms and conditions of the "Notice of Intent to Conduct Exploration Operations," including the restoration of areas as near as possible to their original condition, some adverse impacts still may result. Examples are:

1. Vehicle travel will result in dust, exhaust gases, noise, disturbance, injury or killing of livestock or wildlife, accidents, etc. When existing roads are used, such impacts would be nominal since they primarily would be the result of increased traffic. Advance approval will be required for construction of new roads or trails to assure proper construction and restoration. However, there will be a certain amount of disturbance of vegetative cover and soil surface from cross-country travel on roads or trails that can have temporary impacts until cover is restored and the soil stabilized. Evidence of such roads or trails may remain for several years which could be conducive to casual use by others resulting in further damage. Failure to comply with regulations or exploration stipulations could result in similar impacts but damages could be more significant, particularly if such improper use was not promptly detected and corrected.

   Disturbance of vegetative cover and soil surface by vehicle travel, both on and off road, as well as road and drill pad construction will result in some soil loss even if all mitigating measures are followed.

2. Drilling of shallow holes or blasting may be necessary which may result in minor vegetative and surface disturbance in the immediate area of activity. All drill holes will be small and shallow and are to be capped when not in use so no damage is anticipated from such holes. If not capped, small animals could fall into the holes and perish.

3. The presence of men and equipment will increase fire risk in areas of high fire hazard, notably grass, brush and forest lands. Even though operators are required to make every reasonable effort to prevent, control or suppress fires started by their operations, there can be accidents, human error or carelessness, equipment failures, etc., which could result in fires that could have serious environmental consequence.

Test Drilling Phase

Heavy equipment capable of drilling to depths of several thousand feet is required. The enlargement and improvement of existing roads or construction of new roads to provide access for drilling equipment and supplies to the drilling site involved unavoidable impacts from vegetative soil cover removal, surface disturbance, cuts and fills for roadbed, soil erosion and siltation during construction and, to a lesser degree, some impacts even after banks are stabilized, vegetative cover is restored and adequate drainage is installed. At each drilling site a level area of approximately one-half to three acres is required for drilling operations. Steep terrain typical of some areas within the EAR area would require considerable grading if they were selected for drilling. While compliance with lease and GRO Orders will prevent serious adverse impacts, some minor impacts still will result. Most of the potential impacts listed under exploration could be expected with some intensification in areas of heavy activity.

During grading and drilling operation, moderate levels of noise from equipment operation will be unavoidable. Even where special noise control measures are required, noise levels will be above natural levels.

Well blowouts can result in significant venting of steam, associated gases and brackish water to the atmosphere, ground area and surface water, creating air and water contamination as well as high noise levels and exposing individuals to possible injury.

While modern drilling techniques are generally capable of preventing such accidents, there is still the possibility they may happen due to human error, equipment failure, or other factors. Adverse impacts will continue until the blowout is controlled. The seriousness of the incident could range from minor to serious, depending upon location, nature of geothermal emissions, duration of blowout, etc. Blowouts of wells in that part of the watershed lying above the agricultural lands and irrigation canals will result in significant contamination of crop lands and ditches if waters are highly mineralized. Canals could be washed out with serious soil erosion resulting if volume of water from a blowout is high.

Well blowouts emitting noxious or toxic gases could adversely affect the residents of the town of McDermitt and surrounding area, especially during temperature inversions or with northwesterly winds. Depending upon levels emitted and climatic conditions, the effect would range from unpleasant living conditions to unsafe conditions for human habitation. Blowouts could also result from subsequent events such as earth slides, seismic action, vandalism, etc.

Production Testing Phase

The most significant feature of production testing of vapor dominated systems is the release of high volumes of steam for periods of as long as several weeks or even months. This is necessary until the flow attains a uniform level. During this period the impacts of noise and gaseous emissions will be at their maximum level. The degree of noxious gas released to the surrounding atmosphere depends upon the composition of the steam. Release of steam that contains hazardous toxic levels will not be permitted, but the less than toxic condensations can have odor or other adverse impacts. Noise may disturb wildlife or people.

As stated above, releases of even limited amounts of noxious gases could adversely impact the residents of the Jordan Valley community or of other areas, primarily during periods of temperature inversions.

In water-dominated reservoirs, production testing likewise requires production of the formation fluid over an extended period. Disposal of produced water could have an environmental impact if the water containing salts or other toxic substances should be released to the surface environment. Large volumes of liquids could be involved. If not properly contained or re-injected, they could seriously impact on surface water quality and related fish, wildlife, or other water-related values.

Full Scale Operation Phase

Full scale operation will require complete development of well and steam transmission systems, power generation facilities, transmission lines, permanent roads, etc. Many of the potential adverse impacts associated with exploration and testing will no longer exist but other impacts may increase in proportion to the scale of development. Currently about ten wells are needed to supply each generating station. Each well will involve clearing, grading, an improvements. Steam pipelines connecting wells to the generators likewise require clearing and grading. During construction there will be considerable activity, noise, movement of earth, dust, etc. After construction is completed and all necessary environmental protection measures are taken, the nature of the site will be changed from its former state to an industrial complex.

Even with adequate controls, full scale operations will involve higher than natural noise levels, emission of steam and other gases to the atmosphere, disturbance from operation activities, additional vehicle traffic, etc. Transmission lines damaged from storms or other failures can result in fires or personal injury but to no greater extent under these conditions that lines built in connection with other power systems.

Potential adverse impacts will be introduced during full-scale operation from possible land subsidence or increased seismic activity. Land subsidence can roughly be predicted from tests of core material prior to production. It is known to occur primarily in areas consisting of poorly consolidated sedimentary rocks.

One means of alleviating the potential subsidence problem -- and simultaneously disposing of unwanted waste water -- is through pressure maintenance in underground reservoirs by re-injection. This however, can lead to the potential impact of increasing seismicity. The relationship of fluid-pressure changes to earthquakes is not well known. Impacts can be beneficial or adverse.

1. The intrusion of structures, pipelines and transmission lines into this area will create an adverse visual impact. Geothermal development will lessen aesthetic values of an area.

2. Extensive development could lead to damage of cultural sites presently unknown. Discovery of new sites by construction activity could be beneficial as well as destructive, depending on the amount of damage to the site prior to its recognition.

3. The associated structures and lines may prevent subsequent ORV use in those areas affected by the development, as well as decrease the aesthetic values of many scenic regions in the EAR area.

The open desert nature of portions of the EAR area will be converted to that of industrial complexes. Unavoidable changes in the composition of wildlife will result. Pronghorn antelope, raptorial birds, and other disturbance sensitive species will permanently vacate the area while more tolerant forms, such as the numerous rodents and insects, will continue to occupy areas of suitable -- though altered -- habitat.

Clearing operations, and pipelines, structures and fences are activities or forms of barriers which either destroy or restrict access to rangeland areas, shifts in livestock use, and adjustment of livestock numbers, any or all of which can lead to watershed deterioration in over-used areas and increased economic stress on the livestock operators in case of shifts or adjustments of numbers.

The mitigation of the impact of geothermal development on the attitudes of the general public of the area, the lives of individuals in the area, local businesses, county and city government, schools, and health facilities is beyond the realm of responsibility of this analysis. It is worthy to note that this will, in all probability, be a residual impact and should be recognized.

In summary, there are two major residual impacts that will or may result from the proposed action: there will be an impact on the local communities and community services; if blowouts occur, there is a good possibility that adverse effects will be caused from escaping non-condensable gases and/or mineralized or brine water. The major affects of both are off site, occurring on private land or to individuals on private land.

The positive features of geothermal development also serve to mitigate the potentially adverse impacts. Even though some of the grazing or crop land may be used for geothermal development, and this will adversely affect the local economy, this use will be temporary if geothermal exploration is unsuccessful. If a geothermal resource is found, then the value of the resource to the local economy in taxes, royalty, jobs, and energy availability will far outweigh the economic losses.

RELATIONSHIP BETWEEN SHORT TERM USE & LONG TERM PRODUCTIVITY

General

The leasing of lands for geothermal resource development involves the commitment of a portion of the geothermal heat, water, and related land areas and resources of the sites involved. It is particularly significant to recognize that the geothermal heat is a wasting resource that otherwise would be dissipated over time from the surface of the earth to the atmosphere with little or no identifiable benefit. By contrast, development of this resource in an environmentally acceptable manner can have substantial benefit by affording a relatively clean power generation energy source.

The exploration and testing phases of geothermal leasing are designed to determine the nature and extent of geothermal resources. Generally, the active portion of this phase is of short duration, sometimes extending only over a period of days, months, or at most, a few years. It may be intensive and continuous for short periods or periodic over several years. Where such exploration proves unsuccessful, there will not be subsequent use of the land for development and production of geothermal resources.

Under such conditions. leases will terminate at the end of the ten-year primary term. However, in many instances such leases will be relinquished by the lessee at an earlier date to avoid additional lease payment costs. Exploration and lease provisions will require that lands disturbed by unsuccessful exploration will be restored as nearly as possible to their original condition upon termination of these activities. Such restorative measures include grading, intalling proper drainage, soil stabilization, revegetation, removal of all equipment and supplies, proper removal or disposal of all wastes, filling in of holding ponds, etc. Except for scars from leveling of drilling sites, roads or other major earth movement, the areas should return to natural conditions in a short time. Changes in vegetative cover may result, depending upon whether native or non-native plants are used. Generally the native vegetation will retake the area; however, on some sites aesthetic and vegetative impacts may last over a long period due to the slow natural recovery factors.

Where exploration discloses the existence of economically attractive geothermal resources, the development and production of such resources for electric power generation, and possibly water and mineral by-products can be expected to occur. Timing of such development will depend upon electric power markets, power transmission systems, construction schedules, etc. Once production begins the geothermal resource will be withdrawn at a rate greater than the natural replenishment rate. Over a period of years (perhaps 30 to 50 years or even greater, depending upon the nature of the resource province) production capability will be depleted to the point where further operation will not be economically feasible. When the reservoir is no longer capable of sustaining the geothermal operation, the leases will be terminated, the facilities dismantled, and the land restored, insofar as practicable, to its original condition. Most of the area involved in the operation will have become well stabilized except for the actual areas used for the generation facilities, roads, or other structures or facilities. Removal of improvements will result in some disturbance, particularly in well and steam pipeline areas, but such disturbance will be of a temporary nature and subject to appropriate restoration. Unless the land areas occupied by production facilities were to be used for some subsequent and non-related purpose, they will be properly graded, drained, stabilized, and revegetated so that they will again become a part of the natural environment. Relatively large areas of level land will remain, such as the power generator site. Cuts and fills for roads, steam pipeline routes, etc., likewise will remain visible. However, the combination of restoration and natural revegetative recovery will, over time, result in a near natural setting with only contour change as evidence of prior uses. The lands will return to their former productivity or they will be available for other appropriate uses.

The Resource

By developing potential geothermal resources, a previously unused natural resource will be tapped to help meet the Nation's growing energy needs. In terms of total energy requirements, the contribution of geothermal resources may be relatively small but it can be important, particularly on a local or regional basis. The generation of power will be the principal use of goethermal resources; however, there also is a possibility that by-products of water or minerals might be possible. In many cases the geothermal resources may not be of sufficient temperature to be useful for electric power production but will be useful for space heating or industrial processing. Such water, usually below 250 degrees, is subject to standard ground water uses under existing water rights.

While depletion of some of the heat within the geothermal reservoir will occur over the period of operations, no permanent adverse effect is anticipated. Over time, perhaps a hundred or more years, natural heat transfer within the earth might even return the heat content to nearly the same intensity as existed before utilization. At some time in the relatively distant future it might be possible for such areas to again be used for similar productivity. Any use of by-product minerals probably will represent mineral recovery that otherwise would never have occurred. Such use will preclude the need to obtain a like amount of such materials from other sources. Where waste waters are re-injected, the associated mineral values will be returned to the earth.

Water

The consumptive use of water resources, primarily geothermal fluids, in the power generation or mineral by-product process will constitute a depletion of the gross water resources of the area. To the extent that geothermal fluids are withdrawn from the subsurface reservoir and not replaced by re-injection or natural recharge, the waters so consumed represent depletion of water in storage. However, in most instances, due to high mineral content, this will be water that otherwise probably would not be used. If subsidence should occur, the water storage capacity of the geothermal reservoir may be reduced but since such waters probably could not be used for other purposes within the foreseeable future, the reduced storage impact may not be adverse in terms of future water productivity.

Geothermal fluids may also be of sufficient purity to be used for irrigation or other purposes under established water rights after the fluids have been cooled. This could provide a source of fresh water during the period of power operation and it is possible that the wells could continue to be used even after power production has ended. In some areas, the geothermal fluids are expected to be concentrated brine which will not be suitable for any other purpose. In such situations, the wells will be sealed upon termination of power generation. The use of such water should not affect water resources available for beneficial use.

Under the proposed controls for waste disposal, degradation of surface and fresh ground waters is not expected to be significant, especially in a long-term sense. Mishaps or accidents may have short-term impacts that, depending upon the volume and nature of discharge involved, could be serious, particularly on aquatic resources. However, corrective measures such as dilution, diversion of waste waters from streams, capturing in impoundments, etc., should provide adequate measures against serious or long-term impacts.

Land

Land uses during the period of production operations will be changed to industrial operations from wildlife habitat, recreation and grazing. However, many such uses can continue on a compatible, though reduced, basis. Wells, pipelines, powerplants, by-product facilities and power transmission facilities will dominate the local area. Public access in the vicinity of such facilities will have to be restricted to protect the public and the facilities. Development and production of geothermal resources generally are not expected to have any lasting or inhibiting effects on the use of the land after geothermal operations have been concluded and facilities removed.

Should geothermal production result in land subsidence, which is an irreversible process, the subsidence constitutes a long-term effect upon land resources. Such subsidence, however, will not significantly effect use of the Public Land in the EAR area.

Wildlife and Recreation

Geothermal resource development could result in certain localized adverse impacts on wildlife and their habitat. There could be a loss of wildlife habitat in the immediate vicinity of installations and minor loss of birds from collision with electric distribution lines. In addition, restrictions of public access will reduce hunting and related recreational opportunities in the vicinity of installations. A change in the natural setting of lands could result in long-range effects on wildlife by rendering some lands less desirable for wildlife habitat purposes. With increased human activity and geothermal development, chukar hunting will probably become nonexistent. In some instances, wildlife species such as ground squirrels, starling, housefinch, and blackbilled magpie may benefit from development activities.

Reduction of ORV use in this area may cause ORV use to become concentrated elsewhere. This concentration could intensify soil erosion and other problems in adjacent areas. Recreational access closure in the northwest portion of the area would negate further recreational rockhounding pursuits.

Economic and Social

Geothermal development requires substantial investment in drilling wells and construction of roads, pipelines, power and by-product plants, and transmission lines. Such investments result in an increased tax base for the area of development. However, the labor-intensive phase may be short-term, occurring primarily during field development, and would result in significant fluctuations in population levels. The economic benefits probably would have to come from other sources if the geothermal resources were not developed. Tables 9 and 10 reflect estimated costs of electricity from variously fueled plants. Generally, the costs for a hot water geothermal plant are comparable to hydroelectric, nuclear, and oil fired plants. Dry steam plants are much less costly, but few dry steam sources are expected to be found. Gas fired power plants have a cost advantage, but due to the increasing scarcity of natural gas, continued use of remaining supplies represents a waste of this cleanest of energy resources. Coal fired plants appear to have a cost advantage, provided increasingly stringent air quality standards can be met without significant increases in coal production or utilization processes.

Geothermal resources can be economically competitive where such resources can be developed near existing power systems or where additional transmission costs are normal. Since the generation capacity at each site may be small, substantial investments in power transmission systems could cause such development to be uneconomic.

Damage or destruction of known and any unknown cultural resources would be at the expense of the education and enjoyment of future generations. There could be additional aesthetic or social impacts in terms of increased noise levels, odors, additional traffic, etc., even though all of the environmental stipulations of the permit are met. These will be minor but objectionable in terms of pre-occupational conditions. Since such operations could continue for a period of 25 to 50 years, they would exist during most of the lifetime of local residents or users of this area.

IRREVERSIBLE & IRRETRIEVABLE COMMITMENTS OF RESOURCES

The principle commitment of the resources is the depletion of thermal energy and water from the geothermal reservoir. Both of these resources are renewable but not within the life span of a specific project. Once the resources are depleted to the point where economic production cannot continue, production will stop, facilities removed, and the area restored to as nearly a natural state as is practicable. There is no foreseeable alternative use of the stored energy other than possible space heating. The associated water produced by the operation could be of significant value if it is of sufficiently good quality, either naturally or by desalination, to be used for other purposes.

Compaction and subsequent land subsidence that may result from the removal of geothermal fluids can have irreparable consequences. An equivalent amount of water storage may be lost. In developed areas, substantial adjustments might be required to compensate for such subsidence. The EAR area contains developed land and in some cases is characterized by irrigation canals. Subsidence in these areas could cause breaching of the canals, causing considerable damage to adjacent developed land. On the land in the EAR area, however, no adjustment will be required from such a phenomenon. If seismic action results from fluid withdrawal or re-injection, considerable damage could result, depending on the severity of the action.

Some on-site or related ecological features such as plant life, wildlife, and aesthetics can be altered. Cuts and fills for power plant sites, production wells, roads, etc., can leave landscape scars. In some instances roads may be retained as permanent access routes to facilitate other land uses. The extent of such alterations depends upon the individual site and the nature of development.

Dedication of the land surface to industrial uses generally will result in land areas being used for wells, associated surface facilities, power plants, roads and transmission lines. While not of a permanent nature, such uses represent a commitment for a period of 25 to 50 years. This is a relatively long period in terms of the average human life span and related alternative uses of these lands and their other resources.

Human energy, money and construction materials are other resources irretrievably committed in the development of geothermal steam. However, to the extent that these resources represent a commitment to increased power generating capacity to meet regional or national needs, their consumption would be necessary regardless of the technology utilized in the generating process.

OIL AND GAS RESOURCE EXPLORATION AND DEVELOPMENT

ANTICIPATED IMPACTS

General

The following section describes the anticipated environmental effects of oil and gas resource development in the EAR area and recommends specific measures to lessen or preclude such impacts. To make this analysis, the following constraints and conclusions were assumed:

1. All operations undertaken by the lessee will be in conformance with applicable Federal and state laws and regulations and standard lease stipulations as detailed above under Summary of Standard Mitigating Measures in I, Description of Proposed Action and Alternative. The proposed action, as it is regulated by such laws, regulations, and stated operating procedures is what is being analyzed.

2. Additional, site specific, environmental assessments are a prerequisite to all surface exploration and/or development. The purpose of such subsequent analyses is to identify the environmental impacts of the proposed surface disturbing operations and to recommend appropriate mitigating measures to be included in the operations permit.

3. Road construction associated solely with oil and gas exploration will not be extensive. Many existing roads in the EAR area are capable of supporting loads associated with exploration equipment. Additional road construction would be costly and possible locations physically limited by topography.

4. A moderate oil and/or gas discovery is the maximum reasonable level of development; any production will be transported to existing refineries for processing and distribution. This is based upon the history of oil and gas exploration in Malheur County. Over 30 wells ranging in depth from 163 to 8,414 feet have been drilled with no commercial discovery. Even though such history is not conclusive, it appears reasonable to assume that any future commercial discoveries will be small to moderate in size, not justifying the installation of refineries.

In addition to these assumptions, the following analysis must also consider the possible type of impacts associated with the unpredictable --accidents and errors in judgement, e.g. oil spills, fires and well blowouts. Since they are unpredictable happenings, the size or degree of the impact is debatable. A view of recent exploration and development history may help bring some perspective to such a debate.

In fiscal year 1975 (July 1, 1974 - June 30, 1975), according to the USGS, fires and well blowouts occurred on 20 of the 10,092 producing onshore Federal leases as follows:

Fires			Blowouts		
Fires -	Wyoming	7	Blowouts -	Wyoming	2
	Oklahoma	2		New Mexico	4
	Mississippi	1		Colorado	2
		10		Utah	1
				California	1
					10

Table 11 is a compilation of crude oil spills reported to the Environmental Protection Agency in five western states during 1972. The figure represents only oil spills attributed to field operations and does not include transportation or refining of crude oil. Of the total, 40 percent resulted from flow line corrosion or freezing with the remaining 60 percent caused by human error, mechanical failure, natural causes, poor maintenance, or in a few cases, vandalism. The data includes spills in all ownerships -- Federal as well as state and private.

Non-living Components

Geology - Slope stability hazards, flood hazards, subsidence, earthquakes and volcanic hazards are the principal geologic hazards which may either interrupt or destroy oil and gas operations in the EAR area. The effects of erosion will be described below under soils. The construction of access raods would probably be the activity most likely to be affected by geologic hazards with pipeline construction, well drilling, and oil and gas production following in order of importance. A possible benefit of oil and gas exploration would add to the fund of knowledge of stratigraphy, structure and geologic history of the region and may aid future evaluations of mineral and energy potentials. Additional load construction associated with exploration and development could be used for range management and recreation access.

1. Slope stability hazards - The probability of mass movements of unstable slope material in the EAR area is not as great as in some Public Lands, but remains as a factor which must be considered in oil and gas resource development planning. Landslides, rockfalls, debris avalanches, mud flows and soil creeps are natural phenomena which have been known to occur in the area. Triggering events include human activities and natural processes such as earth quakes, heavy rains, and rapid snow melts.

a. Slides - Slides usually involve surface material such as soil, rocks and vegetation. However, some slides contain bedrock. Bedrock slides commonly move along planes of weakness in the rock. Planes containing clay materials in tuffaceous shales dipping 15 degrees or more tend to be more plastic when wet and large masses of material can move if the slope is steep enough.

   Steep slopes are prone to rapid slides or rock falls with movement of materials as high as hundreds of feet per second. Areas are considered to be steeply sloping when regional slopes average 50 percent with local slopes ranging from 30 percent to vertical. Areas with moderate slopes, ranging from 20-30 percent, may be prone to slower moving slides. Rapid slides have been known to have caused fatalities and extensive property damage. Slower slides, even though they are not usually fatal to man, have caused significant property and environmental damage.

   In oil and gas fields, slides can rupture pipelines, cause oil spills and well blowouts, rupture wells, pollute groundwater and damage foundations.

b. Mud flows - Mud flows are not common in the EAR area. These occur when water on sloping land saturates the soil, reducing its internal friction. Mud flows can move quickly, especially on steep slopes, or barely perceptible rates on gradual slopes.

2. Flood hazards - Should oil and gas resource development facilities be placed on terrain that has a flooding potential, the resultant flooding could rupture pipelines, wash out roads, damage wells, and create other environmental problems.

3. Subsidence - Subsidence of the ground surface above an oil and gas reservoir could result from the withdrawal of large volumes of fluids from poorly consolidated formations charged at greater than hydrostatic pressure. Such subsidence would reach a maximum rate during the production phase. Subsidence can be reduced or prevented by adequate geological studies, planning and engineering controls.

   Subsidences can cause cracked foundations, structural damage to large storage structures and other facilities, reservoir failures, pipeline ruptures, and subsurface aquifer damage.

   Most incidents of deep subsidence have been caused by fluid withdrawal at depth. Usually, the withdrawn fluids have been either water, oil, or both. Deep subsidence can be prevented or stopped by reinjecting fluids or slurry.

Shallow subsidence occurs when surficial material settles. Heavy structures on poorly consolidated soils such as low density silts, peat, peaty soils, or wet marshy soils have caused subsidence. The pressure of a heavy structure or structures is sufficient to drive much of the water out of the soil or compact low density dry silts. Heavy structures may also sink into soft clayey soils with low bearing strengths.

4. Earthquakes - Historical data on earthquakes in Oregon indicate that there has been no loss of life and damage confined to cracked walls, masonry chimneys, broken lights and windows, and objects falling from shelves. Although Oregon lies within the Circum-Pacific Earthquake Belt, the state has fewer recorded earthquake shocks than either California and Nevada lying to the south or Washington to the north.

   Figure 11 depicts the locations and intensities of earthquakes in Oregon in recent times. Generally, earthquakes fall between Intensity V and VII on the modified Mercali Scale (Intensity I: Low -- Intensity XII: total destruction) at the rate of one per decade.

   There has been some speculation that a fault zone under stress could trigger earthquakes. The only recorded instance involving petroleum operations occurred in Rangely Field, Colorado, where earth tremors appeared to be related to fluid injection in connection with petroleum waterflooding. A U. S. Geological Survey report on the Rangely Field indicated, however, that water injection could possibly assist in preventing earthquakes. Although it is a well known fact that earthquakes occur when there is movement along a fault zone, such as the San Andreas Fault near the Pacific Coast, many subsurface faults related to known oil and gas reservoirs have retained their stability over long periods of geologic time. This is evidenced by the fact that these faults (known as "sealing faults") often form subsurface traps for petroleum.

   If these had not maintained their stability the petroleum would not have remained trapped for long periods of geologic time.

5. Volcanic hazards - The probability of hazards from volcanic activity in eastern Oregon is extremely remote.

<u>Soils</u> - Soil erosion and probability of slope failures will increase with the construction of access roads, trails, drill pads, tank batteries,

pipelines and associated field facilities. The increase will result from the removal of protective vegetation and associated detritus, the compaction of soil, alteration of natural drainage systems, and undercutting or overloading of natural slopes.

The movement of heavy equipment and various construction activities increases airborne dust particles and deteriorates air quality in direct proportion to the loss of protective vegetation. Road construction not only destroys vegetation but channels over surface water flow, increasing the sediment load of run-off water and, consequently, the scouring action. Increased soil loss and stream sedimentation result.

Increased human activity on the land within the EAR area increases the potential for accidental fires. Vegetation destroyed by fire increases the loss of soil through wind and water erosion.

The sidecast of roads built on steep sideslopes can be unstable, depending on the nature of the soil. The sidecast can become fluid during heavy snow melts or during short periods of hard rainfall and "sluiceouts" result, scouring away soil in its path. The result is loss of vegetative growth sites and high amounts of sediments in streams.

Road construction could also initiate rotational type slides. Slides of this type are found on slopes usually less than 50% when the toe of a rotational slump is removed, it increases the likelyhood of mass soil movement by the removal of support. The size of rotational slump ranges from a few hundred cubic yards to several million.

Soil could be eroded if drill cuttings were accidentally jetted from the mud pits during the drilling of stratigraphic test holes and wildcat wells. The chemical additives in the drilling mud could also destroy nearby vegetation and increase the potential for erosion. If the well were not properly cased, briny water could enter an aquifer which had been penetrated while drilling. The polluted water could lead to the surface where the aquifer outcrops, destroying vegetation and causing erosion. Accidents such as explosions, fires, spills, leaks, and blowouts could reduce vegetative cover over relatively large areas. Such accidents could also cause soil sterility.

The overall erosional impact would be greater and of longer duration during the development stage. However, it would occur over a limited area. The wells would be connected by road systems which would have a greater impact than a road to a single exploration well. Each additional well would increase the overall impact due to the additional area involved. The construction of dams, tank batteries, pump stations, camps, and flow lines would have a moderate to severe impact on soils due to erosion caused by the loss of vegetation, compaction, and disturbance caused by construction. The impact from accidents would be the same as those described for the exploration phase. Each new well would decrease the potential for accidents. The potential for well blowouts would decrease if the subsurface pressures were known.

Erosional impacts of drilling would increase as the production phase is entered should additional oil and gas zones be discovered.

In secondary recovery operations, additional erosion would be caused by construction of drill sites, flow lines from the separation facilities, and water sources for injection wells. Continual use of roads and trails by heavy tank trucks and maintenance vehicles would compact the soil. Overland water flow would increase unless the roads were surfaced. Erosion would occur along stream banks if streams were forded at low water crossings.

The magnitude of fires, leaks, and spills during the production phase could be greater than during other stages of development. Fires at a tank battery or treatment plant could cause erosion because of the loss of vegetative cover and temporary soil sterilization.

In the abandonment of a field, it might not be possible to reclaim all disturbed sites to their condition prior to development. As a result, erosion rates might be higher than they were before oil and gas were discovered. If mud pits were not properly reclaimed, they might be breached after field abandonment. The escaping fluids could destroy vegetation and lead to soil erosion.

Improperly abandoned roads could create additional erosion problems.

Land Use - Oil and gas exploration, development and production activities may conflict with other land uses, particularly in areas where comprehensive land use plans have not been adopted and implemented.

The amount of land required for oil and gas field operations would be influenced by well spacing patterns, whether oil or gas were discovered, the extent to which oil and gas field facilities were duplicated, and terrain. The land used for all facilities in a developed field may range from approximately 22 acres per square mile with a 20-acre per well spacing pattern, to less than 3 acres per square mile with a 640-acre per well spacing pattern. The amount of ground used in actual operations may be greater in some areas and less in others. Most spacing units established at the present time for oil wells on Federal leases are from 10 to 40 acres per well. Less land is usually used in gas fields than in oil fields because gas production often does not require storage on the lease. The most common spacing patterns established at the present time for production of gas on Federal leases are 160, 320, or 640 acres per well. Generally, more land would be used for roads in steep terrain than in flat county.

Construction and operation of oil tank farms, battery and pump stations, oil collection and transportation lines, and electric transmission lines associated with an oil or gas field could constrain or curtail land use activities in the immediate vicinity.

Roads, trails, airstrips, and other facilities left after abandonment of oil and gas operation could benefit exploration and development of other mineral resources. The presence of electric transmission lines could provide a ready source of power for development of minerals other than oil and gas in an abandoned field.

All phases of oil and gas operations would affect, to some degree, recreation uses and values. Construction of facilities would change the appearance and character of the land. Where development occurred, land would be removed from recreation use. Public access to operating fields, unless closely supervised, could be denied because of possibilities of vandalism or injury.

Recreational uses which depend on motorized travel such as fishing, hunting, rockhounding, and off-road vehicle uses, could benefit because of improved access. Better access, however, could adversely affect some resources because of overuse and crowding.

Oil and gas operations could disrupt agricultural activities on surrounding land. The impact on livestock forage losses caused by roads, wells, and other developments would normally be minor. Livestock grazing would be adversely affected to a minor extent by the intensive activity associated with a developing field. Historical or seasonal patterns of livestock use might be disrupted. In some areas, roads developed for oil and gas operations could be used for range management purposes.

All phases of oil and gas operations would introduce changes in populated areas. The possibility of accidents such as fires, blowouts, and subsidence would be a matter of some concern. Oil and gas operations could also produce noise, odors, and visual intrusions in these areas.

Air - Preliminary investigations using existing systems of unsurfaced roads during dry weather may raise heavy clouds of dust. Dust levels could be especially high in xeric sites during the dry summer season, especially during the intensified construction activity of the development phase.

During the construction of access roads and drilling sites in the exploration and development stages, the engines of construction machinery emit exhaust fumes and particulate matter.

A well blowout may discharge natural gases into the atmosphere. These may be odorous or toxic, or both, such as hydrogen sulfide. Other blowout emissions include brackish or saline water, drilling mud and (very rarely) oil. These pollutants may be sprayed hundred of feet into the air and, in strong winds, can be carried for distances of more than a mile.

Air quality would be degraded if natural gas were flared or oil were burned during drilling and testing operations.

A blowout can result in a fire when highly volatile hydrocarbons are ignited by contact with hot engine manifolds or sparks from engine exhausts. The fire may burn for days or weeks before it can be extinguished, emitting smoke and the products of hydrocarbon combustion into the atmosphere.

It is well known that the climate near the ground and surrounding vegetative cover (micro-climate), may differ significantly from the surrounding macro-climate. Oil and gas activities which remove vegetation alters micro-climates. Although such changes may be limited to relatively small areas, the micro-climate within those areas undergo significant damage. Destruction of vegetative cover exposes the soil surface to direct solar radiation, increased air movement and higher wind activities. As a result, soil temperatures and moisture losses from evaporation will increase. The effects of destroying or changing the vegetation will vary with the size and density of the vegetation and the size of the area.

Water - The greatest impact of preliminary investigation activities on water resources would be an increase in the suspended sediment concentration of streams caused by road construction and increased travel of vehicles over un-roaded terrain. This would be particularly true if roads were hastily constructed by tractor and where streams were forded by heavy equipment.

Exploratory wells in the EAR area would probably penetrate groundwater aquifers. If the wells were not properly cased or sealed as called for in Federal and state regulations, brines could contaminate groundwater supplies.

If mud pits constructed for exploratory wells were improperly located on sites which could slide into streams, fine silts and clays, caustic chemicals, acids, soaps, oils, and brines contained in drilling mud could enter streams. The silts and clay could increase suspended sediment concentration of the water and form channel deposits subject to further erosion during periods of high flows. The remaining pollutants could reduce the quality of the water for use as a domestic supply. At high concentrations, some chemicals could be toxic to aquatic vegetation. Destruction of stream channel vegetation could increase channel erosion.

Development of an oil or gas field would require the construction of additional roads. If they were improperly constructed, they could contribute excessive suspended sediment to streams and introduce the possibility of oil leaks entering streams.

If sewage disposal systems for crew housing were improperly designed or constructed, streams could be contaminated with sewage effluent. Some soils in the area are unsuitable for septic tanks because of low permeability and/or high groundwater tables.

During the production phase, water could be contaminated because of leaks in pipelines and corrosion of well casings in producing wells and injection wells. Effects of groundwater contamination might not be noted for some time if the permeable layer intersected a stream a long distance away or if a groundwater pumping well were far removed from the oil well. If the aquifier were extensive but not used, the potential for future groundwater utilization would be reduced.

If mud pits were not properly reclaimed upon the abandonment of a field, they could be breached and allow sediments to reach bodies of water. Abandoned roads could continue to erode and contribute sediment to streams. Corrosion of the casings of capped and plugged wells could allow contamination of groundwater reservoirs.

Living Components

Aquatic Vegetation - Activities associated with discovery, development, and abandonment of an oil and gas field could impact aquatic vegetation as a result of (1) surface disturbance and accompanying erosion; (2) disposal of by-products of the production process; (3) accidental spills of drilling mud and oil; and (4) use of water for oil and gas field operations.

Construction of access roads for preliminary investigations, exploration, and development would cause some soil erosion. Cut and fill slopes which expose soil to wind and rain could ultimately result in soil particles being carried into the aquatic habitat. When roads are built across steep slopes, the potential for mass soil movements is increased. If landslides enter stream channels, stream banks with steep gradients are scoured and downstream vegetation is covered by sediment and debris. Where slides do not enter stream channels, runoff from the newly disturbed areas can contribute large quantities of silt to the stream below. The chronic low-level yield of soil from gravel-surfaced roads causes sedimentation of aquatic habitats. As vehicles use the road, small quantities of silt are worked to the surface and washed into drainageways with each rain.

Construction of roads and survey lines during the exploration and development phases would destroy aquatic vegetation where they crossed streams, marshes, or small ponds.

Sedimentation caused by oil and gas construction operations would have a long-term effect on aquatic plants, especially in shallow waters of marshes and ponds. Deposition of sediments changes habitat conditions by making water more shallow, accelerating the natural process of plant succession. Turbid water prevents solar radiation from penetrating to lower levels and limits photosynthetic activity, reducing the productivity of the water mass. It can also smother vascular plants with a deposition of fine particles.

Aquatic vegetation could suffer both short and long-term impacts if exploratory actions disrupted or eliminated the water supply of small springs. If they were improperly cased, stratigraphic and wildcat wells could alter ground water hydrology, reducing aquifer flows. Lowering of ponds, springs or marshes or reduction of summer stream flow adversely affects aquatic plants. As water levels and/or stream flows are reduced, less living space and few nutrients are available to the aquatic vegetation.

Aquatic habitat would be adversely affected during the development and production phases if oil entered streams as a result of pipeline leaks in the gathering system; spills, leaks, and equipment failures while handling and storing extracted oil; and defective separators. Experiments and studies of accidental spills show that crude oil and distilled products are toxic to plants.

Fire started by blowouts, explosions, or other accidents could burn riparian vegetation as well as emergent plants in marshy habitats.

Terrestrial Vegetation - Vegetation can be affected during the preliminary investigation and exploration phases by cutting and clearing of vegetation, earth moving operations, and exposure to fire.

Vegetation destroyed by clearing operations is not always confined to sites cleared for roads, buildings, flowlines, wells, and other facilities also call for clearing operations. Soil erosion which starts on the cleared sites may progress to adjacent lands. As the productivity of the lands is lowered, vegetative growth will be reduced because of the loss of organic matter and nutrients, a breakdown of soil aggregates, a reduction of field capacity, a reduction in the rate of infiltration of water, and a decrease in activity of the soil flora and fauna. In addition, material carried away from the cleared area can kill vegetation when deposited elsewhere. In general, regions having steep slopes, weak underlying rocks, a surface bare of vegetation, and subject to torrential rains suffer most from erosion.

Another adverse impact associated with surface clearing is reduction of site productivity due to soil compaction by heavy machinery. Where compaction occurs, vegetative growth is reduced due to the physical restriction of root growth and reduction of water available for plant growth. Wet soils are most susceptible to compaction.

Site productivity is also reduced on cutbanks and sidecast material where soil humus has been removed or covered by sterile soils from lower horizons.

Oil or briny water could kill terrestrial vegetation and reduce site productivity. Vegetation could also be killed or damaged if mudpits leak, break, or overflow.

Vegetation might be adversely affected by polluted air if hydrogen sulfide escaped from oil and gas wells or if liquid or gaseous wastes produced during well testing were burned.

Oil and gas operations could increase the potential of wildfire in the proposed lease areas. Fires could be started by well blowouts, operation of mechanized equipment, and careless smokers. The threat of wildfire in the EAR area ranges from slight to none during winter to high during the dry period of June through September. Fire may reduce soil productivity through loss of soil nitrogen and other essential elements either directly or through loss of vegetation.

The greatest threat to vegetation during the production phase is exposure to oil, brine, and toxic gases. The potential of spills increases as flowlines, valves, pumps, and storage tanks deteriorate during the life of the operation.

Aquatic Wildlife - Activities associated with oil and gas exploration and development could adversely affect aquatic organisms by increasing stream sediment loads and by physically changing or polluting aquatic habitats.

The sediment loads of most streams in the EAR area are the results of natural erosional processes. However, oil and gas exploration, development and production activities could cause sediment loads to exceed those attributable to natural processes. Most natural sediment is transported during high stream flows of winter when impacts to the biota are minimal. Sediments created by land disturbance activities frequently occur at lower flows and at other more critical times of the year.

Oil and gas activities which can lead to sedimentation include:

- Road construction. The potential for sedimentation would be particularly high if steep cut banks along streams and gullies were disturbed, gravel removed from streams, stream channels relocated, or streams forded or crossed without culvert installations. Roads that are poorly maintained or not surfaced for year-round use often contribute heavy sediment loads.

- Drilling of stratigraphic and exploratory wells.
- Accidents which result in loss of vegetation.
- Construction gathering system pipelines.
- Clearing for well sites and tank battery installations.
- Constructing crew facilities and sanitary facilities.
- Constructing drilling mud pits.
- Preparing areas for abandonment.

These activities could alter aquatic ecosystem by causing sediment to be deposited in stream channels and ponds. The physical changes would have undesirable effects on populations of fish and other aquatic organisms.

Sediment blocks the transmission of light through water, reducing algal and vascular plant production and imparing the ability of many species of fish, including trout, to feed. When sediment covers spawning and feeding grounds, it reduces the survival potential of many species and encourages higher rates of cannibalism among many.

Sediment can adversely affect other aquatic wildlife by filling living spaces, covering food supplies, interfering with feeding, interrupting reproductive functions, and smothering aquatic invertebrates such as mussels and larval insects. All of these impacts would reduce the numbers and productivity of invertebrates.

If road construction initiates land slides, aquatic habitat could be adversely affected by excessive sedimentation and stream channel scouring. The resulting movement of soil and debris into streams can displace and kill fish and other aquatic life downstream from the slide. Of greater impact than the immediate mortality of aquatic life is the loss of the stream's biological productivity due to physical alterations. Stream banks can be scoured, gravel lost, pools obliterated, and barriers created. The habitat may not be restored to its former productivity for many years. The potential for slides is high in several portions of the EAR area because of steep slopes, unstable soil materials, and periodic heavy moisture, especially during the winter months.

Large quantities of sand and gravel are often required for roads, well sites, and other construction. If these materials were removed from streams, fish and other aquatic life could be lost and aquatic habitat destroyed. Channel changes frequently reduce total habitat and increase gradient. Increased gradients cause increased velocities, greater scouring, and less hospitable habitat. Fish cannot negotiate streams with excessive velocities.

If culverts were not installed to appropriate standards, barriers for resident fish, especially during spawning seasons, could be created. Conditions at the outfalls of improperly installed culverts keep fish from entering the culvert; or velocities are too great for fish to swim the length of the culvert.

Crude oil contains a water-soluble fraction that is toxic to fish and other organisms.

Saline water emitted during well blowouts may be blown great distances if strong winds prevail at the time. Leachates from the briny water could degrade surface water quality after the accident.

Water contaminated with hydrogen sulfide gas could accidentally enter surface water during well drilling operations or well blowouts. The gas is highly toxic to fish.

Caustic additives to drilling mud could get into local waters during blowouts or if mud pits were accidentally breached. Caustic compounds destroy sensitive gill tissue of many organisms, causing impaired ability to absorb dissolved oxygen and dispell metabolic wastes.

Shallow ground water aquifers could become contaminated by saline water, oil and gas from stratigraphic test holes and wildcat wells if they were improperly cased. Blowouts could also add pollutants to subsurface supplies of fresh water.

If an oil field were improperly abandoned, breached mud pits, leaking wells, or steep cut banks could cause continued sedimentation of streams. Briny water and oil could also pollute sub-surface waters after abandonment if wells were not adequately plugged or capped. This chronic sedimentation and pollution would continue to have a debilitating effect on aquatic organisms as long as it was allowed to continue.

Terrestrial Wildlife - Airborne reconnaissance flights by fixed wing aircraft or helicopters at low levels during preliminary investigations could disturb and displace migratory waterfowl, breeding animals, and nesting raptors. Wildlife is particularly vulnerable during crucial periods such as breeding and raising of young. Occasional flights by fixed wing aircraft would cause the least disruption, but continued intensive search, especially helicopters, could pose a particular hazard to wildlife in the area.

Migrating waterfowl congregating in large flocks on bodies of water for resting and feeding, and can be easily driven away from these sites by low flying aircraft.

If water demands during drilling were excessive and lowered water tables and drained small ponds, all plant and animal life could be adversely affected. If hot water, sometimes a by-product of drilling, were allowed to contaminate surface water, temperatures could be increased beyond the tolerance of all plants and animals.

Pipelines constructed above ground tanks, pumping stations, air strips, and camps could interfere with the free and accustomed movement of animals. These facilities and activities associated with their use and maintenance could impede the use of mule deer and pronghorn antelope migration routes and wintering, fawning, and calving areas.

Most of the environmental impacts associated with development could continue during the production phase. Production could be prolonged through secondary recovery by the injection of gas or water producing wells. This could cause a water shortage for wildlife if surface water were used as the source for injected water.

Domestic Livestock - Drill pad, pipeline, and associated construction as well as off-road vehicle traffic may disturb livestock in areas where animals normally concentrate, such as water sources and preferred grazing areas. Emissions of waste and mud pit water may be hazardous to livestock. Pipelines and equipment may interfere with livestock movement. Loss of forage production will take place if disturbed areas are not reseeded. If development occurred on one of the many small areas leased to grazing, a well site could eliminate a portion of the lease area.

Human Values

Historical-Archeological Resources - The educational and scientific potential of a cultural resource, whether historic, archeological or paleontological, is greatest when that resource is undisturbed. Any surface disturbing activity which encompasses all or part of the site where that resource is located detracts from its value by destroying or obscuring the intra-site relationships which existed between the various elements of the site. In addition, the educational value of a cultural resource may be impacted by adjacent off-site activities which destroy or substantially alter the original setting.

Discovery of previously unrecorded archaeological sites during the exploration and development phases of petroleum operations is a possibility. Road construction, drill pad construction, etc. will remove vegetative cover from areas previously hidden from view facilitating the search for archeological resources. This is viewed as a positive impact provided that any sites discovered are promptly brought to the attention of the Authorized Officer.

Anticipated adverse impact on cultural resources during the preliminary investigation phase of petroleum exploration (seismic, geochemical, and soil gas testing) is slight. With the exception of seismic testing, investigative techniques employed during this phase to not involve significant levels of surface disturbing activity. Seismic testing, regardless of the technique used to generate shock waves, involves localized surface disturbance at the point of the test. Additional surface disturbance may occur if it is necessary to construct access roads to facilitate seismic testing operations.

Exploratory drilling, will result in disturbance of the surface at the site of the test. Stratigraphic tests require an area approximately 30' x 30' for the placement of the truckmounted drill rig. Some drillsite preparation (clearing) may be necessary to construct a temporary access road to reach the selected test site.

Exploratory wells require larger drill rigs and more extensive support facilities including access roads, drill pads, and mud pits. The average drill site occupies approximately one acre which must be cleared and graded flat.

Development activities including the drilling of additional wells and the construction of support, transport and storage facilities will have the greatest potential impact on cultural resources. The magnitude of this impact is in direct proportion to the number and kind of facilities necessary to realize full production capabilities. Adverse impact may be anticipated as a result of drill site preparation, access road construction, pipeline construction, and tank battery construction.

Additional adverse impact can be anticipated should accidental oil spills occur during the production, transport or storage of crude petroleum. Archeological sites are particularly vulnerable because contamination of charcoal samples with petroleum renders the samples useless for radio-carbon dating purposes.

Additional impact on cultural resources is not anticipated during the reclamation and abandonment phase of petroleum activities.

Social Welfare - The personal income and employment generated by an oil and gas development would in most cases represent the major economic effects. The discovery and development phases would likely require local employment in road building, site construction and other field crew operations. It has been estimated that in most cases local labor is used for 10 to 15 percent of oil and gas field employment. Many companies will train and retain local labor for the production phase. The specific impact on local employment will depend on the size of the exploration effort and size of the field if discovery is made. Even though unemployment has been relatively low in Malheur County in recent months, any oil and gas development could be beneficial at this time.

Specific employment and income effects can be estimated when a detailed description of the operation is made available (site specific). If it can be determined how many employees will be hired for a particular site as each phase progresses, an income effect can be determined.

All oil and gas operations, regardless of size, would require a certain amount of support from local trade and service industries. If the company decided to purchase much of the equipment and supplies required for their operations from local sources, this impact could be more significant than the direct employment effect.

The following aspects of social welfare are considered separately for purposes of this EAR:

(1) Local Economic Stability - The high value of oil and gas resources typically results in a "land rush" situation when new fields are discovered. Rapid development may create a very unstable economic and social situation in small rural communities. Larger urban areas would feel little effect, but since oil and gas operations usually take place in remote rural areas, it is likely some smaller towns would be affected. A large oil and gas field may cause a small community to gear up for a substantial increase in economic activity and then leave the town in a vacuum when activities or the resources begin to decline or the field abandoned.

(2) Populations - Population in the proposed oil and gas lease areas are characterized by low density and stablilized growth. The discovery and development of oil and gas in these rural areas could result in significant population in-migration.

(3) Community Services - As populations increase, especially if resource development is rapid with little or no lead time, additional burdens are placed on housing, schools, police and fire protection, medical facilities, and other public services. Small towns and communities may have an especially difficult time adjusting to the strain of added populations. Planning and financing such facilities in such areas may be a slow process and the quality of services for all might suffer initially.

    With abandonment of an oil and gas field, some emigration can be expected. When local communities have provided services and facilities to meet demands during development and production phases, they may now be left with facilities far in excess of long-range needs. The greatest impacts would occur when (1) substantial emigration occurs, and (2) local communities have incurred large bond indebtedness to pay for facilities no longer needed.

(4) Life styles and cultures - In the final analysis, impacts of oil and gas development on existing life styles in the community can only be evaluated fully by persons in the "real" situation.

Sudden growth and development can change local life styles. Increased population and some urbanization are in themselves a threat to the life styles of residents who have enjoyed a stable rural environment. A small community can be transformed into a group of secondary communities--each with different economics and social interests.

Oil and gas development might hasten local urbanization. Urbanization is not simply the growth of population. A town can become "urbanized" without an increase in population. For example, the activities of the residents might become increasingly tied into and dependent upon decisions made in urban control centers. Such an arrangement could change existing communities into "bedroom communities" with most residents traveling to outlying areas for work and many of their needs. Life styles could change if oil and gas development created a greater division of labor and if residents became less oriented toward local cultural and historical values and more oriented toward extra-community events.

Landscape Character and Aesthetics - All phases of the proposed oil and gas exploration will have impacts on the landscape quality. In some areas, seismic survey lines have been the major visual impacts of oil and gas exploration. The criss-cross pattern of brushed lines has interrupted the texture and color of the vegetation and superimposed unnatural lines on the land form. In the proposed lease area, surveys may be done mainly along existing roads and the visual impact should be relatively slight. The impact of exploratory drilling will be very noticeable but localized in nature.

The most obvious visual impact to be expected from the exploratory drilling phase would result from any new road construction involved and from clearing and leveling the drill sites. Whenever possible, a drill site is selected on reasonably level ground, accessible by an existing road. If a promising location warrants it, however, considerable road construction and site preparation may be undertaken. About one acre is required for the average drill site.

The actual drilling operation would result in an obvious but temporary visual intrusion. Any road construction or site clearing would be a visual contrast of a permanent nature.

Visual impacts of the development and production stages would be similar to those of exploration activities. Development of a producing field may include additional road building, drilling sites, power lines, pipelines, and tank facilities.

Ecological Interrelationships

Ecological interrelationships in the Agropyron - Festuca Association are relatively unstable and are more likely to be upset by mans activities than are more mesic associations. Oil and gas operations which alter any abiotic or biotic component of a grassland community may adversely affect their ecological interrelationships. The nature of many of the chain-like relationships in the cycles and flaws that link environmental components are not fully known. In most instances, impacts on one part of the ecosystem will affect other components.

Any oil and gas operation which affects soil, water or atmosphere could upset natural ecological relationships. The immediate impacts of some actions, such as the destruction of soil micro-organisms or the failure of water to infiltrate compacted soils in amounts required to maintain the nutrient cycle, may not be noticeable. However, the effects would eventually become apparent in the plant community's lack of vigor, in higher vegetative mortality, in greater volume of surface runoff, and in increased stream turbidity.

If the soil were polluted by saline water, spilled petroleum, or other chemicals, decomposes organisms may be reduced or eliminated. If soil were compacted by heavy equipment and off-road traffic, its pore space could be so reduced that its permeability and water-holding capacity would be impaired. Soil pollution and compaction could therefore inhibit nutrient cycling and reduce the vigor of producer vegetation, and of the remainder of the community.

If improperly designed operations caused mass soil movements which exposed underlying rock or poor and immature soil, the original vegetative species may not become re-established for a very long time.

The aquatic ecosystem's stability depends on the maintenance of water quality. Sedimentation and pollution of natural waters resulting from oil and gas operations could kill aquatic micro-organisms, vertebrates, and aquatic vegetation, or inhibit the capacity of the aquatic biota to reproduce and maintain itself.

Amphibians, birds and mammals partially dependent upon natural waters may also be adversely affected by degradation of water quality.

Emissions of toxic gasses during oil and gas operations could adversely affect vegetation in the area.

Food and Community Relationships

Food relationships will be altered on localized areas by loss of vegetation and subsequent animal production. The loss of use areas, critical for a species to complete its life cycle, would obviously be detrimental to that species. For example, the significance of destruction or encroachment upon a large segment of critical deer winter range could depend upon the exact location and amount of land involved.

Most impacts relating to the development and operational stages have been discussed previously, increased activity, noise, pollution of existing water, etc. All of these factors may alter the animal habitat relationships either directly or indirectly.

POSSIBLE MITIGATING MEASURES

Non-living Components

Geology - Most of the geological hazards described above can be prevented or minimized by properly designing and placing roads and other oil and gas facilities. Necessary geologic information should be collected before a drilling permit applicants surface use plan is approved.

Some slopes show signs of instability, including fresh or healed cracks, sag ponds, and back-tilted blocks. Some unstable slopes are not obvious and verification may require careful study. Flood prone areas can be identified and facilities designed to reduce or eliminate flood hazards. Subsidence can be prevented or stopped by monitoring fluid withdrawals and reinjecting fluids when necessary.

Soil - Several measures may be utilized to lessen soil erosion caused by road construction during the preliminary investigation and exploration stages:

- Use of existing roadways as much as possible.
- New road construction only when necessary, and of a minimum operable width.
- Minimal construction during periods of heavy rainfall.
- Inclusion of facilities to control drainage, such as perforated pipe to provide sub-grade drainage, waterbars and culverts.
- Revegetation of roads not needed after preliminary investigations and exploration activities.

Steep slopes are common in the EAR area. Oil and gas operations, like other intensive land uses could cause mass wasting of the slopes if proper precaustions were not taken in the design and construction of roads, pipelines, well sites, and other facilities. Wet soils and areas where consolidated bedrock is more than 10 feet below the surface tend to be unstable on steep slopes. Water tends to float the soil mantle out of a wet area if a road cut removes the support. Deep, fractured, or weathered bedrock on steep slopes does not provide good support after the slopes are disturbed. Steep slopes with wet soils and areas where consolidated bedrock is not near the surface should be avoided when possible in the siting of roads and other oil and gas field facilities.

Design features which reduce the potential for mass wasting could be incorporated if roads are built on steep slopes. Special effort and design features include, but are not limited, to the following:

- Designing the road segment to the minimum width which will safely accommodate traffic and equipment for the intended uses.
- Road location and design such that excavation will not remove support from the base of over-steepened slopes or remove the toe of previous slides.
- Efforts could be made to avoid locating roads in steep headwalls of drainages where sidecase of excavated material would increase the potential for mass wasting. If this is not possible, materials could be endhauled to a suitable disposal site.
- Perforated pipe could be installed in road ditches where ground water is contributing to slope instability.

All trails and fire lines could be seeded or mulched, cross-ditched, or waterbarred before the first winter. Spacings and design of cross-ditches and waterbars could be implemented to remove water from the trail before it gains enough erosive power to cause rilling. The water could be discharged onto materials or structures which would dissipate its energy and disperse the flow to prevent erosion of the slope below the waterbar.

Roads constructed during the preliminary investigation, exploration, and development phases and intended for permanent use could be surfaced and regularly maintained. Where necessary, material could be endhauled rather than sidecasted. Cut and fill slopes could be limited to prevent exceeding the normal angle of repose.

The erosional impacts of water flowing from seismic shot holes can be eliminated by requiring that the holes be adequately plugged. In areas of high hydrostatic pressure, the holes could also be cased.

Revegetation should be accomplished rapidly by clearing and constructing drill sites in a planned operation. Revegetation may be accomplished more rapidly if the top soil in the disturbed areas is removed, stock piled, and then respread.

The use of mud pits and protective or secondary dikes around the mud pit and around the low side of the drill site would reduce possible impacts from jetting of drill cuttings and from accidents. The use of proper drilling methods, including drilling with proper mud weight and viscosity, could assure well control and reduce the threat of erosion caused by accidents such as blowouts and salt-water flows.

Mitigating measures used during preliminary investigation, exploration, and development phases can also be used to mitigate the impacts of production facilities. Disturbed areas near these facilities would be in continued use and should have a permanent cover to protect the soil from erosion.

Impacts of accidental spills from storage facilities can be minimized by requiring secondary or protective dikes around the facilities. The potential for leaks and spills from pipelines and flow lines can be reduced by periodically testing the lines under abnormal pressures. X-ray tests of valves, pumps, and lines subject to high corrosion can be run periodically to calibrate remaining effective strength.

During abandonment of a field, drilling pads, temporary roads, and other facility sites can be ripped, topsoil redistributed, tilled, and re-vegetated.

Land Use - Land use conflicts can best be resolved by comprehensive local and regional land use planning and the adoption of effective land use controls before leasing and exploration takes place.

Land uses such as intensive recreation, wildlife habitat, and urban residential development, which are basically incompatible with oil and gas operations, can be protected by stipulations in leases or by excluding such areas from leasing.

Land uses such as agriculture and livestock grazing, can co-exist reasonably well with oil and gas operations. Impacts on these land uses can be mitigated by employing the erosion control, revegetation and water quality protection measures previously discussed. Roads developed for oil and gas development may facilitate range management if oil and gas and range programs were coordinated.

Possible conflicts involving electrical transmission and natural gas lines right-of-way corridors could be resolved prior to leasing and exploration activities. Road use and access problems could be resolved in a like manner.

Air - The following methods could be used to reduce the amount of dust created by construction of access roads during preliminary investigation:

- Require operators to use existing roads whenever feasible.
- Permit the construction of new roads and trails and off-road vehicular travel only when absolutely necessary.
- Limit earth movement disturbance of vegetation by building roads to the minimum level required by the geophysical equipment.

- Close and revegetate roads not needed after investigations are completed.

During the exploratory phase, roads to stratigraphic drilling sites and wildcat wells may be restricted to the minimum required by drilling equipment. If roads are constructed during dry periods, they could be watered regularly. If oil and gas is not discovered, the roads could be closed and the surface reclaimed.

The potential for air polluting accidents such as well blowouts and fires can be reduced by developing contingency plans, training oil and gas field employees, and using equipment such as blowout preventers. Particulate concentration build-up during periods of inversions could be lessened by the curtailment of drilling activities at such times.

Microclimatic changes can be minimized by limiting the areas cleared of vegetation; preventing spills, fires, and other accidents which can kill vegetation; and revegetating facility sites and roads when they are abandoned.

Water - Frequent inspections of oil and gas operations could be made to insure that contract stipulations are being followed. Periodic inspections of streams for evidence of increased suspended sediment loads and petroleum related pollutants could insure the maintenance of state water quality standards.

The number of stream crossings needed to gather geophysical data on an area can be reduced by planning geophysical operations. Stream crossing sites could be specified before operations begin. Crossings, culverts or bridges may be designed to carry a reasonable peak flow capacity; approaches would be constructed to minimize sediment production; roads leading to the crossing could be surfaced with rock and designed for proper drainage. Ford construction could be restricted to areas of the stream where the bottom is rocky enough to prevent the dispersion of sediment.

When the U. S. Geological Survey and the State of Oregon issue drilling and waste discharge permits, additional stipulations may be included to insure adequate containment or disposal of caustic drilling fluids and brines. Proper casing and sealing of wells could prevent contamination of ground water aquifers. Stream channels and ponds may require the application of slant drilling and cluster-well technique to insure adequate protection in particular areas of concern. Mud pit berms may be constructed large enough to insure containment of contents and anticipated additions due to rainfall.

Holding tanks and other storage areas surrounded by impermeable dikes and berms could catch oil in the event of spills. The immediate cleaning up of oil spills would reduce the possibilities of water pollution. Reinjection of produced water and gas into production formations may reduce the chance of polluting water in other formations.

Proper cleanup, removal and burial of wastes during the abandonment phase could mitigate adverse impacts to water quality. All sites with exposed soil could be seeded and fertilized to replace protective vegetation.

Living Components

Aquatic Vegetation -- Measures to prevent soil erosion, degradation of water quality, loss of water supplies, destruction of terrestrial vegetation, and destruction of aquatic wildlife would also mitigate harmful impacts of oil and gas operations on aquatic vegetation.

During the preliminary investigation, exploration, and development phases, roads, pipelines and other facilities could be located to minimize the destruction of aquatic vegetation at stream crossings and to avoid disturbance of significant aquatic habitats. This could be accomplished by joint planning before preliminary investigations begin and by developing and enforcing stipulations in leases and drill permits. Equipment operators and others whose actions may damage aquatic resources could receive training on the importance of resources and on methods of doing their work without causing undue damage.

Mitigative measures to keep saline water and other toxic materials from killing aquatic vegetation include: (1) adequate well casing; (2) preventing well blowouts; (3) locating wells away from streams or ponds; (4) proper containment and reinjection of briny water into producing formations; (5) proper construction and maintenance of drilling mud pits; and (6) adequately sealing wells during abandoment. Secondary dikes may be built around exploratory and production wells to prevent toxic substances in drilling mud from reaching streams. After the drilling is done, drilling mud pits could be drained and rehabilitated. The mud can be disposed of at sites where it would not affect water quality and vegetative growth.

Terrestrial Vegetation - The destruction of vegetation during clearing operations can be reduced by limiting the number of dimensions of road, pipelines, trails, test wells, and other facilities required to complete the work. The use of existing roads would further reduce the amount of vegetative destruction.

Vegetative destruction can also be minimized by controlling soil erosion. Measures which can be taken to control erosion are described in the soils section of this chapter.

Disturbed areas should be revegetated as soon as possible. Special measures may be necessary to successfully revegetate some areas, such as topsoil replacement, ripping of compacted soil, fertilization, mulching, watering, and use of vegetative species not normally available.

Erosion hazard areas could be revegetated initially with fast growing herbaceous vegetation with good soil holding characteristics. Subsequent efforts can be made to insure early development of native vegetation.

The chances of vegetation being killed by spills or leaks of oil or briny water can be reduced by: (1) locating wells, storage facilities and pipelines as far from drainages as possible; (2) constructing dikes around all facilities that generate or store contaminants; (3) using proper mud weight for drilling and blowout prevention equipment; (4) using tanks to contain fluids during drill stem tests; (5) reinjecting brine into the ground rather than using evaporation pits; (6) development of, and adherence to, contingency plans for controlling blowouts, spills, and leaks; (7) installing monitoring systems, including x-ray tests of valves and pumps to detect and shut down mechanical failures which could result in leaks, spills, or other accidents; (8) casing all wells and test holes where there is a possibility that oil or brine can mix with aquifers; and (9) upon abandonment, seal wells, remove storage tanks and flow lines, drain mud pits, and dispose of material in a proper waste disposal site.

Wildfires can be prevented or controlled by: (1) using spark arrestors on tractors and other power equipment; (2) maintaining adequate fire fighting equipment and material such as retardants and water supplies at all operating sites; (3) maintaining adequate communications with state and Federal fire fighting organizations; (4) insuring the availability of adequate numbers of trained fire-fighting personnel; (5) keeping all personnel educated as to the hazards of fire; (6) maintaining fire breaks around fire hazard areas; (7) maintaining constant surveillance of all operating areas during periods of medium to high fire danger; (8) halting all operations during periods of extreme fire danger; and (9) properly disposing of vegetative debris.

Since the list of rare or endangered plant species contained in this report is general in nature as are potential work sites, a field check by a qualified botanist prior to the leasing of specific areas or before resource development begins is recommended to assure protection of these species. It is imperative that these plants be considered for special protection measures since any exploration or development within or adjacent to their habitat would negatively impact their survival.

Aquatic Wildlife - The most serious impacts of oil and gas operations on aquatic resources are the result of excessive sedimentation; accidental well blowouts; leaks and spills of oil, briny water and caustic components of drilling mud; contamination of ground water; physical alterations to the aquatic habitat; and improper disposal of domestic wastes.

Many of the measures directed toward maintenance of soil and water quality would also serve to maintain satisfactory habitat conditions for aquatic life.

Some accidents, such as leaks and blowouts, probably would occur regardless of the mitigating measures employed. However, the frequency and magnitude of such accidents could be reduced by careful operative practices and good maintenance practices. The use of blowout preventors could reduce well blowouts. Since it is most important from the standpoint of aquatic life to prevent oil, brine and drilling mud from getting into streams or lakes, slant drilling could be required at some sites to keep drilling operations away from surface waters. When drilling is required in sensitive areas, secondary dikes could be constructed around the drilling sites to retain oil and brine in case of blowouts. Tanks could be used to contain any liquids that flowed from the well during drill stem testing. Drilling muds could be disposed of where they would not degrade the environment. Mud pit sites can be restored to their former conditions after completion of the drilling.

Ground-water aquifers could be protected from oily and brine by sealing off the water-bearing strata with plugs about the well casing.

Consumption of water during drilling could be reduced by casing wells in highly permeable areas.

Careful planning of roads, pipelines, separators and storage batteries during oil field development would eliminate unnecessary roads and reduce soil disturbance. Stream crossings can be carefully planned and executed to minimize soil erosion. Cuts, fills and exposed banks can be mulched and seeded to minimize surface erosion.

Unavoidable stream damage may be mitigated by installing gabions, still logs, drop structures, riprap or sheer logs to create desirable habitat in adjacent areas.

Terrestrial Wildlife - Crucial wildlife areas, including wintering, breeding, nesting, fawning, and calving areas, and migration routes can be identified. These areas can be protected with protective stipulations or excluded from oil and gas activities.

Aerial and seismic activity can be timed to avoid wildlife areas during critical periods. Well heads can be located away from important habitat areas and slant drilling can be required to explore or tap pools located beneath critical habitat.

During preliminary investigation, exploration, and production drilling, drilling water and mud can be kept out of wildlife water supplies by storing them in metal tanks or leakproof pits. Briny water resulting from producing wells could be reinjected into the ground. Mud pits located near waterfowl habitats could be covered to prevent waterfowl entering and getting trapped in them. Fences may be built around mud pits if they are located in areas where large animals may fall in.

Waste by-products from drilling can be prevented from entering wildlife habitat with proper storage, treatment and disposal methods. Power lines located on or near heavily used flyways could be located underground where feasible. Safety devices could be installed on power poles and cross arms to prevent electrocution of perching birds, especially raptors. Utility poles located near busy roads can be designed to prevent raptors from perching on them.

Above ground installation of pipelines would provide easier detection of leaks, reducing the hazard to wildlife habitat from oil spills.

Temporary construction camps and permanent field operation facilities can be located away from crucial wildlife habitat. Compliance with state and Federal air and water quality and solid waste standards may prevent or minimize impacts on wildlife.

Reclamation of abandoned drilling sites and producing fields could include revegetation of disturbed areas with plant and grass species beneficial to wildlife. Open pits can be filled in and revegetated as well.

Human Values

Landscape Character - Measures which can be taken to reduce the visual impact of preliminary investigation and exploration include:

- Limiting access to existing roads and trails. If additional clearing is needed, it could be limited to that necessary to get the equipment to the site.
- Access roads could be designed to conform to the landscape as much as possible, following contours where possible, and have adequate drainage and erosion controls.
- Drill sites and pads could be kept to a minimum size.
- Retaining dikes may be built around mud pits and sumps.
- Drill sites could be located in areas which are as inconspicuous as possible, hidden from heavily traveled roads, and below skylines wherever possible. Drill sites could be prohibited on steep slopes where extensive excavation is required to make a level pad.

Much of the web of roads, seismic lines, pipelines and powerlines associated with field development could be reduced by advance planning. Much of the visual impact could be eliminated by properly locating powerlines, tank batteries, pump stations, and other surface structures. Immediate revegetation of all exposed soil on cut and fill slopes would reduce the impact of surface scars. Facilities could be made less obvious from a distance by painting them colors which blend with the surrounding landscape.

Little additional visual impact occurs in the production phase. The measures outlined above for development should be applied to the additional pipelines, pump stations, and treatment facilities constructed during this phase. Most of the noise associated with production can be controlled with engine mufflers and housings for flowline pumps.

Visual impacts in many areas can be largely eliminated in the abandoment phase by removing all surface structures, regrading well pads, roads, and impoundments to as near the original surface as possible and replanting with native vegetation.

Historical-Archaeological Resources - Two possible alternative measures are available for the mitigation of adverse impacts on cultural resources. Restrictions on surface occupancy may be used to protect known cultural resources present on Public Lands. The second mitigation measure available consists of a standard stipulation which will be included in all oil and gas leasing agreements issued by the Bureau of Land Management in the State of Oregon. The text of this stipulation is set out in the following two paragraphs.

Prior to any operations under this lease, the Lessee will engage a qualified archeologist, acceptable to the Supervisor, to make a survey of the land to be disturbed or occupied. A certified statement signed by the qualified archeologist, setting out the steps taken in the survey and the finds thereof as to the existence of antiquities or other objects of historic or scientific interest, shall be submitted to the Supervisor. If the statement indicates the existence of such materials which might be disturbed by operations under this lease, the Lessee shall take such mitigating actions as may be required by the Supervisor, including, but not limited to, archeological salvage or protective measures or avoidance of the site, to protect and preserve such objects. The responsibility for the cost of the certificate, survey, and salvage will be borne by the Lessee, and such objects shall remain the property of the Lessor, or the surface owner if other than the Lessor.

If a cultural resource is discovered during project operations, activities will be stopped until a survey of the materials is completed by a qualified archeologist engaged by the Lessee and acceptable to the

Supervisor, including but not limited to archeological salvage or protective measures or avoidance of the site, to protect and preserve the materials. Such materials shall remain the property of the Lessor, or the surface owner if other than the Lessor.

Social Welfare - The major potential adverse socio-economic effects of oil and gas development are:

(1) An increase in population placing a strain on local community facilities and services.

(2) Economic instability created by a rapid increase in employment, increase and demand for goods and services and a change in community life styles.

The impact on community service depends not only on the size of the development, but also on the rapidity of the development. Local officials of potentially impacted towns or cities could attempt to determine the development possibilities for their area well in advance of the time development might begin. The Geological Survey could confirm the location of oil and gas deposits. Companies could be requested to spell out possible development plans as soon as such plans for increased community development in case oil and gas development becomes a reality. Preplanning would eliminate some of the strain on facilities.

Economic instability could be partially alleviated by local officials understanding the uncertainty and finite nature of an oil and gas development operation. When the resource becomes depleted, demand for local community services and labor ceases. Local communities should be careful not to overreact in providing housing, services, and other facilities, and be left with a substantial excess when abandonment occurs.

If development resulted in a large influx of population into a small rural community, there might be little that could be done to mitigate the impact on life styles. The increase in population and the attendant crowding and urbanization could represent an adverse effect on those who have enjoyed a stable rural community life. New residents probably would not perceive historic landmarks and cultural values in the same manner as original residents. The dissemination of information to new residents about these values might provide a common understanding.

Ecological Interrelationships

Measures to mitigate adverse impacts of oil and gas operations on individual components of the environment are described in previous sections of this chapter. Collectively, these measures represent actions which could be taken to maintain stable ecological interrelationships.

The more xeric portions of the _Agropyron-Festuca_ Association and aquatic ecosystems are examples of areas where the maintenance of stable ecological interrelationships would be particularly important.

RECOMMENDATIONS FOR MITIGATION

Non-living Components

Geology - A geologic survey should be made before a drilling permit applicant's surface plan is approved. Such a survey should identify unstable terrain, springs, rock units and faults. In addition, flood prone areas should be identified and facilities designed to avoid flood hazards.

Subsidence should be reduced or stopped by monitoring fluid withdrawals and reinjecting fluids when necessary. Measures should be taken during reinjection to prevent contamination of groundwater supplies.

Soils - Surface occupancy should be prohibited where soil disturbing activities will cause mass wasting or cause soil damage for which there are no reasonable mitigating measures. Surface occupancy is questionable on slopes greater than 65 percent.

The following measures should be employed to lessen or minimize soil erosion caused by road construction during the preliminary investigation, exploration and development stages:

- Use existing roadways, landings and disturbed areas as much as possible.
- Construct new roads only when necessary, and keep to minimum operable width.
- Restrict construction during periods of heavy rainfall.
- Control drainage by use of perforated pipe, waterbars and culverts.
- Revegetate roads not needed after preliminary investigations and exploration activities.
- Avoid road construction on slopes over 75 percent. If steep slopes cannot be avoided, endhaul side slopes over 80 percent and headwalls over 75 percent.
- Locate waste sites for endhaul material on stable slopes.
- Avoid dug pickets of unstable soils on gentle slopes that are prone to slumping. If unavoidable, then stabilize by such measures as riprap, horizontal drains and surface drains.

All trails and fire lines should be seeded or mulched, cross-ditched, or waterbarred before the first winter. Spacings and design of cross-ditches and waterbars should be implemented to remove water from the trail before it gains enough erosive power to cause rilling. The water should be discharged onto materials or structures which would dissipate its energy and disperse the flow to prevent erosion of the slope below the waterbar.

Roads constructed during the preliminary investigation, exploration, and development phases that are intended for permanent use should be regularly maintained. Roads needed for yearlong use should be surfaced. Where necessary, material should be endhauled rather than sidecasted. Cust and fill slopes should be limited to prevent exceeding the normal angle of repose.

Revegetation should be accomplished rapidly by clearing and constructing drill sites in a planned operation. Topsoil in the disturbed areas should be removed, stockpiled, and then respread.

Mud pits and protective or secondary dikes around the mud pit and around the low side of the drill site should be required to reduce possible impacts from jetting of drill cuttings and from accidents. The use of proper drilling methods, including drilling with proper mud weight and viscosity should be required to assure well control and reduce the threat of erosion caused by accidents such as blowouts and salt water flows. Any excess contaminated water that could produce soil erosion or pollute the soil should be hauled off-site to a designated disposal area.

Mitigating measures used during preliminary investigation, exploration, and development phases should also be used to mitigate the impacts of production facilities. Disturbed areas near these facilities would be in continued use and should have a permanent cover to protect the soil from erosion.

Secondary or protective dikes should be required around storage facilities to minimize impacts of accidental spills. Pipelines and flow lines should be tested periodically under abnormal pressures. X-ray tests of valves, pumps, and lines subject to high corrosion should be run periodically to calibrate remaining effective strength.

During abandonment of field drilling pads, temporary roads and other facility sites should be ripped and topsoil re-distributed, tilled and revegetated with natural plant species.

Land Use - Ideally, land use conflicts should be resolved prior to leasing and exploration actions. Such problems can normally be solved by comprehensive local and regional land use planning. The adoption and implementation of effective land use controls further this end. Land uses, such as recreation, which are incompatible with oil and gas operations should be protected by stipulations in leases or by exclusion of such areas from leasing. Those land use conflicts that appear after oil and gas activities begin will ultimately have to be resolved at a more personal level (e.g., between the private landowner and the resource operator).

Impacts on land uses such as livestock grazing should be mitigated by emphasizing the erosion control, revegetation and water quality protection measures previously discussed.

Air - The amount of dust created by access road construction during the preliminary investigation phase should be mitigated by: (1) requiring operators to use existing roads whenever feasible; (2) allowing new road and trail construction only when absolutely necessary; (3) restricting earth movement and disturbance of vegetation during road construction to the minimum required level; and (4) closing and revegetating roads that are not needed after investions are completed.

Roads constructed during the exploratory phase to drilling sites should be kept to the minimum size and number required by oil and gas operations. Roads that are constructed during dry periods should be watered regularly to keep dust levels down. Should operations enter the production phase, heavy use roads should be surfaced.

The development of contingency plans, training oil and gas field employees, and using equipment such as blowout preventors will reduce the potential for air polluting accidents. Should inversions occur during periods of drilling activity, such operations should be curtailed until the inversion has broken up.

Water - Maintenance of water quality and quantities at existing sources may be achieved by employing the following mitigative measures:

(1) All operations should be required to meet the established water quality standards of the State of Oregon.

(2) Construction of roads and watercourse crossing structures should be limited to the dryer part of the year, generally from June through October.

(3) Disposal of waste products into either surface or ground water sources, or where it can enter surface waters during periods of high flows should not be permitted.

(4) Buffer strips should be required about all lakes and reservoirs and along all streams in order to protect riparian vegetation.

(5) Waste ponds should not be constructed within the flood channel of any stream.

(6) Holding or storage areas should be surrounded by an impermeable berm to contain any spills.

(7) All sites with exposed soil should be reseeded preferably with natural vegetation and fertilized.

(8) No water will be removed from any lake, reservoir, spring, or well on Public Lands without advanced written authorization of the Authorized Officer. Compensation will be made for any water removed from any Bureau of Land Management well.

Living Components

Aquatic Vegetation - Measures to mitigate adverse impacts on aquatic vegetation include the proper location and construction of stream crossings, roads, pipelines and other facilities. These actions will be accomplished as a joint planning function on the part of the Bureau of Land Management, U.S. Geological Survey and the resource developer. The development and enforcement of stipulations for leases and drilling permits will lessen the adverse impact potential throughout all phases of oil and gas operations.

Resource developers should educate their equipment operators and others whose actions may damage aquatic resources, on the importance of resources and on methods of getting the job done without causing undue damage.

Mitigative measures that should be employed to keep saline water and other toxic materials from killing aquatic vegetation include: (1) adequate casing of wells; (2) use of well blowout prevention devices; (3) locating wells away from streams or ponds; (4) proper containment and reinjection of briny water into producing formations; (5) proper construction and maintenance of drilling mud pits; and (6) adequately sealing wells during abandonment. Secondary dikes may be built around exploratory and production well facilities to prevent toxic substances in drilling mud from reaching streams. Upon completion of drilling, drilling mud pits will be drained and rehabilitated. Mud disposal should be at sites where it will not affect water quality and vegetative growth.

Terrestrial Vegetation - The number and dimensions of roads, pipelines, test wells, and associated facilities should be limited to those required to accomplish the work. Such restrictions would result in minimizing the amount of vegetation destroyed.

Vegetative destruction from soil erosion is an inherent factor of all surface disturbing actions. Mitigating measures that should be employed to control erosion are described above in the soils section.

Revegetation of disturbed areas should be completed as soon as possible. To successfully revegetate some areas, it will be necessary to employ measures such as topsoil replacement, ripping of compacted soil, fertilization, mulching, watering and use of seedlings of plant species not readily available.

Revegetation of erosion hazard areas should be with fast growing herbaceous vegetation with good soil holding characteristics. Subsequent efforts should be made to insure early development of native vegetation.

Mitigative measures that should be employed to reduce the chances of vegetation being killed by spills or leaks of oil or briny water include: (1) locating wells, storage facilities and pipelines as far as possible from drainages; (2) construction of dikes around all facilities that generate or store contaminants; (3) use of proper weight mud for drilling and blowout prevention equipment; (4) use of tanks to contain fluids during drill stem tests; (5) reinjection of brine into the ground rather than using evaporation pits; (6) development of, and adherence to, contingency plans for controlling blowouts, spills, and leaks; (7) installation of monitoring systems, including x-ray tests of valves and pumps to detect and shut down mechanical failures which could result in leaks, spills, or other accidents; (8) casing of all wells and test holes where there is a possibility that oil or brine can mix with aquifers; and (9) upon abandonment, seal wells, remove storage tanks and flowlines, drain mud pits, and dispose of material in a proper waste disposal site.

Oil and gas operations, like other land use activities on Public Lands, requires constant surveillance for wildland fire. Steps that should be taken to prevent or control wildfires are: (1) use of spark arrestors on tractors and other power equipment; (2) have adequate fire fighting equipment and materials at all operating sites; (3) maintain adequate communications with state and Federal fire fighting organizations; (4) insure that an adequate number of trained fire-fighting personnel are available; (5) keep all personnel educated as to the hazards of fire; (6) halt all operations during periods of extreme fire danger; and (7) properly dispose of accumulated vegetative debris.

Since there is a possibility of rare or endangered plant species within the EAR area, field checks by a qualified botanist are recommended before the initiation of any phase of work to assure the protection of these species.

Aquatic Wildlife - The following mitigative measures should be applied to maintain and/or minimize adverse impacts on aquatic wildlife habitats: (1) all stream crossing structures should be constructed so as not to reduce or impede normal rates of streamflow; and (2) restrictions described under water, above, are adequate to maintain and/or minimize adverse impacts on aquatic wildlife habitat.

Terrestrial Wildlife - In order to maintain and/or minimize adverse impacts on terrestrial wildlife habitats, the following mitigative measures should be applied to oil and gas resource developments: (1) exploration activites within identified crucial habitat areas should be prohibited; (2) activities within reasonably important habitat areas should be restricted to periods of non use; (3) habitat areas within lease areas, such as stream banks and marshes, should be protected from disturbance; (4) on-site protective measures should be formulated to give protection to wildlife species inhabiting the area; (5) construction facilities should be located away from crucial wildlife habitats; and (6) reclamation of all disturbed sites should be required.

Human Values

Landscape Character - Oil and gas resource development during the preliminary investigation and exploratory phases could have adverse impacts on the landscape. However, these impacts would be widely scattered and relatively localized in nature. Impacts to be expected during the development phase would be basically the same.

Most of the EAR area is classified as "D" quality scenery with some "C" quality scenery in the areas around Battle Mountain Ridge, the southern high country, Pole Creek, and the upper and lower reaches of Antelope Creek (Owyhee River Basin). Excellent scenery ("B" quality) is represented by Little Owyhee Canyon (Louse Canyon) and Rattlesnake Creek and Canyon.

Measures that should be taken to reduce the visual impact of both exploration and development activities include:

- Use existing roads whenever possible. Utilize natural benches or log landings for drill sites where possible.
- Keep drill sites to the minimal size practical.
- Keep drill sites located as inconspicuously as possible. If located along main roads, leave a screen of trees or brush if practical.
- Consolidate pipelines, powerlines and roads or common rights-of-way.
- Structures should be located to be as inconspicuous as possible, and should be painted to blend with the landscape.

In the abandonment phase, the following mitigative measures should be taken to eliminate visual impacts on the landscape:

- Completely remove all structures, material and debris. Properly dispose of any spills or waste.
- Regrade well-pads, access roads (if no longer of use for other purposes) and impoundments to as near the original surface as possible. Replant with natural vegetation.

Historical-Archaeological Resources - In addition to two sites of potential historic values, several sites of archeological and paleontological significance are known to exist in the EAR area.

The standardized antiquities stipulation added to all oil and gas leasing agreements issued by the Bureau of Land Management in Oregon will provide adequate protection and impact mitigation for heretofore undiscovered cultural resources within the analysis area.

Social Welfare - Immigration into southern Malheur County and adjacent areas in response to new employment opportunities will be the inevitable result of discoveries of marketable quantities of oil and gas in the area. This will precipitate an increased demand for goods and services which local communities must meet. Affected communities would be well advised to anticipate these increased demands by careful evaluation of the production potential of the discoveries as that data becomes available. Using these evaluations communities can more accurately predict population growth and attendant demands for goods and services. Facilities and services can then be provided to meet actual projected needs avoiding the problem of grossly over or under estimating needed facilities and services.

Ecological Interrelationships

Mitigative measures to avoid alternations to the abiotic environment or the biotic community would necessarily incorporate the sum total of all mitigative actions recommended for the various components of this section, i.e., non-living and living. Collectively these mitigations should reduce or lessen the adverse impacts to be expected on ecological interrelationships.

Standardized Mitigating Measures

The Federal leasing procedures and state regulations on oil and gas resource development and the notice forms, stipulations, and regulations are summarized under this heading in I, Proposed Action.

RESIDUAL IMPACTS

This section describes impacts which could remain after mitigating measures are applied. Many of the impacts described below would result only if accidents, such as spills or well blowouts occur. The probabilities of such accidents and the ensuing impacts occurring on any given lease would be low, but the possibilities cannot be ignored.

Non-living Components

Geology - Some land subsidence and groundwater contamination could occur despite mitigative measures.

Although facilities may be built to withstand most earthquakes, the possibility exists that a particularly severe quake could rupture pipelines and storage tanks or trigger landslides on slopes on which access roads have been built.

Soils - Soils are affected whenever the natural interactions of parent material, vegetation, topography, and climate are disrupted. Measures to mitigate the effects of oil and gas operations would not restore soils to their natural state. Some measure of impact would remain until natural interactions had time to again reach harmony with each other.

Erosion processes are accelerated any time the protective cover is removed and the soil is disturbed. Mitigating measures could reduce erosion, but not eliminate it.

Productivity of the natural vegetation would be reduced if the area were disturbed or the soil compacted, and the reduced vegetation cover would lead to increased erosion. Some fill or cut bank failures could occur if roads, trails, or buildings were constructed on steep terrain. Accidental spills of some materials could sterilize soils. Areas where drilling mud, brackish water, or oil were stored or spilled would not recover to their initial state.

Land Use - Four factors are considered under this heading: recreation, mining, agriculture, and urban uses. A fifth topic, forestry, is of no significance in the EAR area.

1. Recreation. Roads and structures associated with oil and gas development change the character of the natural landscape. Although the increased access might benefit some recreational users, the majority of the impacts on an area's recreational values would be negative. During the development and operation phases, relatively small portions of the oil field may be off-limits to recreationists.

2. Mining. Oil and gas resource development precludes the use of a given area for other types of mineral development during the producing life of the field.

3. Agricultural. Disruption of grazing activities could not be avoided in some areas. Relatively small areas would be taken out of the grazing program in an oil and gas field. The overall impact would be comparatively minor.

4. Urban uses. Although extensive steps have been taken in other areas to minimize conflicts between oil and gas operations and residental, commercial, and industrial land uses, conflicts with these intensive land uses -- particularly residential -- cannot be entirely avoided. The possibility of explosions, fires, and other oil and gas field accidents poses the most serious, unavoidable conflict with other intensive land uses.

Air - Strict enforcement of air quality standards cannot entirely eliminate atmospheric pollution by oil and gas operations. Air quality would be degraded, at least temporarily and locally, by engine emissions and dust arising from construction activities and travel on gravelled roads. Well blowouts and accidental fires could occasionally add toxic vapors and particulates to the atmosphere. Air pollution would also result from some types of pumping equipment, and from fumes from the crude itself.

If oil and gas operations were carried out in the EAR area, some alteration of microclimate would be inevitable. Removal of vegetative cover for access roads and drilling sites would continue to affect microclimate in the field during the life of the oil and gas operations. If vegetation were disturbed on sites where revegetation to existing plant species is difficult, the microclimatic changes could remain long after reclamation operations are carried out during the abandonment phase.

Water - Stream crossing would inevitably produce sediment. Unexpected, or unusual, peak flows could cause erosion or the failure of stream crossing structures.

Geophysical data could be misinterpreted and shallow or narrow groundwater aquifers might be overlooked and not cased, allowing contamination by oil and briny water. Well casings for both production and injection wells could leak and allow contaminants to reach groundwater aquifers.

Living Components

Aquatic Vegetation - Some aquatic vegetation would be destroyed or buried by road or pipeline construction at stream crossings. The loss of productivity would depend on the size and number of crossings and would be long-term in nature unless a similar amount of vegetation could be established elsewhere in the ecosystem.

In many cases, aquatic vegetation destroyed through massive earth slides can be replaced only by natural processes. The impact can be severe and last many years.

Sedimentation of aquatic ecosystems would be increased above natural levels despite all mitigative efforts to prevent it. Unavoidable sediment deposits in streams and standing water habitats would result primarily from roads, trails, and pipelines. Accidents during exploration and development would contribute additional sediment to streams and lakes. The long-term effects of excessive sedimentation are often more serious to aquatic plants in shallow water habitats than short-term effects from a single pollution kill.

Many measures can minimize the impacts of most planned actions on aquatic vegetation. However, some severe short-term effects are unavoidable because of accidents, human error, and mechanical failures. Leaks or spills from pipelines or storage facilities would occur periodically, causing pollution of surface waters despite contingency plans and quick cleanups. As a result of these events, some aquatic vegetation would be killed by oil, saline water, toxic substances in drilling muds, fires, and contaminated groundwater. Most of these impacts would be short-term in nature. However, the effects could be serious if large amounts of water and gas were spilled into streams or lakes or if subsurface water contaminated by oil, gas, or briny water polluted aquatic habitats for prolonged periods.

Terestrial Vegetation - Mitigative measures could minimize the impact of most oil and gas operations on vegetation. However, the possibility remains that accidents such as leaks, spills, or fires could cause adverse impacts that could not be easily or rapidly remedied. It is also possible that planned rehabilitative measures, such as ripping of compacted soils or revegetation of disturbed areas, would be ineffective due to unforeseen circumstances. In some instances, it may be many years, especially in unfavorable sites, before native plant species become established.

Aquatic Wildlife - Even though mitigative measures were taken, soil erosion and sedimentation of surface waters would increase because of the construction of roads, trails, and pipelines during exploration and development phases. The damage to aquatic resources would vary, depending upon variables such as soil types, terrain, climatic conditions, degree of development, and time of year.

The long-term ecological effects of sedimentation of streams, ponds, and lakes are often of greater consequence to aquatic species than immediate, short-term effects of direct mortalities. For example, heavy sediment loads alter habitat conditions, making surface waters shallower and warmer. This creates unfavorable habitat conditions for cold water game fish, resulting in a predominance of undesirable non-game fish or total elimination of cold water fishes.

Even with good mitigative efforts, some short-term sedimentation can be expected from stream crossing, from gravel removal operations, and from channel changes. Sedimentation during construction would be short-term. However, it could continue for several years during heavy surface runoff until disturbed areas become stabilized with vegetation.

Little can be done to mitigate the effects of landslides on aquatic wildlife after they occur. The only effective mitigation measures are through planning, careful construction, and proper maintenance.

High turbidities during fishing seasons cause a reduction in effort and catch rates, and consequently a reduction in the harvest of the resource.

Excessive turbidities may have greater impacts if they occur during times of critical biological activity. These times are generally associated with reproduction, feeding and movement. These events occur during different times of the year for different species.

The most important unavoidable impacts on water quality and aquatic life would happen during exploration, development, and production phases. Despite the implementation of stringent mitigative measures, the possibility of accidents such as leaks, spills, explosions, fires, and blowouts could not be entirely eliminated.

Well blowouts could cause serious impacts on aquatic wildlife if the oil flowed directly into standing or running-water habitats. Complete cleanup might be impossible. Local waters could be damaged for relatively long periods of time, and detrimental effects could extend downstream for considerable distances.

Pipeline leaks could also cause considerable damage to freshwater fish and fisheries. The magnitude and longevity of the impact would depend upon the volume of oil lost, water levels, sediment loads, location of the spill, and the season and temperature. Plankton, benthic organisms, insects, fish, and spawning areas would likely suffer long-term effects from a large spill. Contamination of stream banks could preclude recreational use of areas for short times.

With the possible exception of incidents caused by well blowouts, contamination of surface waters by chemicals used in drilling mud can be prevented.

Some contamination of groundwater may occur during well blowouts, well drilling and subsurface waste disposal during secondary recovery operations. Polluted groundwater may enter surface water and degrade the aquatic environment. Damage to aquatic ecosystems would probably not be substantial or long lasting unless a badly polluted aquifer discharged a large flow into a small stream or pond.

Stratigraphic testing, well drilling, blowouts, and secondary recovery operations could cause groundwater losses which could not be mitigated. Diminishing groundwater levels could dry up small springs, sloughs or ponds, resulting in the decline or death of aquatic species.

Terrestrial Wildlife - While most impacts on wildlife could be reduced, some mortality or displacement of individual animals would be inevitable. Preliminary investigation and exploration activities such as aerial reconnaissance, seismic testing, and wildcat drilling would affect wildlife to some degree, but the impacts would largely be temporary. Discovery and subsequent development of a producing oil and gas field would remove habitat currently used by many species of wildlife. Critical habitat areas could be excluded from exploration and development, but less important habitat would be removed from wildlife use. Wildlife harrassment caused by human activity in and around producing fields could not be entirely mitigated. Large species of wildlife, especially predators, would be adversely affected.

Accidental oil spills might occur even though extreme caution were used in extracting and storing oil. Normally such spills could be mitigated through cleanup and restoration. However, spills on habitat essential to wildlife would have adverse impacts that could not be mitigated for at least the time required to clean the spill site.

Human Values

Landscape Character - Impacts on the visual environment would be unavoidable during all phases of oil and gas operations. Vegetation patterns would be altered for varying lengths of time in the exploration, development, and production phases. Some soil movement would occur in all phases. Both the structures and the soil movement would interupt the natural character of the landscape and neither could be entirely mitigated.

If proper mitigating measures were taken after a field was abandoned, there should be little adverse impact on the visual environment.

Exceptions might include areas where revegetation is a slow and difficult process and steep areas with extensive cuts and fills.

Social Welfare - The greatest impact on life styles might occur in the smaller rural communities. Opportunities to mitigate the impacts of increased populations in these areas is limited.

Because of the finite and relatively short-term nature of oil and gas resource development, a certain amount of short-term economic instability may be unavoidable.

Ecological Interrelationships

Actions which alter the abiotic environment on biotic community can affect ecological relationships in varying degrees and mitigative measures cannot be entirely effective. Despite all feasible precautions, some oil and gas resource development procedures would upset the natural balance of any ecosystem, at least temporarily. Actions or accidents which destroy vegetation, disturb soil, degrade water quality and pollute air would cause some disruption of ecological interrelationships. In such instances, the nutrient and hydrologic cycles may be interrupted until the affected area was revegetated and soil stabilized, or until the source of pollution was removed.

If grazing, road construction, mining or other activities had already affected ecological interrelationships, the added impact of oil and gas resource developments could create a cumulative effect that may not be offset by mitigating measures.

RELATION BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

This section considers the relationships between short-term use of the environment for oil and gas resource operations and the long-term productivity of the environment and its maintenance for other uses.

"Short-term" use refers to the period during which oil and gas operations would occur. This extends from exploration through abandonment and completion of reclamation. Short-term use may range from several months should preliminary investigations or wildcat drilling prove unsuccessful to up to over 50 years if commercial quantities of oil and gas were discovered.

"Long-term" is that time in which the subsequent effects of the action will still impact the environment. This may be considered to be the period of time beyond the point when all possible restoration has been completed.

Non-living Components

Geology - If oil and gas were discovered and developed, their use in the short-term would preclude long-term use of the resources for engergy or as raw materials in manufacturing processes. If oil and gas activities caused geological subsidence, the effects would extend into the long-term future.

Soils - Long-term productivity would be reduced where oil and gas activities create soil erosion or compaction. Productivity losses would be greatest in areas directly affected by facilities such as mud pits and toxic waste disposal sites.

Land Use - Oil and gas operations would have long-term impacts in areas with highly significant recreational value. Long-term rangeland productivity could be impaired by soil erosion caused by oil and gas activities. Livestock grazing would be restricted during field operations but could be resumed after abandonment. Oil and gas activities in developed areas could attract other industrial and commercial activity, usually based directly or indirectly on oil and gas resource development, and detract from the long-term value of the area for residential uses.

Air - Micro-climates would be permanently modified in areas where roads and other developments were maintained after oil and gas operations were abandoned and in those abandoned drill sites and roads in which the vegetative cover could not be restored to its orignal state.

Water - One long-term effect of the construction of roads and other facilities required in oil and gas resource development would be increased sedimentation in streams and reservoirs. Mitigative measures could reduce, but probably not entirely eliminate, sedimentation resulting from resource development activities on steep slopes. A very long period of time may be required for sediment-laden streams to regain a state of equilibrium.

Should ground water aquifers inadvertently become contaminated through oil and gas operations, it may take many years for the effects to be noted. Such contamination can usually be corrected only by natural processes which take many years, if not centuries.

Living Components

Vegetation - The long-term productivity of both aquatic and terrestrial vegetation could be reduced by construction activities, earth slides, accidents, human errors, and mechanical failures associated with oil and gas operations.

Destruction of vegetation when roads and pipelines across or adjacent to aquatic habitats results in reduced long-term productivity. A fill or sidecast placed in any aquatic habitat may remain there after the facility is abandoned.

Large oil spills reaching surface waters could have a detrimental long-term impact on vegetation in the vicinity of the spill. Production of aquatic vascular plants, algae, and phytoplankton could be adversely affected, causing reduced production of all organisms throughout the food chain.

The long-term effect of increased sedimentation from oil and gas activities would be to shorten the life span of some aquatic ecosystems, thus eliminating aquatic plants from the environment sooner than under natural conditions.

Aquatic vegetation in small springs or ponds could be lost if shallow water aquifers were drained during well drilling.

The potential for long-term negative impacts on terrestrial vegetation would be greatest in areas with steep slopes, unstable soil, or fragile ecosystems. On sites where oil and gas activities caused soil erosion, compaction, or pollution, productivity could be reduced to the extent that indigenous plant species could not be established after the sites were abandoned. Only brush or forbs, for example, might grow on sites which previously supported associations of desirable range grasses.

Aquatic Wildlife - Accelerated sedimentation caused by oil and gas operations would adversely affect the long-term productivity of aquatic wildlife. The long-term ecological impact of sedimentation in streams is reduced production of indigenous cold water fishes. Habitat conditions become more favorable for non-game species that thrive in warm and shallow waters while cold water species, generally those sought by sportsmen, are either reduced in numbers or eliminated from an area. Some aquatic insects and benthic organisms, some of which serve as food for various fishes, are affected in a similar manner by changes in habitat caused by sedimentation.

Earth slides triggered by road construction could continue to occur after an oil field is abandoned, creating further adverse long-term impact on aquatic habitats.

Oil pollution of aquatic ecosystems from blowouts, leaks, and spills could reduce the long-term productivity of aquatic habitats. Plankton could suffer long-term adverse effects from oil pollution, as could populations of larger species which utilize the plankton directly or indirectly as food and which are utilized in turn by the sportsman.

Consumption of surface and ground water during oil and gas operations could cause a short-term depletion of water supplies, but impacts on aquatic habitats and their fauna could be long lasting. Ground water levels and aquifer pressures could be lowered, thus decreasing the rates of spring flows. During some years, this could eliminate small springs, marshes or ponds that are habitat for some species of fish.

Terrestrial Wildlife - Oil and gas preliminary investigations and exploration usually would not restrict long-term usage of the lands for wildlife habitat unless endangered species were affected. However, should oil and gas resources be discovered, subsequent development and production could have a short-term effect on wildlife through loss of wintering, breeding, feeding and migration areas. After production and site abandonment, the ecosystem may not be entirely rehabilitated. Human settlement and accompanying settlement may after the resources were depleted. Wildlife formerly found in the area of development may not use the habitat again due to changes in land use.

Smaller wildlife species such as rabbits, ground squirrels and other rodents, and many birds and small predator species that prey on them may reinhabit portions of their former habitats. Changes in the habitats may encourage exotics such as pheasants to become established.

Human Values

Landscape Character - Oil and gas field facilities would create a visual intrusion on the natural landscape during the short-term life of the operations. After field abandonment, the long-term effects would vary with the susceptibility of the landscape to reclamation. Areas with steep slopes, erodible soils, or fragile ecosystems would be most likely to bear long-lasting scars of oil and gas operations.

Social Welfare - In the short-term analysis, local communities may experience additional demands upon goods and services created by an expanding population responding to potential opportunities of new employment. Should oil and gas resources be sufficient size to warrant extended exploration and/or production activities, much of this new population could become permanent in nature.

With the cessation of oil and gas exploration and production activities, an emigration of most of the new population could be expected. This could result in a disproportionate amount of goods and services, etc., compared to the needs of the remaining population.

On a long-term basis, it is not expected that any action of proposed oil and gas lease operations would have any adverse impacts of a permanent nature on the social welfare of the residents of the analysis area.

Ecological Interrelationships

Short-term actions such as oil and gas operations pose their greatest threat to the continuing productivity of those ecosystems which contain plants having low growth rates and animals, usually most wildlife species, with low reproduction rates. These conditions are typical throughout much of the EAR area. In any small ecological unit, however, oil and gas operations would alter the natural balance and reduce long-term productivity where permanent roads and structures were installed and where mass soil movement occurred. The productivity and ecological equilibrium of aquatic habitats in streams and ponds could be permanently affected by actions associated with oil and gas operations.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Non-living Components

Geology - The major irreversible impacts on geologic resources would be the consumption of oil and gas and the commitment of construction materials such as sand and gravel for the development of the oil field.

Soils - Actions which destroyed topsoil or caused erosion could permanently affect vegetative productivity. The magnitude of the impact could be reduced by implementing appropriate mitigating measures.

If land slides exposed bedrock and precluded revegetation, the micro-climatic changes created by loss of vegetation would be irreversible.

Land Use - The effects of oil and gas operations in significant recreation areas could be irreversible. To a large extent, agricultural and forestry land uses could be resumed after field abandonment. Urban development resulting from oil and gas production could establish long lasting land use patterns.

Air - Micro-climatic changes created by loss of vegetation through land slide and erosion would be irreversible if revegetation did not occur.

Water - If there were no accidents or failures in any phase of oil and gas activity, there would be no irreversible and irretrievable commitment of water. However, some accidents would probably occur in spite of precautions. If ground water aquifers were contaminated, water quality would be reduced for long periods of time.

If subsidence occurred, ground water aquifers could be permanently impaired.

Reservoirs could suffer permanent loss of storage capacity because of increased sedimentation.

Living Components

Aquatic Vegetation - If ground water aquifers were drawn down excessively, aquatic habitat in small springs or ponds could be permanently eliminated due to desiccation, resulting in an irretrievable loss of aquatic vegetation.

The natural conversion of standing water habitats to land masses could be accelerated by oil and gas operations which contribute to sedimentation. Massive earth slides are the most visible sources of sedimentation, but the cummulative effect of increased sediment from other actions can cause the greatest effect on aquatic plants.

Minor amounts of aquatic vegetation would be eliminated at road and pipelines water crossings.

Terrestrial Vegetation - If all or most of the soil on a site were eroded or removed in a mass movement, the effect on vegetative productivity could be irreversible. If oil and gas operations contributed to the elimination of a threatened plant species, the effects would be irreversible.

Wildlife - It is not anticipated that oil and gas operations in the EAR area would result in the loss of an endangered species. Should it occur, however, it would represent an irreversible and irretrievable commitment. Small non-mobile species dependent on a microsite or other limited habitat would be especially vulnerable. Other more mobile species, such as the characteristic major wildlife species, could be eliminated from an area for a long period of time. Whether this would be irreversible is not known.

Discovery and development of an oil field might result in permanent urban development. The loss of habitat and attendant human activity could result in the loss or displacement of major game species and the larger predatory birds and animals. Any fish or wildlife production that is foregone during periods of development would be lost forever.

Heavy industrial and domestic water use could lower water tables, draining marshes and other wetlands. Waterfowl, other birds, amphibians, and small mammals formerly inhabiting the wetlands might be displaced or permanently lost.

Human Values

If properly planned and carried out, mitigation and rehabilitation measures should be able to restore aesthetic values in many areas. The original character of the landscape may never be retrieved where road building or other construction initiated land slides or other mass soil movements.

ALTERNATIVE TO THE PROPOSED ACTION

Denial of geothermal or oil and gas leasing on Public Lands within the EAR area may be considered an alternative to the proposed action. However, considering the nature of the laws and regulations pursuant to which such lease applications are made, denial requires cause, and denial for cause assumes an objective evaluation. Such is one purpose of this environmental analysis--to speculate on the significance of residual environmental impacts (those that remain after all reasonable mitigating measures are applied) to determine if there is justification for a recommendation of denial. Denial, therefore, is a possible environmental consideration in the process of deciding whether to lease or not to lease. For the following reasons an analysis of the "no leasing" alternative would have little practical significance:

(1) As an alternative action, since no exploration or development would take place, lease denial would obviously have no adverse, on-site, environmental impact relative to Public Lands.

(2) Off-site impacts, primarily socio-economic in nature, could be affected by the no leasing alternative only if an economic quantity of geothermal and/or oil and gas resources is assumed. Using that assumption, the impacts of "no leasing" involve considerations far beyond the reasonable scope of a regional or local analysis, e.g., National Energy Supply Policies.

(3) "No leasing" of Public Lands would not necessarily preclude resource development--because of the checkerboard public/private pattern of land ownership, geothermal or oil and gas development could preceed on private lands.

The spin-off effect on private lands resulting from "no leasing" on intermingled Public Lands must also be recognized. Though conjectural as to degree, the effect could be over-development of private lands with the possible multiplication of on-site environmental impacts.

In addition, a "no lease" decision could conserve portions of possible oil and gas resources for use by future generations. Such a decision would also conserve other natural resources, including fish and wildlife, that would be unfavorably affected by oil and gas operations.

IV. PERSONS, GROUPS, AND GOVERNMENT AGENCIES CONSULTED

The following local people or agencies were consulted concerning geothermal or oil and gas resource exploration and development in southern Malheur County.

Oliver Wendell Collins
City Councilman
Jordan Valley, OR 97910

James Connors, Chairman
Humboldt Co. Planning Comm.
Winnemucca, NV 89445

Mike Hanley
Jordan Valley, OR 97910

Harold Jackson, Mayor
Jordan Valley, OR 97910

Mahlon Marshall
McDermitt, NV 89421

Oregon Fish & Wildlife Comm.
Route 1
Ontario, OR 97914

Alford Pottorff
Malheur County Planner
Courthouse
Vale, OR 97918

Robert Skinner
Jordan Valley, OR 97910

U.S. Geological Survey
Conservation Division
345 Middlefield Road
Menlo Park, CA 94025

U.S. Fish & Wildlife Service
Division of Ecological Services
Portland Field Office
727 NE 24th Avenue
Portland, OR 97232

Domingo Urquiaga
Arock, OR 97902

In addition, BLM personnel of the Vale District have, during the past three years, made several trips and requested assistance from several groups or individuals concerning geothermal or oil and gas resource development:

- Five members of the Vale District Office visited The Geysers Geothermal Development near Ukiah, California.

- Five members of the Vale Bureau of Land Management District attended a Geothermal Seminar in Portland, Oregon, sponsored by the Bureau of Land Management. One member of the Vale District attended a Geothermal Seminar on Non-power Uses of Geothermal Energy at Klamath Falls.

- Assistance was requested from the U.S. Celogical Survey con cerning geothermal development. Bruce Hellier and Bill Lee of the USGS and Richard Bowen of the Oregon State Department of Minerals and Geology Research visited the District Office to explain geothermal energy.

- Two members of the Vale District attended a Geothermal Seminar in El Centro, California, at which several experts in the field spoke on the subject and made themselves available for questions. A tour of the Cerro Prieto geothermal development in Mexico was provided.

- Three Geothermal Seminars were held in the Vale area. George Nielson of the BLM California State Office spoke and answered questions at these seminars.

- Interviews with residents of Jordan Valley and McDermitt were made by members of the Vale District Office to obtain opinions concerning geothermal and oil and gas resources.

V. INTENSITY OF PUBLIC INTEREST

Response to the District's request for input for this EAR document has been minimal as has response to previous requests on geothermal and oil and gas EARs. Responses have ranged from no objections to the proposed leasing to requests for additional information as the work develops.

The proposed geothermal development had aroused only mild public interest. This assumption is based on the number of people that have attended public meetings concerning the Vale KGRA and the Bully Creek Geothermal Interest Area and their reaction to the explanation of geothermal development and the number of contacts that have been made with BLM personnel concerning proposed geothermal development in these two EAR areas.

The failure of previous drilling operations in Malheur County to discover commercially significant resources of oil or gas has created a general attitude of pessimism among many residents of the area towards the possibilities of economic discoveries by future operations. Some individuals residing within the EAR area believe that the discovery of economically significant resources is remote at best. Their beliefs are based upon the fact that past drilling activities have produced only minor shows of oil and gas. No oil and gas operations in Malheur County have ever progressed beyond the exploratory phase.

Some private land owners have been approached by oil companies representatives concerning possible leasing of their property for oil and gas resource development. Their response has ranged from refusal to acceptance of lease terms.

Many residents within the EAR area have heard or read about interest in and the proposed leasing of certain public lands for oil and gas resource developments. However, most are not fully aware of what these resource developments would mean to them or what the processes involved would entail and only a few expressed any interest.

For these reasons, it was decided by the BLM not to hold public meetings concerning geothermal or oil and gas resource exploration and development in the EAR area. However, letters of inquiry were sent to 301 individuals, groups and governmental agencies soliciting comments on the environmental impacts of geothermal and oil and gas leasing in the Oregon Canyon area. Replies were received from 14 parties. Copies of our letters, the lists of persons to whom they were sent, and the replies can be found in Appendix F.

VI. PARTICIPATING STAFF

This Environmental Assessment Record was prepared in the Vale District, Bureau of Land Management by:

Thomas A. Moore - Chief, Division of Resources
Richard A. Diener - Planning and Environmental Coordinator
Philip R. Rumpel - Range Management Specialist
Robert R. Kindschy - Wildlife Biologist
John V. Roberts - Geologist
Sheldon E. Saxton _ Realty Specialist
Gerald F. Henrie - Soil and Water Specialist
Gerald A. Meyer - Recreational Specialist
Barry D. Stallings - Manager, Southern Malheur Resource Area

VII. SUMMARY CONCLUSIONS

Geothermal Resources

There are two major residual impacts that may result from the exploration and development of geothermal resources. There will be an impact on the local communities and community services; if blowouts occur, there is a good possibility that odorous effects will be caused from escaping non-condensable gases. Both impacts would be of short duration.

Development of the geothermal resources in an environmentally acceptable manner can have a substantial benefit by affording a relatively clean energy source for power generation.

The exploration phase of geothermal leasing is of relatively short duration. If exploration is unsuccessful, there will be no subsequent development or use of the land, and restoration can quickly be made.

If exploration discloses an economic resource, then development of an energy source and possible by-products such as space heating can occur. Over a period of years, 20-50, depending on the nature of the resource, production may be depleted to a point it is no longer economical.

Removal of improvements will cause some disturbance but this will be short lived. Vegetational disturbances will be restored with only contour changes remaining.

The principle commitment is the depletion of the thermal energy and water from the geothermal reservoir. These resources are renewable, but not within the life span of a specific project. Once they are depleted to a point where economic production cannot continue, production will stop and the area will be restored to as nearly its original state as possible.

The proposal to develop geothermal resources in the Vale area received only mild public interest. This is based on the number of responses we received from inquiries and the light attendance at our public meetings.

Oil and Gas Resources

Three major impacts could occur as a result of oil and gas resource exploration and development:

1. Alteration of the existing environment.

2. Temporary or short-term impacts on communities within the influence of the EAR area.

3. Contribute energy resources to meet the Nation's energy needs.

The degree of impact will be dependent upon the discovery of economically recoverable oil and/or gas resources and the size of the resource supply.

In summary, the environment may be considered to consist of the abiotic environment (soil and water) and the biotic community (vegetation and wildlife). Residual impacts on these components would occur in spite of close adherence to mitigative recommendations. These are as follows:

1. Soils

   Erosion of a short-term nature would occur until revegetation and reclamation actions were completed.

   Some loss of topsoil would occur.

   Some soil compaction on sites of intensive use will occur and remain in spite of attempts to rip these areas. Complete soil reclamation will only be achieved by the successful revegetation of such areas.

2. Water

   Some sedimentation will occur, but it will be of a short-term nature.

   Reductions in available water supplies will result when the sources are used for oil and gas operations, but this would be a short-term impact in most cases. Contamination or depletion of ground water aquifers could result in a permanent loss of the resource.

3. Vegetation

   Removal of some species of range vegetation to facilitate oil or gas operations will require considerable time to replace. Other changes in the flora will be inevitable due to invasion by new species.

   Some areas will remain denuded due to loss of topsoil and proximity of bedrock to the surface.

Habitat abandonment by some species could be of a long-term nature

Some mortality among smaller species would occur.

If exploration proved unsuccessful, there would be no subsequent development or land use, and restoration could be quickly made. Consequently, there would be no contributions to the national energy needs, and there would be no demands upon community goods and services.

The chief commitment would be the depletion of oil and gas reserves. These resources are not renewable.

The proposed leasing of Public Lands in the Vale District for oil and gas operations has received only slight interest. This is based primarily on the results of previous exploratory operations which have located no commercially important oil and/or gas reserves.

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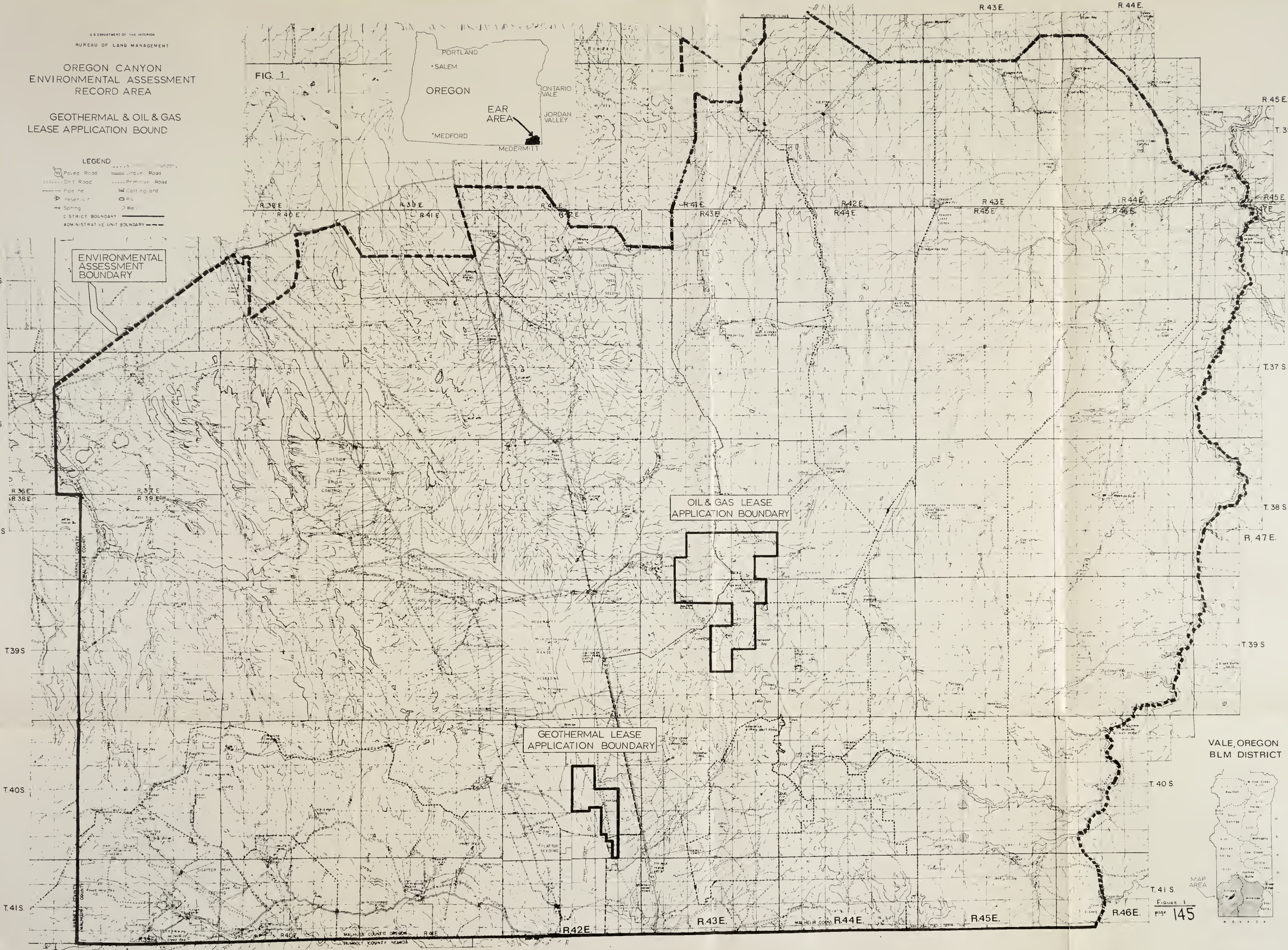

Figure 1
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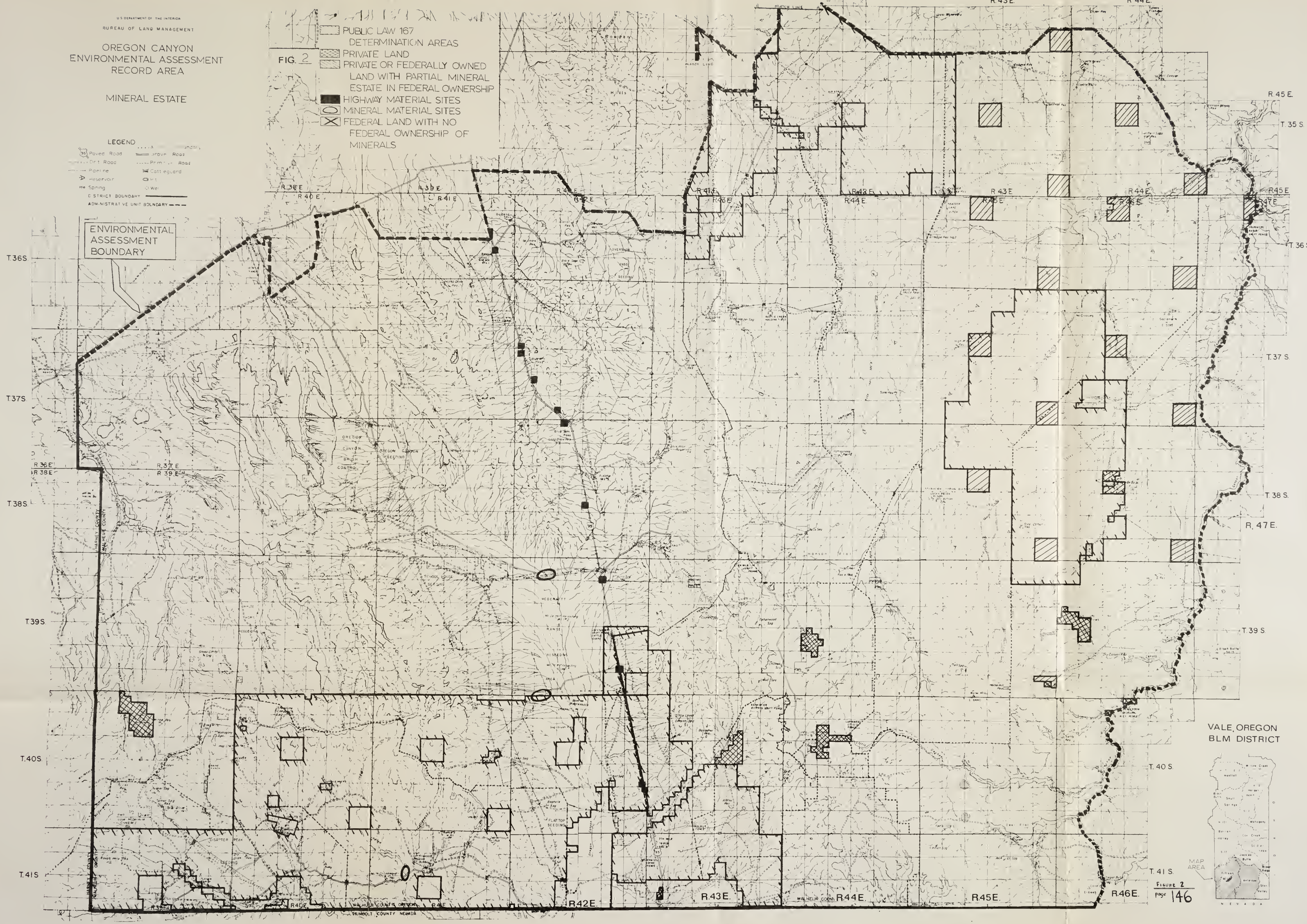


U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
OREGON CANYON ENVIRONMENTAL ASSESSMENT RECORD AREA
MINERAL ESTATE
FIG. 2
PUBLIC LAW 167 DETERMINATION AREAS
PRIVATE LAND
PRIVATE OR FEDERALLY OWNED LAND WITH PARTIAL MINERAL ESTATE IN FEDERAL OWNERSHIP
HIGHWAY MATERIAL SITES
MINERAL MATERIAL SITES
FEDERAL LAND WITH NO FEDERAL OWNERSHIP OF MINERALS
LEGEND
Paved Road
Dirt Road
Pipeline
Reservoir
Spring
Cattleguard
Well
DISTRICT BOUNDARY
ADMINISTRATIVE UNIT BOUNDARY
ENVIRONMENTAL ASSESSMENT BOUNDARY
R.43 E.
R.44 E.
R.45 E.
R.46 E.
R.47 E.
R.42 E.
T.35 S.
T.36 S.
T.37 S.
T.38 S.
T.39 S.
T.40 S.
T.41 S.
VALE, OREGON BLM DISTRICT
MAP AREA
NEVADA

Figure 2

FIGURE 3

THE APPROXIMATE REQUIRED TEMPERATURE OF GEOTHERMAL FLUIDS FOR COMMERCIAL PURPOSES

°F		°C	
392		200	
374		190	
356		180	Evaporation of Highly Conc. Solutions
350	Neal Hot Spr (est. aquifer temp.)		Refrigeration by Ammonia Absorption Digestion in Paper Pulp, Kraft
338		170	Heavy Water via Hydrog. Sulphide Proc. Drying of Diatomaceous Earth
320		160	Drying of Fish Meal Drying of Timber
302		150	Alumina via Bayers Proc.
284		140	Drying Farm Products at High Rates Canning of Food
266		130	Evaporation in Sugar Refining Extraction of Salts by Evaporation and Crysfalisation
248		120	Fresh Water by Distillation Most Multiple Effect Evaporations, Concentr. of Saline Sol. Refrigeration by Medium Temperatures
230		110	Drying and Curing of Light Aggreg. Cement Slabs
212		100	Drying of Organic Materials, Seaweeds, Grass, Vegetables, etc. Washing and Drying of Wool
208	Vale Hot Spr		
194		90	Drying of Stock Fish Intens De-Icing Operations
188	Neal Hot Spr (sur. temp.)		
176		80	Space Heating Greennouses by Space Heating
162		70	Refrigeration by Low Temperature
158	Mitchell Butte Hot Spr		
140		60	Animal Husbandry Greerhouses by Combined Space and Hotbed Heating
122		50	Mushroom Growing Balneological Balhs
104		40	Soil Warming
86		30	Swimming Pools, Biodegratation, Fermentations Warm Water for Year Around Mining in Cold Climates De-Icing
68		20	Hatching of Fish; Fish Farming

Saturated Steam: approx. 212–392 °F (100–200 °C)

Water: approx. 68–248 °F (20–120 °C)

Temp. Range of Conventional Power Production: 140–180 °C

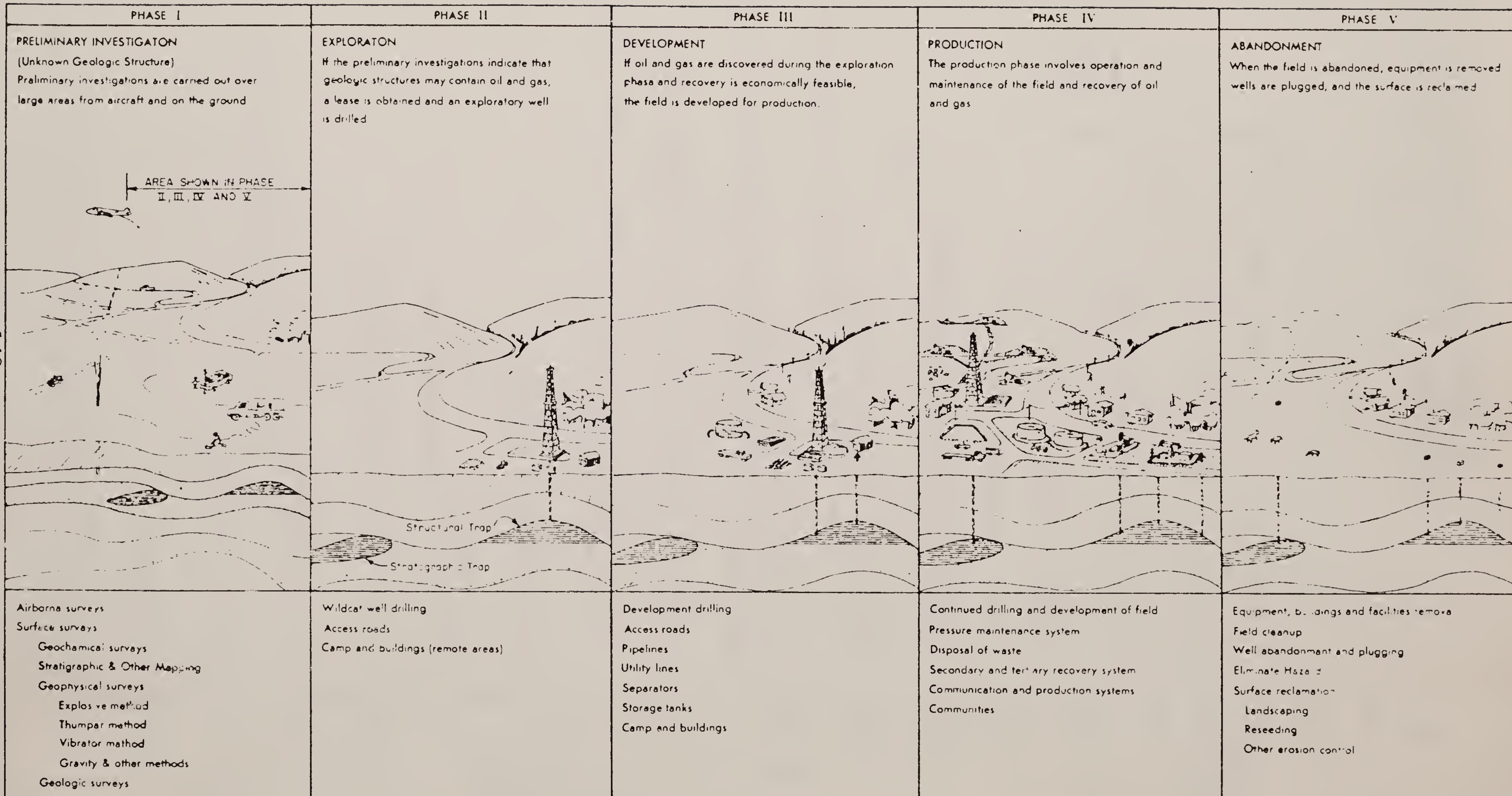
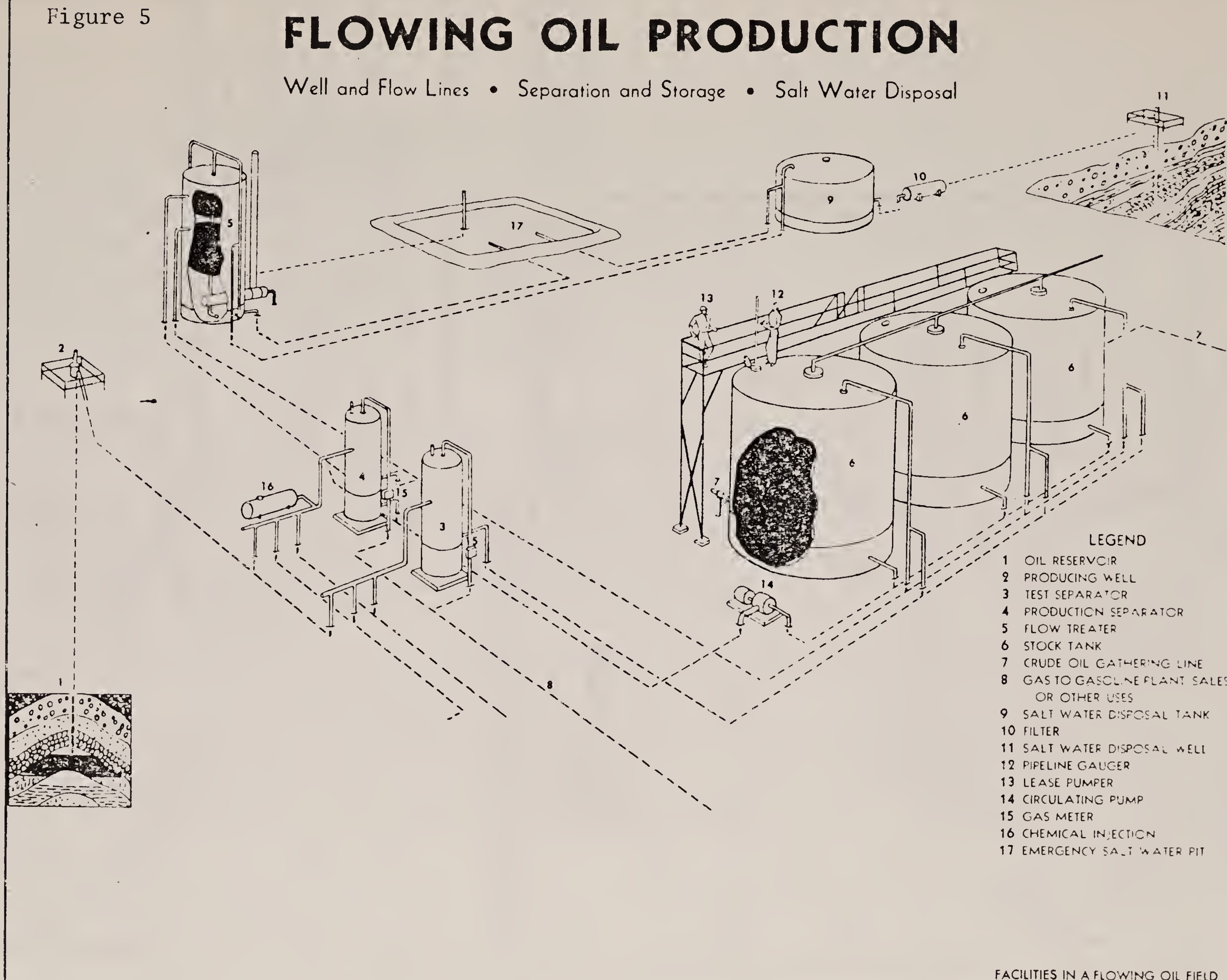


Figure 4

SEQUENCE OF OPERATIONS IN AN OIL AND GAS FIELD

Figure 5



FLOWING OIL PRODUCTION
Well and Flow Lines • Separation and Storage • Salt Water Disposal
LEGEND
1 OIL RESERVOIR
2 PRODUCING WELL
3 TEST SEPARATOR
4 PRODUCTION SEPARATOR
5 FLOW TREATER
6 STOCK TANK
7 CRUDE OIL GATHERING LINE
8 GAS TO GASOLINE PLANT SALES OR OTHER USES
9 SALT WATER DISPOSAL TANK
10 FILTER
11 SALT WATER DISPOSAL WELL
12 PIPELINE GAUGER
13 LEASE PUMPER
14 CIRCULATING PUMP
15 GAS METER
16 CHEMICAL INJECTION
17 EMERGENCY SALT WATER PIT
FACILITIES IN A FLOWING OIL FIELD

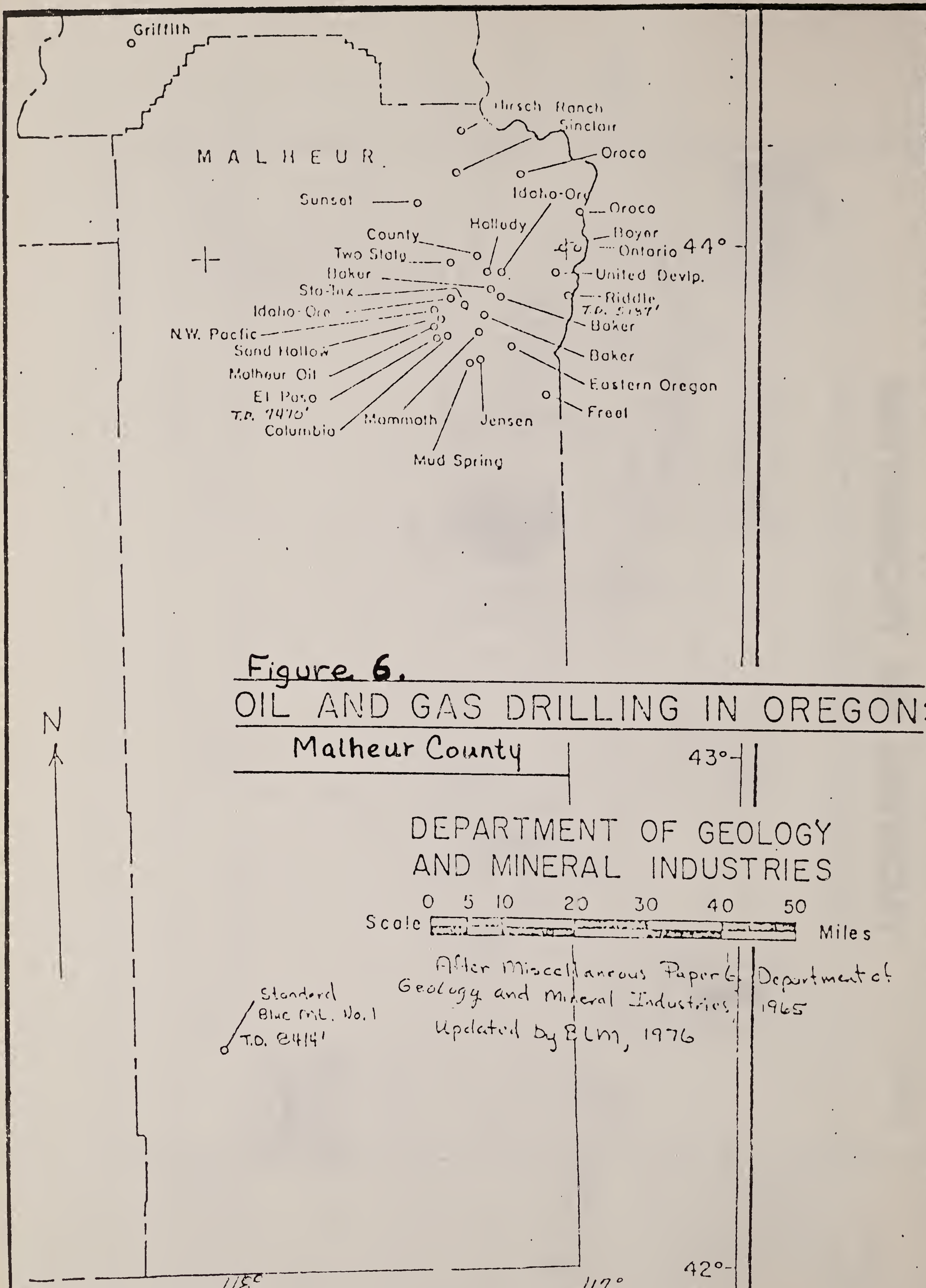


Figure 6.
OIL AND GAS DRILLING IN OREGON:
Malheur County

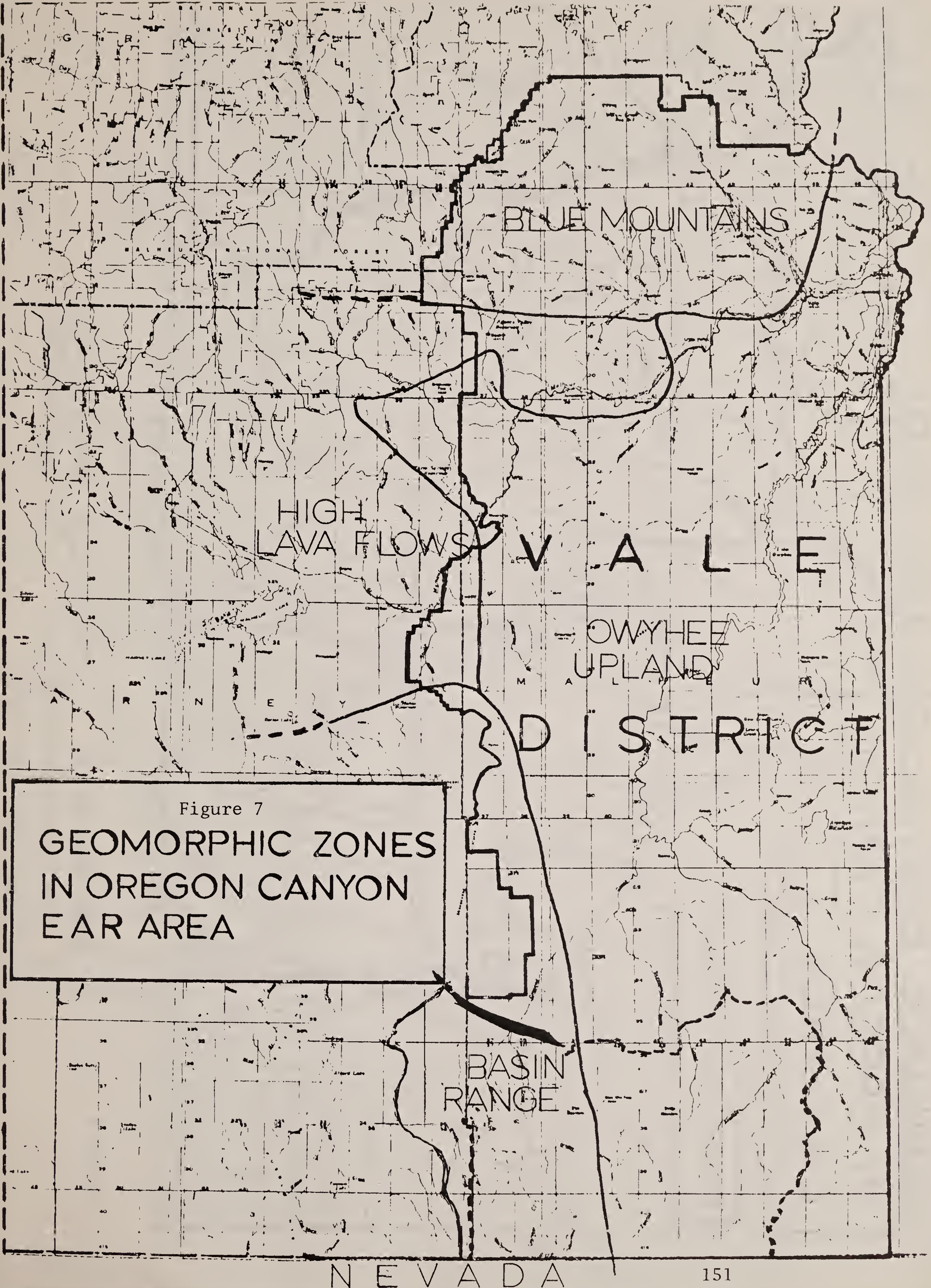


Figure 7
GEOMORPHIC ZONES
IN OREGON CANYON
EAR AREA

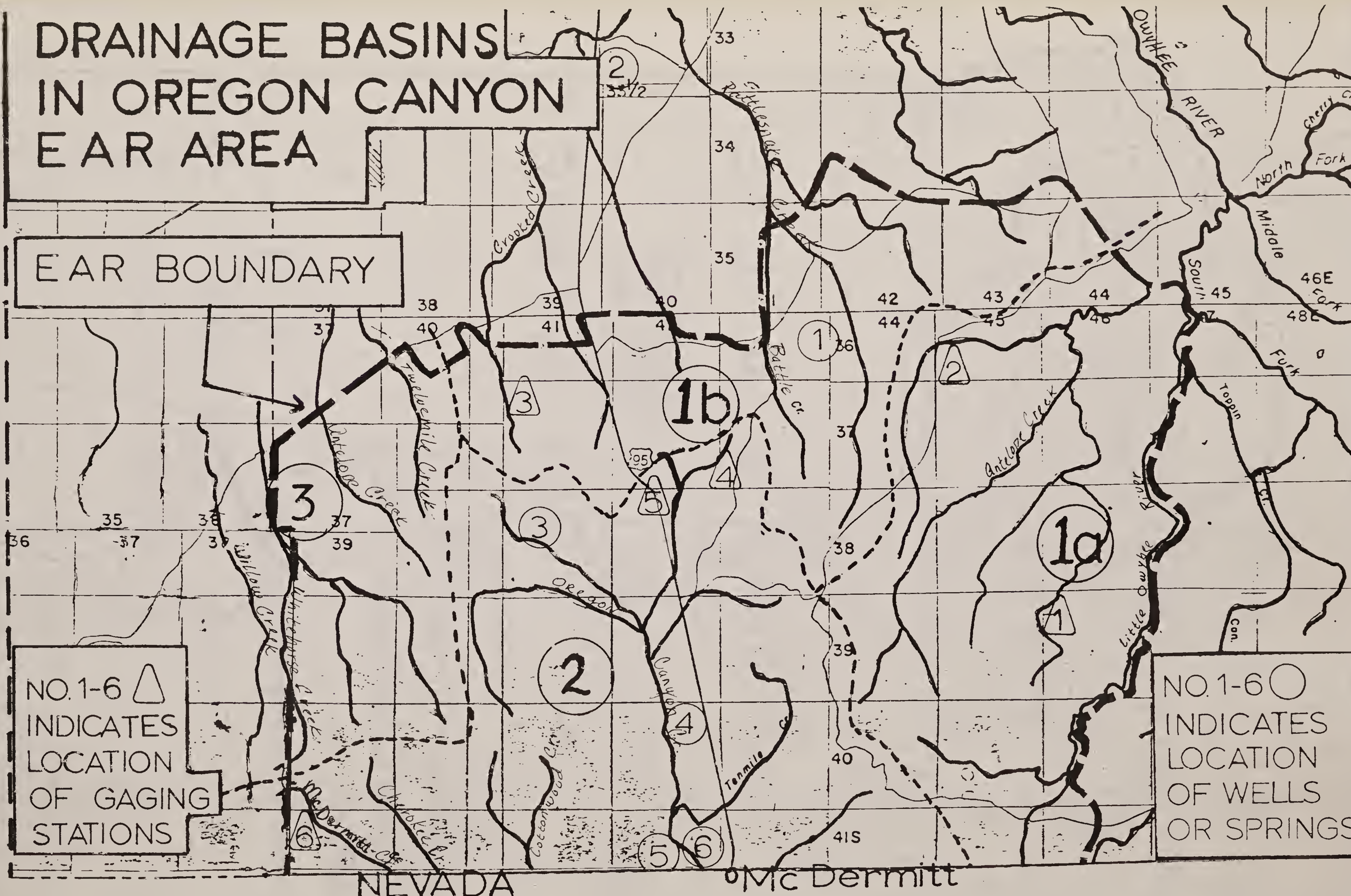


Figure 8

1. Owyhee River Basin
   1A Upper Owyhee Subdivision
   1B Crooked Creek Subdivision
2. Quinn River Basin
3. Alvord Lake Basin

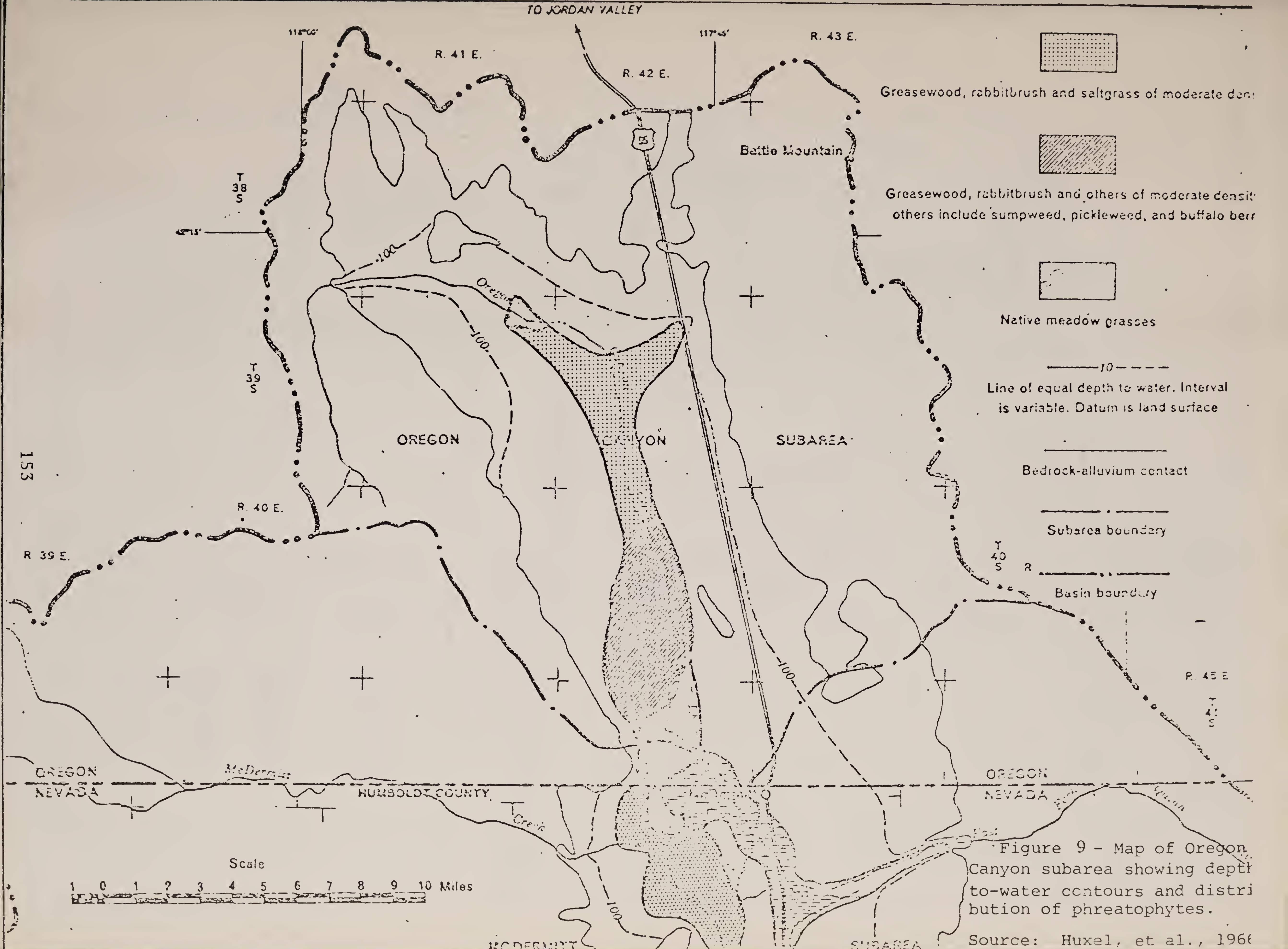
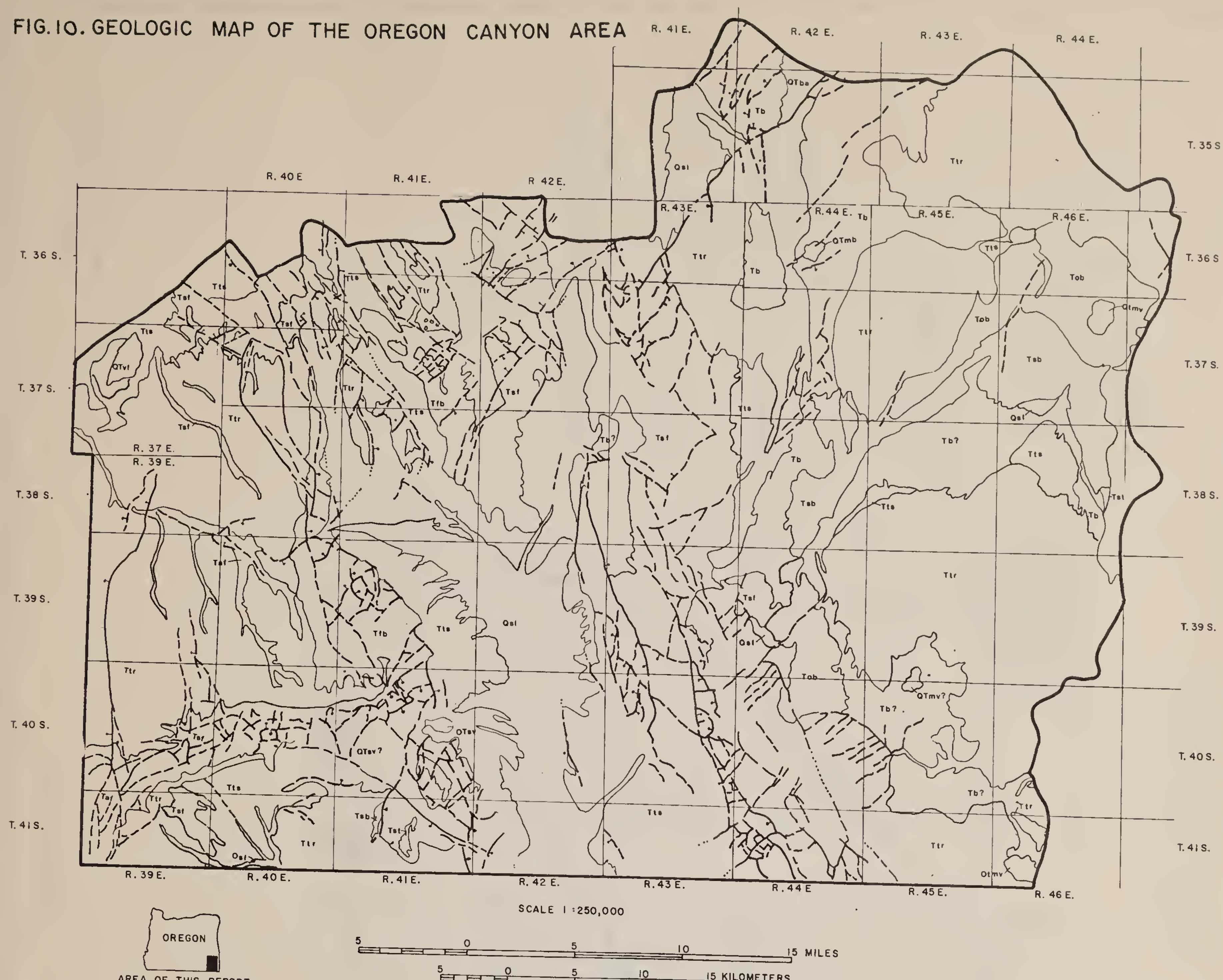


Figure 9 - Map of Oregon Canyon subarea showing depth to-water contours and distribution of phreatophytes.

Source: Huxel, et al., 196(

FIG. 10. GEOLOGIC MAP OF THE OREGON CANYON AREA



Map and Explanation taken from Reconnaissance Geologic Map Of The Adel Quadrangle, Lake, Harney, and Malheur Counties, Oregon (1965), and Reconnaissance Geologic Map of the West Half of the Jordan Valley Quadrangle, Malheur County, Oregon (1966). Both maps by George W. Walker and Charles A. Repenning.

EXPLANATION

QUATERNARY	Qb	Olivine-bearing basalt flows, commonly highly feldspathic
	Qp	Playa deposits
	Qal	Alluvium
	Qls	Landslide debris
TERTIARY AND QUATERNARY	QTm	Mafic intrusive rocks
	QTp	Pyroclastic rocks of basaltic cinder cones
	QTsv	Rocks of silicic vents
	QTmv	Rocks of mafic vents
	QTba	Olivine-bearing basalt and minor basaltic andesite
	QTvf	Exogenous domes mostly of rhyodacitic composition
TERTIARY	Tsb	Tuffaceous sedimentary rocks with interbedded basalt
	Tst	Tuffaceous lacustrine deposits
	Tob	Vesicular basalt flows
	Tb	Tertiary basalt, commonly highly feldspathic
	Ttf	Tuff of rhyolitic and dacitic composition
	Tts	Fine-grained tuffaceous sedimentary rocks
	Ttr	Partly to densely welded tuffs
	Tst	Semiconsolidated lacustrine tuffaceous sandstone and siltstone
	Tfb	Basalt and andesite flows and flow breccias
	Taf	Platy andesite flows
	Tbf	Massive basalt flows and minor interbeds of tuff and scoria

Generalized geologic column of the Owyhee Upland
(After Walker and Repenning, 1966)

QUATERNARY	Holocene and Pleistocene	Extensive basalt flows in Rome-Jordon area. Semi-consolidated sand and gravels with interbedded basalt flows
	Pleistocene(?) Pliocene upper Miocene(?)	Tuffaceous sedimentary rocks, tuffs, ash flows and interbedded basaltic and andesitic flows
TERTIARY	Upper and middle Miocene	Conglomerate, sandstone, tuffaceous sedimentary rocks, tuffs and silicic flows
		Basaltic and andesitic flows and flow breccias
		Varicolored tuffs and ash flows ? ? ? ? ? base not exposed

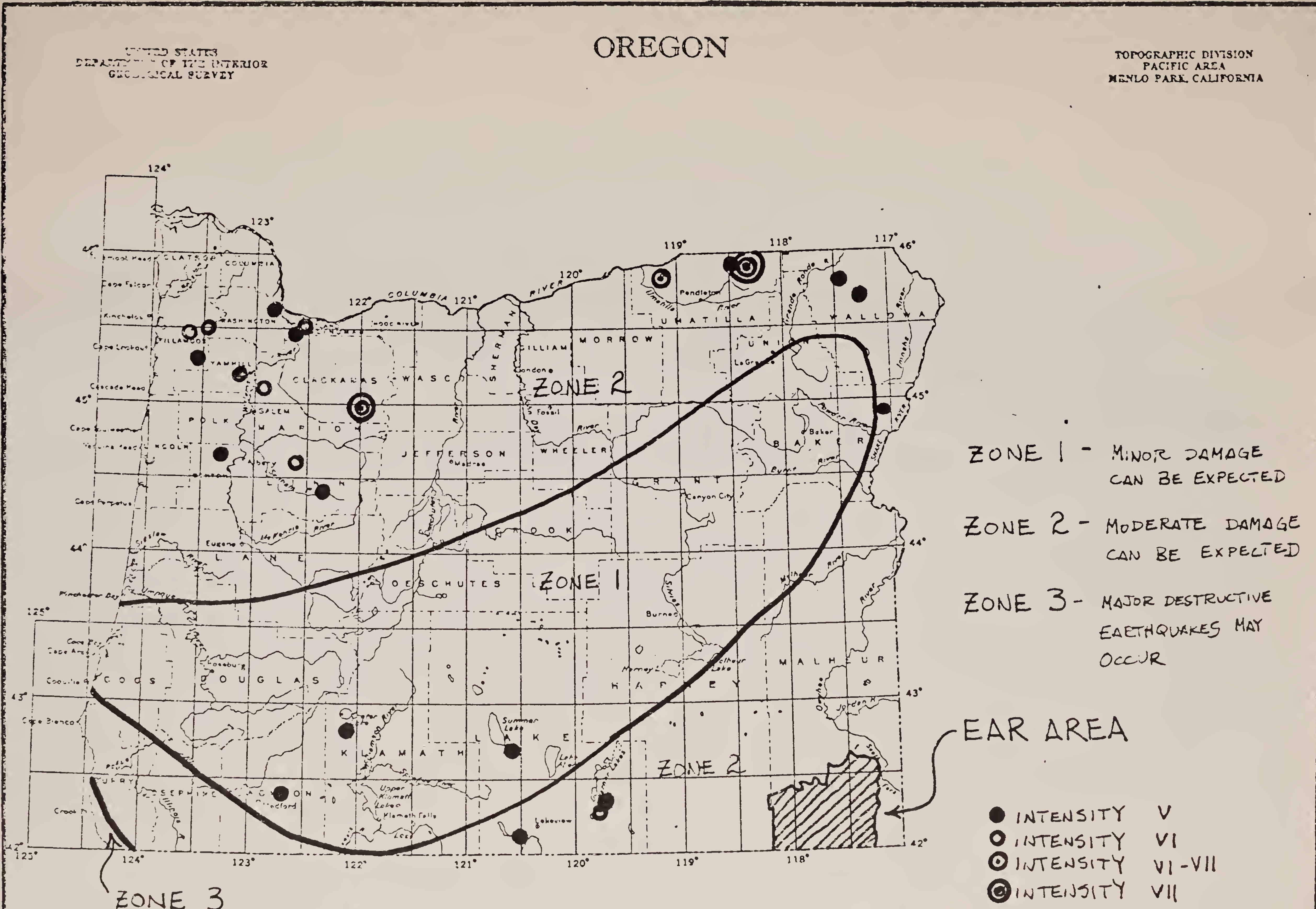
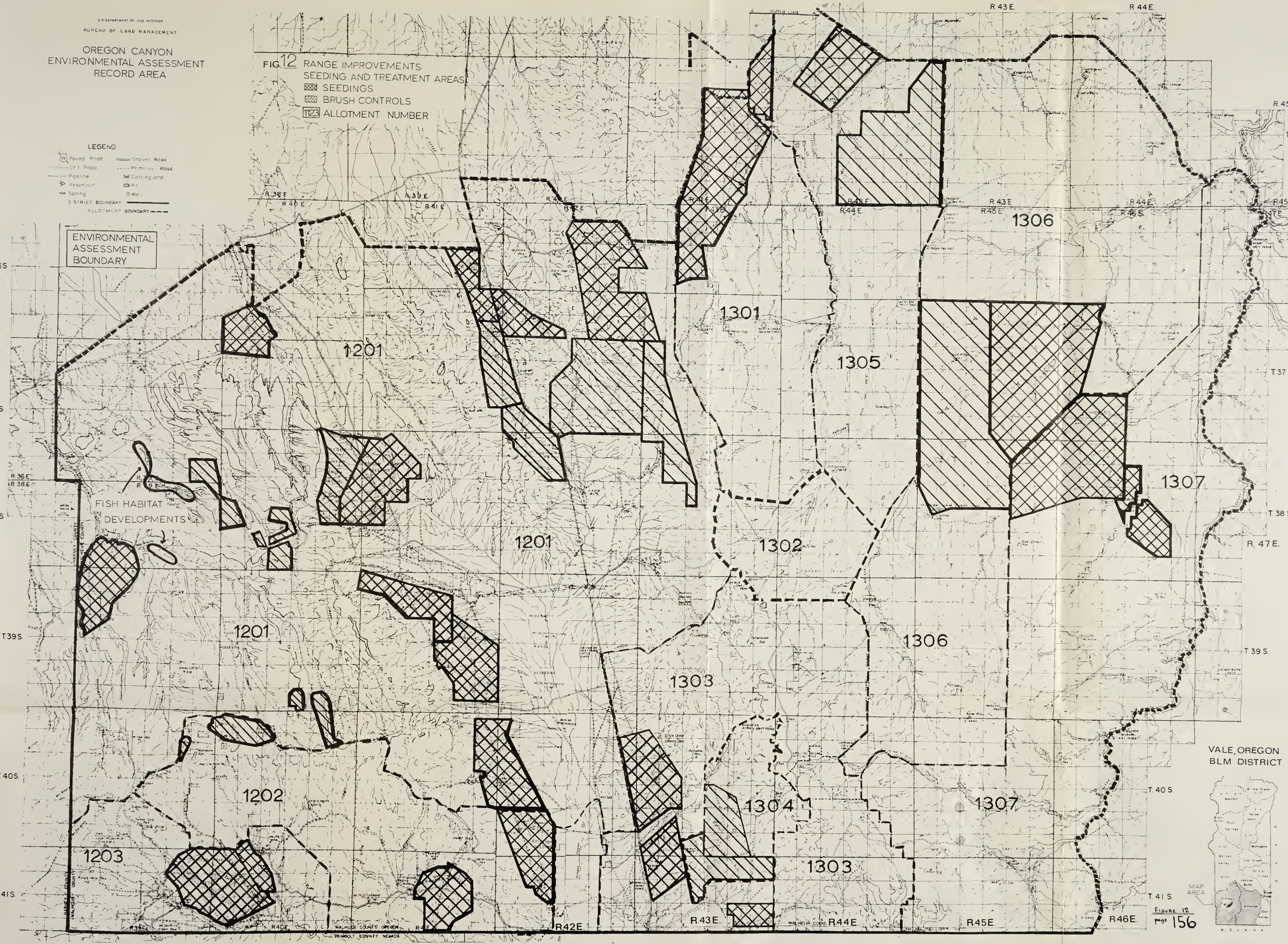


FIGURE 11.—OREGON EARTHQUAKES

TAKEN FROM EARTHQUAKE INFORMATION BULLETIN, MAY–JUNE, 1976, VOLUME 8, NUMBER 3


U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
OREGON CANYON
ENVIRONMENTAL ASSESSMENT
RECORD AREA
FIG 12 RANGE IMPROVEMENTS
SEEDING AND TREATMENT AREAS
SEEDINGS
BRUSH CONTROLS
1123 ALLOTMENT NUMBER
LEGEND
Paved Road
Gravel Road
Dirt Road
Primitive Road
Pipeline
Cattleguard
Reservoir
Pit
Spring
Well
DISTRICT BOUNDARY
ALLOTMENT BOUNDARY
ENVIRONMENTAL ASSESSMENT BOUNDARY
FISH HABITAT DEVELOPMENTS
1201
1202
1203
1301
1302
1303
1304
1305
1306
1307
T.35 S
T.36S
T.37S
T.38S
T.39S
T.40S
T.41S
R 36E
R 38E
R 39E
R 40E
R 41E
R 42E
R 43E.
R 44E
R 45E
R 46E.
R. 47E.
VALE, OREGON
BLM DISTRICT
MAP AREA
HUMBOLDT COUNTY NEVADA
MALHEUR COUNTY OREGON
Figure 12
page 156

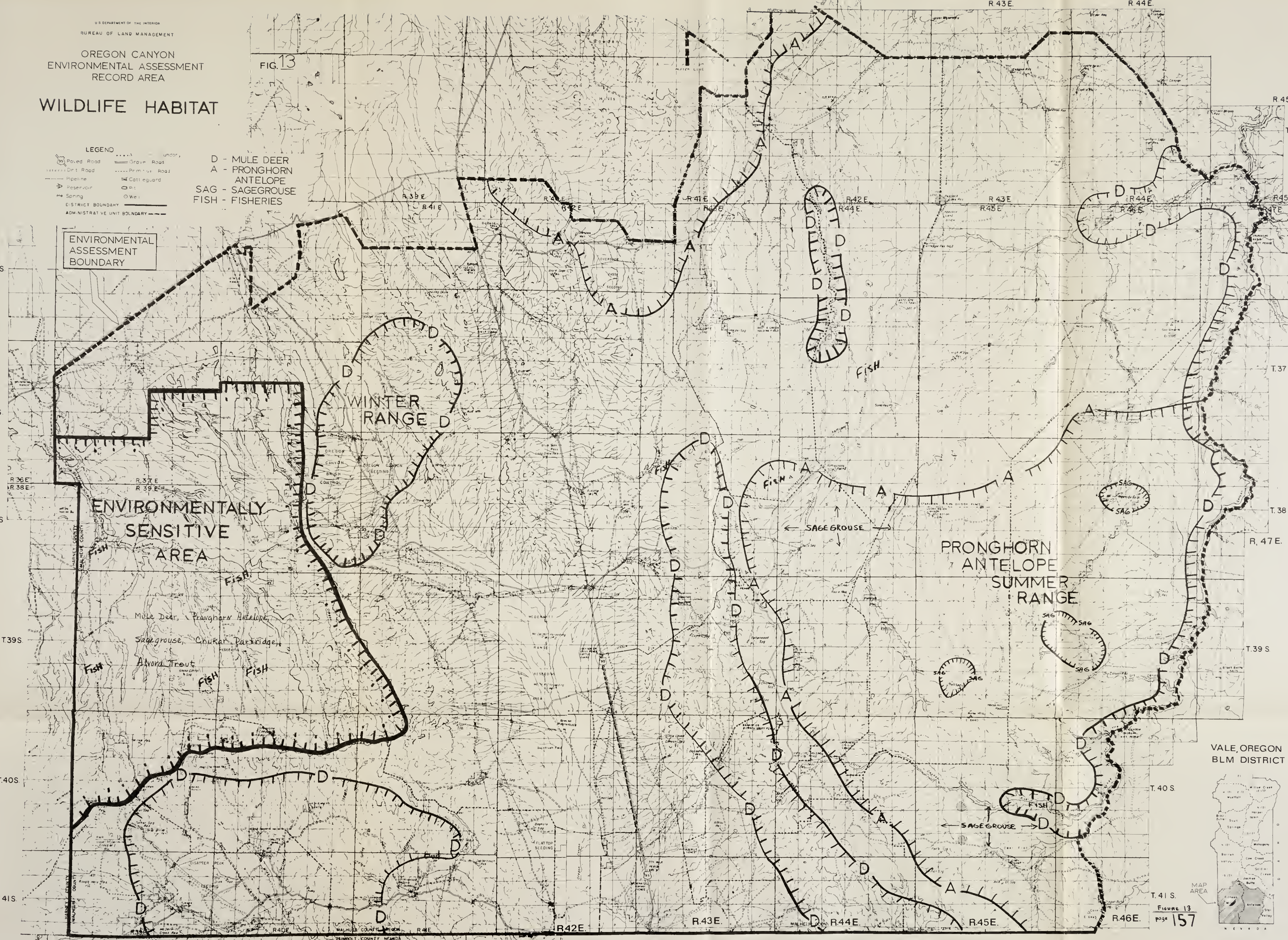
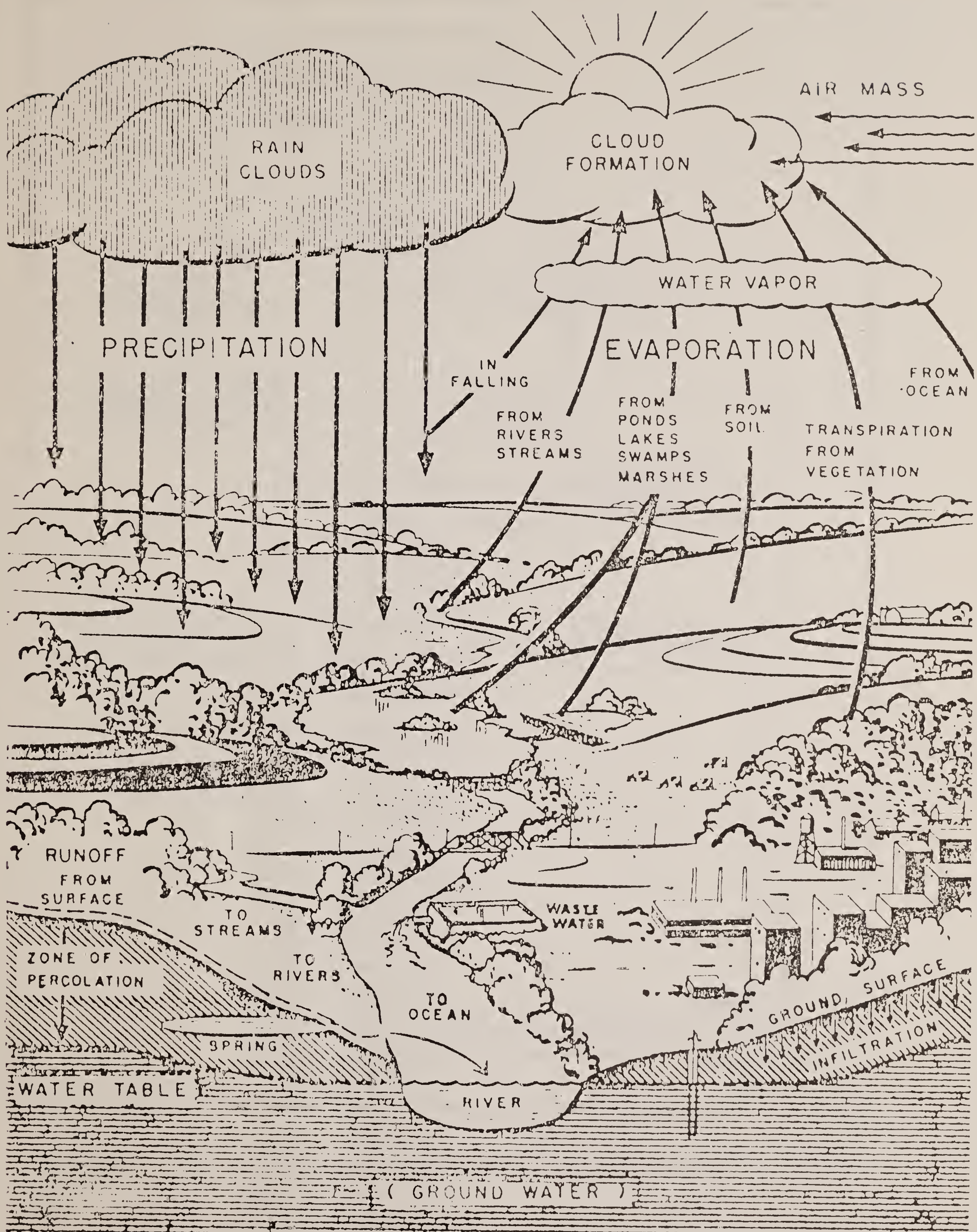


Figure 13
page 157

Figure 14. The Hydrologic Cycle



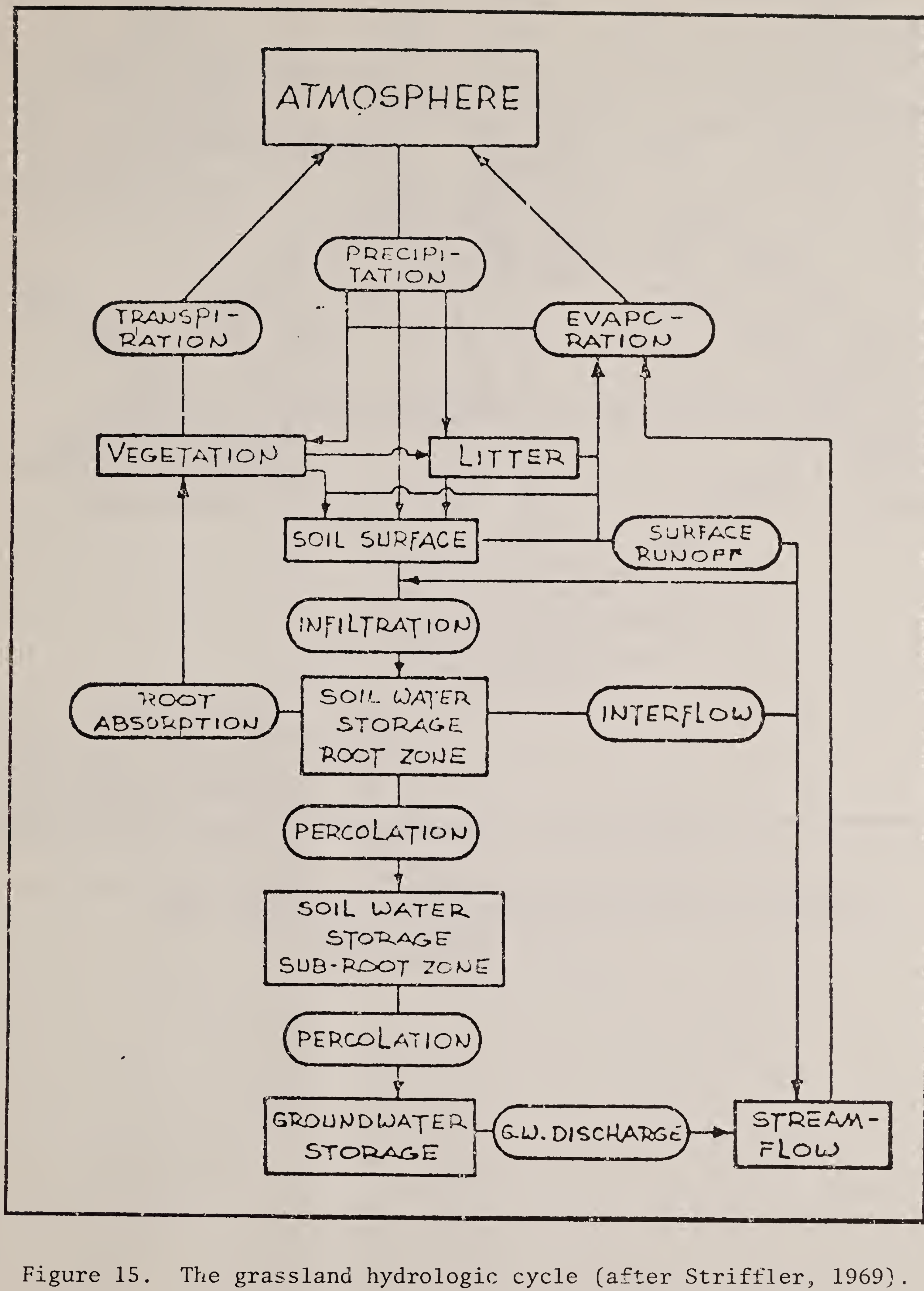


Figure 15. The grassland hydrologic cycle (after Striffler, 1969).

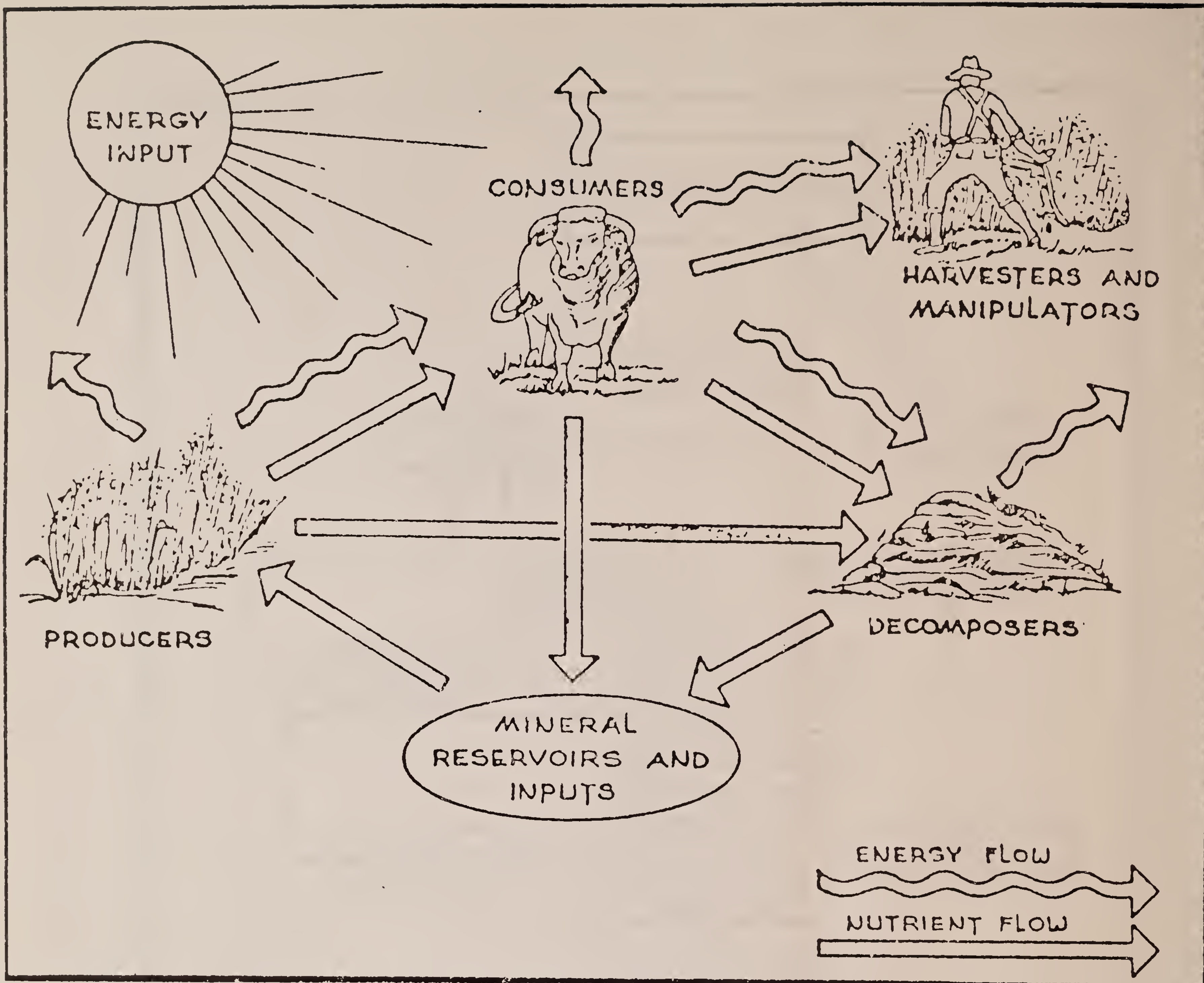


Figure 16. A schematic illustration of pathways of flow of energy and matter through a terrestrial ecosystem (after Van Dyne, 1969).

Figure 17
page 161

TABLE 1 SUMMARY OF OIL AND GAS EXPLORATORY ACTIVITIES

In Malheur County from 1902 to date

(Oregon Dept. Geol. Min. Indust., Misc. Pap. 6; 1965, and US Bur. Land Management)

Company	Well Name	Elevation and Location	Date	Depth	Remarks
Boyer, A.F.	Water well	Ontario, SE¼ Sec. 9, 18S., 47E. Elev. 2159'.	1902	215'	Gas in water, used to supply lighting jets and cooking range for more than 7 years.
?	?	A short distance Northwest of Weiser, Idaho.	1907	1050'	Gas blew mud & water 80' into the air.
Halledy, T.W.	Water well	Vale 18S., 45E. Elev. 2240'	Before 1909	1000'±	Gas encountered in water sand at 900'
Hirsch Ranch	Water well	Dry Gulch, approx. 18 miles North of Vale.	Before 1909	1700'	Gas reported.
Jensen	Water well	Near Mud Spring Sec. 29, 20S., 45 E. Elev. 3000'.	Before 1909	?	Gas reported at 100'.
?	Water well	Mosquite approx. Sec. 19, 15S., 46E. Elev. 2150'.	Before 1909	1400'	Good flow of gas reported at 1400'.
Baker & Malheur Oil Co.	Well No. 3	South of Vale, NW¼ Sec. 29, 19S., 45E. Elev. 2500'.	1909	163'	Cable tools. Few pieces of salt reported.
Boswell & Johnson	Water well	Vale ? 18S., 45E. Elev. 2240'.	1909	300'	Films of oil on sulfur water reported.
County	Water well	Vale Courthouse Sec. 4, 18S., 45E. Elev. 2242'.	1909	1100'	Found a trace of oil at 1100'.
Malheur Oil Co.	?	Southwest of Vale. Sec. 31, 19S., 44E. Elev. 2450'.	1909	1680'	Cable tool. Small amount of gas with H_2S odor.

Company	Well Name	Elevation and Location	Date	Depth	Remarks
Mammoth Oil & Gas Co.	?	Cow Hollow Sec. 6, 20S., 45E. Elev. 2700'.	1909	1280'+	Cable tools. Small amounts of gas and oil reported. Gas had H S odor.
Mud Spring	Gas Occurrence	Sec. 29, 20S., 45E. Elev. 3000'.	1909	--	Cold spring from which a "copious quantity" of gas issued.
Sand Hollow	Oil occurrence	West bank at Sand Hollow Wec. 29, 19S, 44E. Elev. 2390'.	1909	--	Dark gray bed of hard petroliferous freshwater sandstone. Good odor on fresh fracture. Yielded an ambercolored oil by ether extraction.
Small Creek	Oil occurrence	East side of Small Creek. NW¼ Sec. 2, 20S., 44E. Elev. 2600'.	1909	--	Dark gray sandstone, as found in Sand Hollow.
Baker & Malheur Oil Co.	Well No. 1	South of Vale. SW¼ Sec. 4, 19S., 45E. Elev. 2500'.	1909	340'	Cable tool. Oil show reported.
Baker & Malheur Oil Co.	Well No. 2	South of Vale. NE¼ Sec. 10, 19S., 45E. Elev. 2600'.	1909	329'	Cable tools. Some gas reported.
Columbia Oil & Gas	Well No. 1	Double Mountain SW¼ Sec. 4, 20S., 44E. Elev. 2650'.	1909-1910	975'	Cable tools. Hit a strong flow of gas in basalt at 580'. Gas had an H S odor. Oil films noted in bailing water.
Eastern Oregon Oil Co.	Well No. 1	Sec. 12, 20S., 45E.	1909-191	815'	Cable tools. Reported oil shows.

Company	Well Name	Elevation and Location	Date	Depth	Remarks
Ontario Cooperative Gas & Oil	?	Ontario 18S., 47E.	1909-1913	4362'	Cable tools, deepened with rotary. Well blew out while drilling at 1070' and 2200'. Blew mud and water over the derrick crown.
Sunset Oil Co.	?	About 12 miles NW of Vale.	1919	500'	
North-western Pacific Oil & Gas Co.	Well No. 1	Sand Hollow. Sec. 19, 19S.,44E. Elev. 2500'.	1919	1260'	Cable tools. Hit hot water (115 degrees F.)
United Devel. Corp.	Dorman No. 1	Ontario area. Sec. 25,18S,46E. Elev. 2250'.	1932	625'	Cable tools. Gas show reported 540'.
Western Pacific Oil & Gas Co.	Well No. 1	Approx. 8 miles SW of Vale. Sec. 19, 19S., 44E. Elev. 2500'.	Before 1938	1260+'	
Freel, Frank	Water well	Adrian. SW¼ Sec. 14, 21S, 46E. Elev. 2200'.	1942	508'	Cable tools. Gas in water used for cooking and heating, 1942-1960. Gas has H S odor.
Idaho-Oregon Prod. Co.	Elvera-Recla. No. 1	South of Vale. SE¼ Sec. 9, 19S., 44E. Elev. 2332'.	1954	4611'	Rotary. No shows reported.
Riddle H.K.	Kiesel Estate No. 1	Nyssa area. SW¼ sec. 8, 19S., 47E. 1260' N. of S. line & 1370' E. of W. line. Elev. 2177' Gr.	1954	5137'	Rotary. Gassy, fresh water 900-5042'.
Sta-Tex Oil Co. (R.A. Stamey)	Russell No. 1	Vale area, NW¼ Sec. 14, 19S., 44E. 330'S. of N. line & 330' E. of W. line Elev. 2290'Gr.	1954	4336'	Rotary. Some small gas shows.

Company	Well Name	Elevation and Location	Date	Depth	Remarks
El Paso Nat. Gas Co.	Federal-Spurrier No. 1	South of Vale. NE¼ Sec. 5, 20S., 44E. 360'S. of N. line & 5550'W. of E. line. Elev. 2519'.	1954-1955	7470'	Rotary. Some gas shows reported.
Oroco Oil & Gas	Bolles No. 1	Payette area. NW¼ Sec. 15, 17S., 47E. 660'S. of N. line & 400'W. of E. line. Elev. 2147'. Gr.	1955	1966'	Rotary. Well Blew out while drilling at 1540'. Tests showed gassy, brackish water below 1080'.
Sinclair Oil & Gas Co.	East. Ore. Land Co. No. 1	Willow Creek. SW¼ Sec. 15, 16S., 44E. 660'N. of S.line & 400'W. of E.line. Elev. 2147'.Gr.	1955	4888'	Rotary. No shows reported.
Oroco Oil & Gas Co.	McBride No. 1	Weiser area. SE¼ Sec. 19, 16S.,46E. 1566'N. of S.line & 1419'W. of E.line. Elev. 2900'.	1956	4506'	Rotary. No significant shows.
Two State Oil & Gas Co.	Vale City No. 1	Vale SW¼ Sec. 21, 18S., 45E. 3310'S. of N. line & 660' E. of W. line. Elev. 2250'. Gr.	1961-1962	1185'	Cable tools. No shows. Good.
Standard Oil Co. of Calif.	Blue Mtn. Fed. Unit No. 1	SW¼ Sec. 34 T. 37S., R. 41 E. Malheur County		8414TD	Abandoned August 8, 1973.

Table 2. Monthly and annual average precipitation (inches) and mean monthly and annual temperature (^{o}F) for the EAR Area for the indicated period of record (from National Oceanic and Atmospheric Administration, U.S. Department of Commerce).

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Precipitation													
McDermitt, North 1956-1960	1.00	0.56	0.78	0.86	1.26	1.18	0.20	0.39	0.44	0.71	0.99	1.00	9.37
McDermitt, South 1956-1974	0.61	0.75	0.91	0.31	1.82	0.74	0.15	0.32	0.47	0.87	0.77	0.68	8.58
Temperature													
McDermitt, South 1956-1974	30.4	35.8	40.7	44.2	54.0	58.8	70.0	68.0	59.8	49.5	38.3	31.2	48.4

Table 3 -- Estimated average annual precipitation and recharge to the valley-fill reservoir

Precipitation zone (feet)	Area (acres)	Estimated annual precipitation			Estimated recharge	
		Range (inches)	Average (feet)	Average (acre-feet)	Percentage of precipitation	Acre-feet per year
OREGON CANYON SUBAREA (eastern part)						
Above 6,000	10,800	more than 15	1.4	15,000	15	2,300
5,000 to 6,000	46,700	12 to 15	1.1	51,000	7	3,600
Below 5,000	46,100	less than 12	.9	42,000	3	1,300
Subtotal (rounded)	104,000			110,000		7,200
(western part)						
Above 7,000	6,000	more than 15	1.4	8,400	15	1,300
6,000 to 7,000	17,300	12 to 15	1.1	19,000	7	1,300
5,000 to 6,000	40,300	10 to 12	.9	36,000	3	1,100
Below 5,000	55,700	less than 10	.7	39,000	--	--
Subtotal (rounded)	119,000			100,000		3,700
Total for subarea (rounded)	223,000			210,000		11,000

Source: Huxel, _et al_, 1966

Table 4 Soil Properties, Qualities, and Interpretations

Reconn. unit soil series, and/or types	Physiographic area *	Percent slope	Major land use	Drainage class	Runoff	Permeability	AWHC	Effective root zone (inches)	Shrink-swell potential	Workability	Erosion hazard	Poss. of flooding or ponding	Major soil limitation	Irrigation suitability	Temperature limitation **	Hydrologic group ***
Unit 1	A	0-3	Cultivated	Good	Slow	Mod.	High	60	Low	Good	Low	Some	None	Excel.	Strong	B
Unit 2	A	0-7	Range	S.exces.	V.slow	Rapid	Low	20-40	Low	Good	Med.wind	Some	Texture	Fair	Strong	A
Unit 3	A	0-3	Range	Good	V.slow	M.rapid	Low	15-30	Low	Good	Low	Some	Depth	Good	Strong	A
Unit 4	A	7-20	Range	Good	Med.	M.rapid	Low	10-40	Low	Poor	Med.	None	Stones	Poor	Strong a/	B
Unit 6	A	0-7	Range	S.exces.	V.slow	Rapid	Mod.	60	Low	Good	Med.wind	None	Texture	Good	Severe	A
Unit 15	A	0-3	Meadow	Poor	B.slow	Mod.	High	60	Low	Good	Low	Some	Wetness	Good	Strong a/	D
Unit 16	A	0-3	Range	Good	Slow	Mod.	Low	15-24	Low	Good	Low	Some	Depth	Fair	Strong a/	B
Unit 26	B	0-3	Range	Good	Slow	Mod.	Low	15-24	Low	Good	Low	Some	Depth	Good	Severe b/	C
Unit 30	B	0-3	Range	Poor	V.slow	V.slow	Mod.	20-40	High	Poor	Low	Some	Texture	Poor	Severe	D
Unit 31	B	0-3	Range	S.poor	B.slow	V.slow	Mod.	40-60	High	Poor	Low	Some	Texture	Fair	Severe b/	C
Unit 41	B	0-3	Range	S.poor	Slow	V.slow	Mod.	20-40	High	Fair	Low	Some	Texture	Fair	Strong a/	C
Unit 43	B	0-3	Range	S.poor	Slow	M.slow	Mod.	60	Low	Good	Low	Some	Alkali	Fair	Strong	C
Unit 50	A	0-7	Range	S.exces.	Slow	Slow	Low	10-60	Low	Good	Med.wind	None	Depth	Fair	Strong a/	C
Unit 55	A	0-20	Range	Good	Variable	Slow	Low	10-20	Low	Good	Variable	None	Slope	V.poor	Strong a/	D
Unit 56	A	3-20	Range	Good	Variable	Slow	Low	10-20	Med.	Fair	Variable	None	Slope	V.poor	Strong a/	D
Unit 57	A	0-12	Range	Good	Variable	Mod.	High	60	Low	Good	Variable	None	Slope	Fair	Strong	B
Unit 60	D	3-60	Range	Good	Variable	M.slow	Mod.Hi	20-40	Med.	Good	Variable	None	Slope	V.poor	Strong c/	C
Unit 75	C	3-60	Range	Good	Variable	Mod.	Low	10-20	Low	Poor	Variable	None	Slope	V.poor	Severe b/	D
Unit S75	C	3-35	Range	Good	Variable	Mod.	Low	10-20	Low	Poor	Variable	None	Stones	V.poor	Severe	D
Unit 76	C	3-60	Range	Good	Variable	M.slow	Low	10-20	Med.	Poor	Variable	None	Slope	V.poor	Severe b/	D
Unit S76	C	3-60	Range	Good	Variable	Slow	Low	10-20	Med.	Poor	Variable	None	Stones	V.poor	Severe	D
Unit 77	C	3-35	Range	Good	Variable	Mod.	V.low	5-10	Low	Poor	Variable	None	Depth	V.poor	Severe	D
Unit 79	C	0-35	Range	Good	Variable	Mod.	High	60	Low	Good	Variable	None	Slope	V.poor	Strong	B
Unit 82	D	3-60	Range	Good	Med.	Mod.	Mod.	20-40	Med.	Good	Variable	None	Slope	V.poor	V.severe a/	B
Unit 83	D	3-60	Range	Good	Variable	M.slow	Low	10-20	Med.	Poor	Variable	None	Stone	V.poor	V.severe a/	D
Unit 84	D	3-60	Range	Good	Variable	Mod.	V.low	5-10	Low	Poor	Variable	None	Stone	V.poor	V.severe a/	D
Unit 96	C	3-60	Watershed	Exces.	V.rapid	Variable	Variable	Variable	Variable	Poor	Variable	None	Rock	V.poor	Variable	D

* Physiographic group:

A. Recent alluvial bottom lands and older fans, pediments, and terraces
B. Nearly level closed basins or bottom lands
C. Grass-shrub covered lava plateau uplands (basaltic, rhyolitic and tuffaceous bedrock)
D. Canyonlands, strongly dissected sediments, and mountainous uplands

** Temperature limitation:

a. Ranges to severe Units 55 and 56 are moderate at lower elevations
b. Ranges to strong
c. Ranges to moderate

*** Hydrologic group:

A. Lowest potential for runoff: well-drained to excessively-drained, sandy or gravelly soil with rapid rates of water transmission
B. Moderately deep to deep, moderately well to well drained, moderately fine to moderately coarse textured soils, having moderate rates of water transmission
C. Soils moderately deep to bedrock, hardpan, or consolidated sediments; with somewhat poor drainage; and fine to moderately fine textured layers having slow to moderately slow rates of water transmission
D. High potential for runoff; shallow to impermeable bedrock or pans, or clayey soils with low rates of water transmission and drainage

Table 5. Annual Maximum Discharge of Various Streams within EAR Boundaries.

Station No. 1/	Drainage Basin 1/	Drainage Area (sq.mi.)	1971 Date	1971 Gage Height (feet)	1971 Discharge (cfs) 2/	1972 Date	1972 Gage Height (feet)	1972 Discharge (cfs) 2/	1973 Date	1973 Gage Height (feet)	1973 Discharge (cfs) 2/	1974 Date	1974 Gage Height (feet)	1974 Discharge (cfs) 2/	1975 Date	1975 Gage Height (feet)	1975 Discharge (cfs) 2/
1	1a	1.0	1-17	7.05	77	1-21	7.88	105	4-16	4.22	7.2	3-07	4.83	17	4-27	5.11	23
2	1a	3.2	1-17	13.76	132	1-21	12.52	93	4-16	9.24	2.8	4-02	13.08	160	4-27	10.64	33
3	1b	46.2	-	-	-	-	-	-	4-12	11.43	5.0	3-02	10.91	2.0	8-18	-	1.0
4	2	2.2	-	-	-	1-21	3.13	2.2	4-16	2.71	0.72	3-30	2.98	1.5	8-19	3.00	1.6
5	2	6.6	1-17	9.68	7.0	1-21	9.73	7.6	4-16	8.80	1.5	3-30	9.79	8.4	4-27	9.99	11
6	2	2.0	1-17	-	97	3-2	-	57	4-16	-	19	3-30	-	20	4-27	-	14

1/ See figure for station locations and drainage basin location (U.S.Geological Survey Water-Data Reports OR-71-1 thru OR-75-1

2/ CFS = Cubic Feet Per Second

Table 6 . Water Quality Data For Selected Wells and One Spring Within EAR Boundary.

Well (w) or Spring (s)	Date of Collection	Temperature (°F)	Calcium (Ca)	Magnesium (Mg)	Sodium 2/ (Na)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Hardness as $CaCO_3$ Calcium magnesium	no carbonate	RSC 2/	SAR 3/	Specific conductance (micro-mhos at 25°C)	pH
3 (w)	3-6-64	52	48	17	42	228	35	17	14	191	0	1.09	1.3	494	8.8
4 (s)	2-12-64	128	1.6	.2	141	170	51	48	26	5	0	4.39	27	637	9.3
5 (w)	3-10-64	51	32	10	36	169	13	20	14	123	0	.74	1.4	393	8.6

1/ Sodium computed by difference.

2/ Residual Sodium Carbonate

3/ SAR (Sodium Absorption Ration) values are approximate because sodium was computed by difference.

Source: Huxel, et al. (1966).

TABLE 7. SUMMARY OF RANGE IMPROVEMENTS IN THE OREGON CANYON EAR AREA

Improvement Type	Number of Projects	Remarks
Reservoirs	188	Total capacity 462,246 cu. yards
Springs	94	
Wells	6	
Pipelines	22	New waters 149.2 mi., 15.0
Guzzlers	4	
Seedings	19	78,041 acres
Brush Controls	11	60,002 acres
Fences	100	Total length 615.1 miles
Corrals	2	
Cattleguards	61	
Truck Trails	8	Total length 88.6 miles

TABLE 8 GRAZING ALLOTMENTS IN THE OREGON CANYON EAR AREA

Allotment Number and Name	Acres Federal	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Opera-tions	Percent of Allotment EAR Area
1201 15 Mile Comm.	334,620	25,820	0	6	100
1202 McCormick	54,698	8,694	0	1	100
1203 Zimmerman	17,626	4,562	0	1	62
1301 Gilbert	52,049	4,277	0	1	100
1302 Echave	16,240	1,500	0	1	100
1303 Sherburn	41,861	3,613	0	1	100
1304 Albisu-Alcorta	13,465	994	0	2	100
1305 Eiguren	63,870	5,500	0	1	100
1306 Campbell	157,351	14,364	0	1	100
1307 Louse Canyon	127,643	11,135	0	4	100
	879,423	80,459	0	19	

Table 9 Estimated cost of electricity from variously fueled plants

Item	Gas-fired* 1/	Coal-fired* 2/	Hydro-electric	Nuclear**	Geothermal* (Hot water)	Oil-fired* 1/
Unit investment cost of plant $/KW 3/ (July, 1974)	260	310	390	575	4/ 160	350
Annual fixed charge, percent of investment 5/	17	17	17	17	4/	17
Kilowatt-hours generated per year per KW capacity 6/	7,000	7,000	7,000	7,000	7,000	7,000
Heat rate 7/	10,000	9,500	--	10,600	15,700	10,500
Cost of fuel (cents/million BTU)	69.6('74)	20.3('71)	--	17.5('71)	8/ 17('74)	2.40('74)
Cost of electricity (mills/kwh):						
Plant investment	2.6	5.5	9.5	7.3	2.3	2.8
Operation & maintenance	0.6	0.8	0.1	0.4	1.5	0.7
Fuel	3.5	1.9	--	1.9	5.9	6.5
TOTAL	6.7	8.2	9.6	9.6	9/ 9.7	10.0

1/ Outdoor type plant.
2/ Indoor type plant. Data valid only for western states.
3/ Includes land, structures, boilers, turbine generators, electrical equipment, miscellaneous plant equipment. Excludes switchyard.
4/ See following table for explanation of investment costs and annual fixed charges.
5/ Includes cost of money, depreciation, interim replacements, insurance and taxes.
6/ The 80 percent operating factor used here is applicable only to base load plants. Hydro is seldom a base load pla
7/ Varying heat rates representative of power plants under consideration when base loaded.
8/ Cost of fuel based on capital and operating costs of steam-winning system. (July, 1974)
9/ Comparative cost for dry steam approximately 5.3 miles.
*Derived from 17th steam station survey, Electrical World, Vol. 176, Nov. 1, 1971 (recent price increases not reflected).
**Derived from Hottel and Howard, New Energy Technology; article by Benedict, "Electrical Power for Nuclear Fusion," Proceedings of National Academy of Science 68.

Table 10

Geothermal plant investment and annual fixed charges 1/

Item	Unit investment costs	
	10-year life	30-year life
Production well system	$ 48	$ 25
Injection well system	75	32
Make-up water system	7	8
Sub-total, steam winning system	$130	$ 65
Generating plant 2/	0	95
Total	$130	$160
Annual fixed charges percent of investment 3/	23	17

1/ Steam-winning costs based on Geothermal Resources Investigation by U. S. Bureau of Reclamation (Jan. 1972). Costs escalated to reflect inflationary trends in construction industry.
2/ Includes structures, turbine generators, electrical equipment, miscellaneous. Excludes land, steam-winning system, switchyard.
3/ Includes cost of money, depreciation, interim replacement, insurance and taxes.

TABLE 11 <u>Crude Oil Spills During Oil and Gas Development and Production Activities in Five Western States in 1972</u>

State	Total Reported	Total Barrels[1] Spilled	Average-Number of Barrels per Spill	Wells in[2] Production	Number of Spills per 100 Wells in Production
Colorado	37	896	24	2,700	1.4
Montana	27	1,960	73	4,210	0.6
N. Dakota	19	813	42	1,490	1.3
Wyoming	74	9,676	131	9,300	0.8
Utah	16	1,434	90	900	1.8

(1) 646 bbls will cover one acre to a depth of 1 inch (646 bbl = 1 acre-inch)

(2) 1971 figures.

Source: Environmental Protection Agency, Region 8, Denver,Colorado

APPENDIX A

U.S. Department of the Interior Secretarial Order No. 2948, dated October 6, 1972.

Cooperative Procedures Pertaining to Onshore Oil, Gas and Geothermal Resources -- Implementation of Secretarial Order No. 2948.

Copies of these documents may be obtained or reviewed at any U.S. Bureau of Land Management office.

APPENDIX B

STATE OF OREGON REGULATIONS PERTAINING TO OIL AND GAS RESOURCE DEVELOPMENT AND PRODUCTION, AND AN OVERVIEW OF THIS RESOURCE DEVELOPMENT WITH A DESCRIPTION OF STATE-FEDERAL COOPERATION

State of Oregon Department of Environmental Quality memorandum dated September 2, 1975 by Loren Kramer to R.E. Corcoran, Dept. Geol. and Mineral Industry, on Special Conditions to Apply to All Deep Well Exploratory Drilling in Oregon. Establishes criteria for environmental protection during geothermal, mineral, or petroleum resource development.

"Cultural Resource Stipultions to Oil and Gas Leases Issued in Oregon." This document establishes criteria for protecting items of historical or scientific interest during mineral resource development in Oregon.

Chapter 632, Oregon Administrative Rules: Department of Geology and Mineral Industries. These regulations describe regulations for developing oil and gas resource development facilities in Oregon and measures to protect the environment during resource development and production.

"Statewide Overview of Possible Development on Federal Oil and Gas Leases in Oregon." This document describes the history of oil and gas development in Oregon, its potential future, various regulations on development and production, and State-Federal cooperation.

APPENDIX C

COMPREHENSIVE LAND USE PLAN

FOR MALHEUR COUNTY, 1973

This comprehensive land use plan, prepared by the Malheur County Planning Commission, is not included in this reproduction of the Oregon Canyon geothermal/oil and gas E.A.R. A copy of this 44-page plan may be viewed at:

1. The BLM District Office at Vale, Oregon.
2. The BLM State Office at Portland, Oregon.
3. The County Records of Malheur County at Vale, Oregon.

APPENDIX D

MALHEUR COUNTY ZONING ORDINANCE

This zoning ordinance is not included in this reproduction of the Oregon Canyon geothermal/oil and gas E.A.R. A copy of this 56-page ordinance may be viewed at:

1. The BLM District Office at Vale, Oregon.

2. The BLM State Office at Portland, Oregon.

3. The County Records of Malheur County at Vale, Oregon filed as Microfilm Instrument No. 148901 (filed 8/17/1973).

APPENDIX E

GEOTHERMAL ORDINANCE FOR MALHEUR COUNTY

This geothermal ordinance is not included in this reproduction of the Oregon Canyon geothermal/oil and gas E.A.R. A copy of this 26-page ordinance may be viewed at:

1. The BLM District Office at Vale, Oregon.

2. The BLM State Office at Portland, Oregon.

3. The County Records of Malheur County at Vale, Oregon filed as Microfilm Instrument No. 158761 (filed 6/20/1974).

APPENDIX F

Letters soliciting comments on environmental impacts of geothermal and of oil and gas leasing in the Oregon Canyon EAR area with a list of individuals to whom letters were sent and replies to inquiries.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

P. O. Box 700
Vale, Oregon 97918

IN REPLY REFER TO:
3210
(Oregon Canyon
EAR Area)

AUG 23 1976

Dear Sirs:

The Vale District office of the Bureau of Land Management is in the process of writing separate environmental analysis reports on the effect of geothermal leasing and development and leasing for oil and gas resource development on Federal lands within the area outlined on the enclosed map.

If you have any comments on the environmental effects of either type of leasing and development, or suggestions on mitigating measures that should be taken to protect the environment during geothermal or oil and gas development, please submit them in writing, to the Vale District Manager at the above address by September 20, 1976.

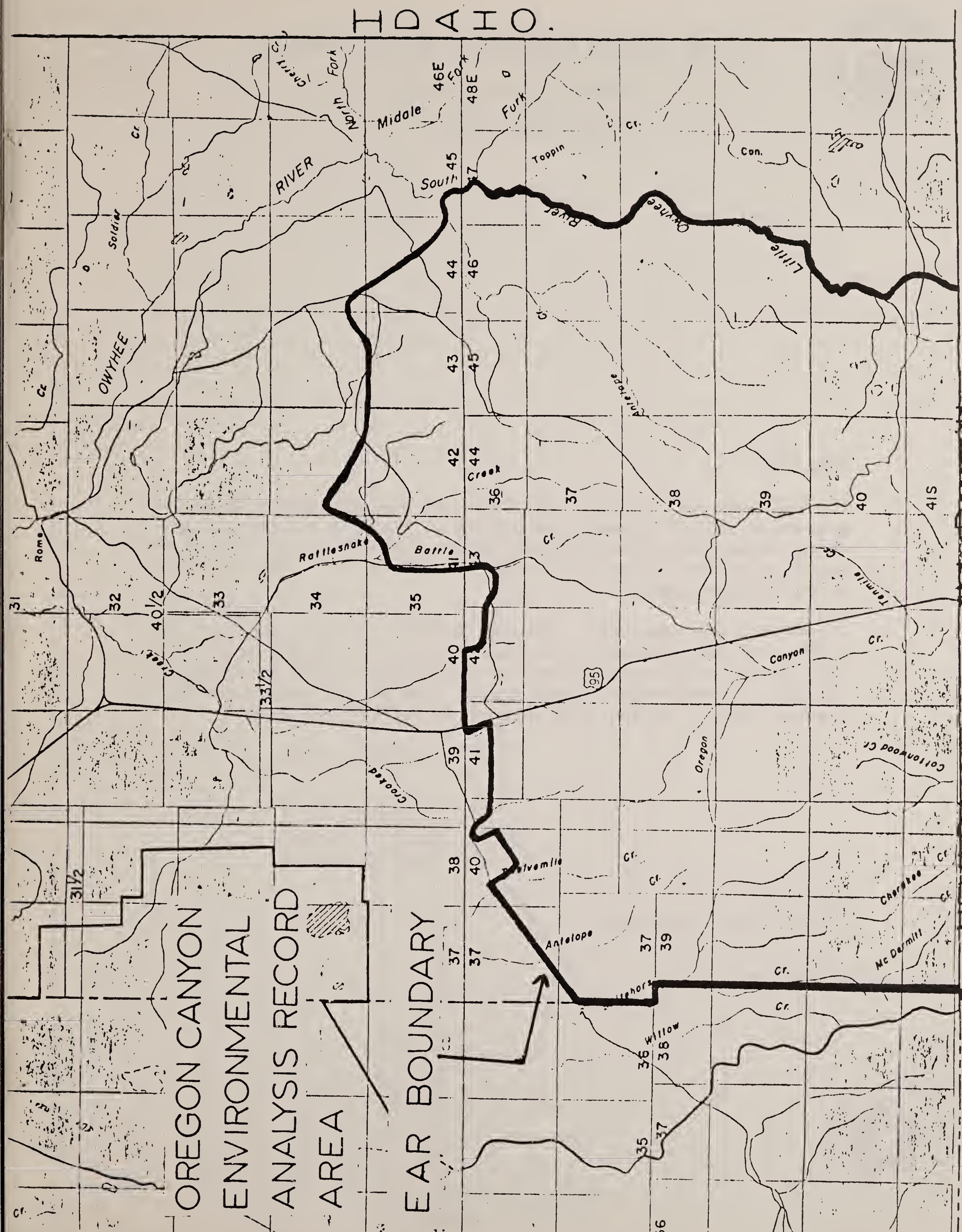
Sincerely yours,

Fearl M. Parker

Fearl M. Parker
District Manager

Encl: (1)
Ore. Canyon Index Map

American Revolution Bicentennial 1776-1976


IDAHO
NEVADA
OREGON CANYON ENVIRONMENTAL ANALYSIS RECORD AREA
EAR BOUNDARY
OWYHEE RIVER
North Fork
Middle Fork
South Fork
Little Owyhee River
Soldier Cr.
Rome
Rattlesnake
Battle Creek
Crooked Creek
Antelope
Oregon Canyon Cr.
Twelvemile Cr.
Cottonwood Cr
Cherokee Cr.
McDermitt
Willow Cr.
Toppin
95

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
P.O. Box 700
Vale, Oregon 97918

IN REPLY REFER TO
3210
(Oregon Canyon
EAR Area)

Dear Sirs:

The Vale District office of the Bureau of Land Management is in the process of writing separate environmental analysis reports on the effect of geothermal leasing and development and leasing for oil and gas resource development on Federal lands within the area outlined on the enclosed map.

If you have any comments on the environmental effects of either type of leasing and development, or suggestions on mitigating measures that should be taken to protect the environment during geothermal or oil and gas development, please submit them in writing, to the Vale District Manager at the above address by October 15, 1976.

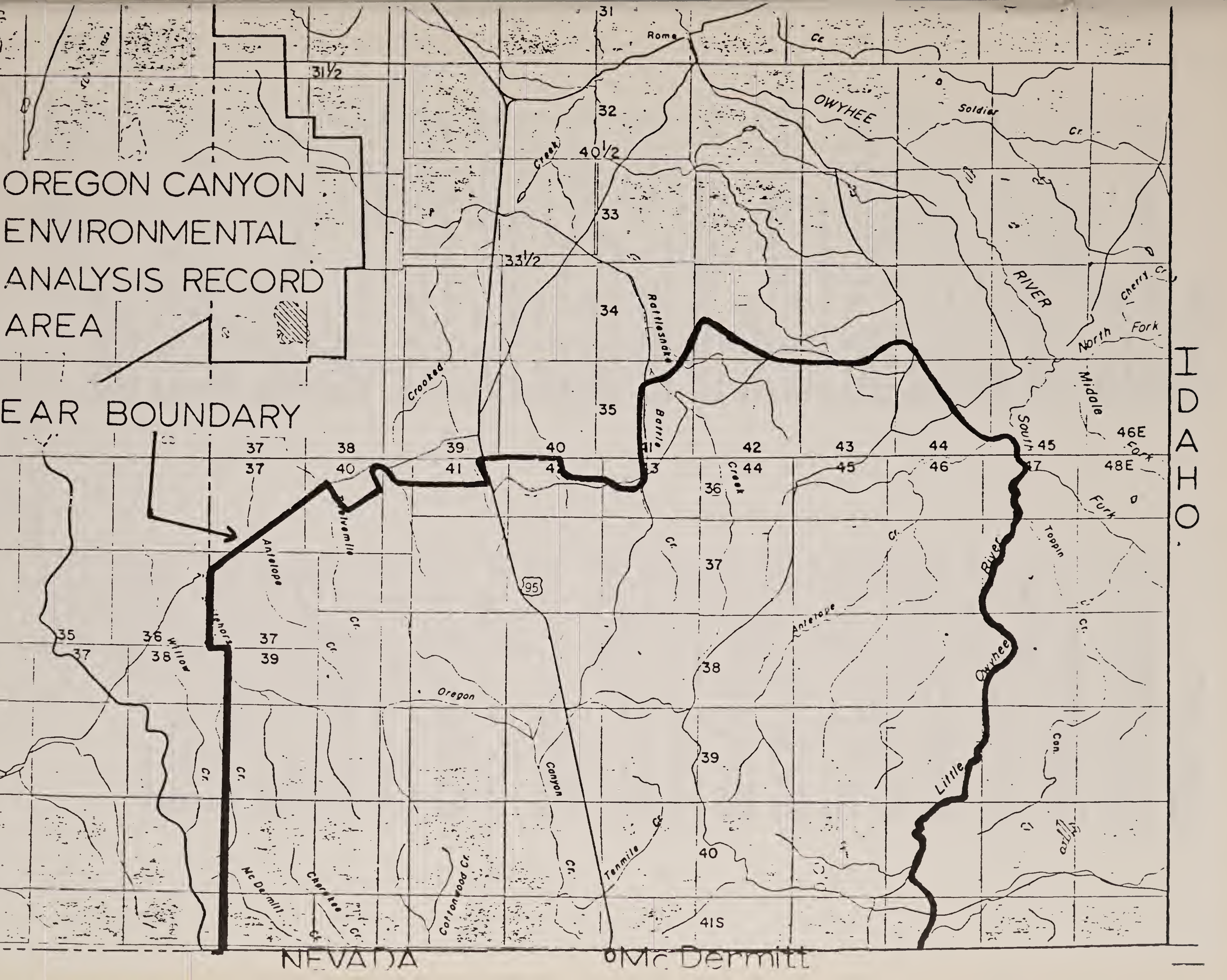
Sincerely yours,

Fearl M Parker

Fearl M. Parker
DISTRICT MANAGER

Encl: (1)
Ore. Canyon Index Map

AMERICAN REVOLUTION BICENTENNIAL 1776-1976


OREGON CANYON
ENVIRONMENTAL
ANALYSIS RECORD
AREA
EAR BOUNDARY
IDAHO.
NEVADA
McDermitt
Rome
OWYHEE
RIVER
Soldier
North Fork
Middle
South
Fork
Cherry Cr.
Toppin
Little
Owyhee
River
Antelope
Con.
Rattlesnake
Battle
Creek
Crooked
Oregon
Canyon
Tenmile
Cottonwood Cr.
Cherokee Cr.
McDermitt
Willow
95
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33
33½
34
35
36
37
38
39
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41
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43
44
45
46
47
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Malheur County National Farmer's Organization
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Alfred Pottorff
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Walter L. McFarland
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Route #3
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School, District #42
Mel Witeman, Principal
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Vale, OR 97918

School, District #51
McDermitt, NV 89421

School, District #61 - Adrian
Glenn E. Ward
Adrian, OR 97901

School, District #66 - Harper
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Robert Patterson
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School, Elementary
James Bolton
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U. S. Department of the Interior
P. O. Box 3737
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Office of Ecological Services
U. S. Fish & Wildlife Service
U. S. Department of the Interior
P. O. Box 3737
Portland, OR 97208

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Region 6
P.O. Box 3623, Portland, Oregon 97208

8420
September 17, 1976

Fearl M. Parker, District Manager
Bureau of Land Management
P.O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

In response to your August 23 letter, 3210 (Oregon Canyon EAR Area), we have the following comments:

The area to be studied is many miles from National Forest System land in Region 6. It does border the northern edge of the Humboldt National Forest in Region 4. We do have an impact concern in that, so far as we are aware, has not been addressed by Interior in any energy environmental statement studies.

This is the impact of energy transmission, should an area under study be commercially developed. Transmission of geothermal generated electricity to population centers may directly impact the National Forests. Any Environmental Analysis Report or statement about an energy production site should also give some qualified attention to energy transmission impacts from a commercial development. Most of the available east-west transmission corridors and mountain passes across the Cascades (and National Forests) are approaching capacity limits in terms of room for additional facilities. In the next few years public land managers will be faced with the problem of greatly expanded demand for east-west energy transmission line locations as nuclear and coal-fired plants are sited east of the Cascades, and as the coal fields east of the Rockies produce an ever increasing share of the energy load.

Parallel to the power line location concern discussed above is that commercial development of any energy resource for electrical power is not totally coordinated. In the western United States a formal group has been organized to be responsible for the coordinated development planning for all forms of electrical generation. This group is called the Western Systems Coordination Council. The facilities, including transmission lines, required to meet electrical generation needs (hydro, coal, or nuclear) through 1990 are now into system planning, including load center(s) served.

The EAR or ES for the area described in your August letter should point this out. As a minimum, it should recommend that any developmental leases contain clauses assuring that commercial development for electrical generation be in accord with coordinated system schedules and needs as now planned and agreed upon.

Sincerely,

Robert T. Tyrrel

ROBERT T. TYRREL
Director
Planning, Programming and Budgeting

DEPARTMENT OF
GEOLOGY AND MINERAL INDUSTRIES

ADMINISTRATIVE OFFICE

1069 STATE OFFICE BLDG. • PORTLAND, OREGON • 97201 • Ph. (503) 229-5580

~~TOM McCALL~~
~~GOVERNOR~~

ROBERT W. STRAUB
GOVERNOR

September 20, 1976

Mr. Fearl M. Parker
District Manager
U. S. Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

This is in response to the notice mailed to us about the environmental analysis being made for oil and gas leasing in your district. We mailed a report on geothermal prospects and possible effects of development earlier this summer. This notice for oil and gas assessment study slipped by us so we have not prepared a report for the analysis study.

We do believe, however, that oil and gas development can be shown to be compatible with other uses. There will be some negative impacts if commercial discoveries are found but we believe the benefits far outweigh these impacts. In most cases the impacts can be mitigated. Field development, if it takes place, will be a temporary disturbance of the environment. If no commercial development takes place, the environmental impact will be negligible.

We feel there is a potential for petroleum resources in the region. The prospects are very speculative since little is known about subsurface conditions in eastern Oregon

Sincerely,

Vernon C. Newton Jr.

Vernon C. Newton, Jr.
Geologist - Petroleum Engineer

VCN:bj

Oregon High Desert Study Group

RECEIVED
SEP 20 1976
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

COLLEEN GOODING
COORDINATOR

POST OFFICE BOX 25 • ST. PAUL, OREGON 97137

September 13, 1976

Mr. Fearl Parker
District Manager
Vale District Office
Bureau of Land Management
P.O. Box 700
Vale, Oregon 97918

RE: Oregon Canyon EAR
Letter No. 3210

Dear Mr. Parker:

Thank you for giving the Oregon High Desert Study Group the opportunity to comment on the Oregon Canyon geothermal and oil and gas leasing Environmental Analysis Reports.

We are particularly concerned about the following areas which are either in, or border, the lease area: the South Fork of the Owyhee River, Antelope Creek and its tributary, Twin Springs Gorge, Toppin Creek, the West Little Owyhee River, as well as the rangeland which is adjacent to these canyons.

In September 1975, six members of the Group, Tony George, Cliff Perry, Gordon Whitehead, Julie Ambler, Bill Eklund and myself, along with Bill Schneider from the Vale BLM office, spent three days exploring and evaluating this portion of the Owyhee region. (Refer to the attached Study Trip Report).* From a base camp located near the confluence of the West Little Owyhee and the South Fork, we explored:

1) the Owyhee River downstream to Antelope Creek
2) up Antelope Creek to Twin Springs Gorge
3) up Twin Springs Gorge
4) from camp, upstream along the Owyhee to a private property boundary marker
5) we hiked up the West Little Owyhee, past the mouth of Toppin Creek and climbed out of the canyon east of Sacramento Hill

I have not drawn boundaries around the areas we explored, since our studies are not complete. We are certain there are additional adjacent areas which are also environmentally sensitive.

Besides being outstandingly beautiful, we believe that these areas are de facto wilderness and meet the criteria for a BLM Primitive Area, as well as the following criteria of the 1964 Wilderness Act:

1) an area where earth and its community of life are untrammeled by man; where man is a visitor and does not remain.

2) an area of undeveloped federal land retaining its primeval character and influence without permanent improvements of human habitation which is protected and managed so as to preserve its natural condition.

3) appears to have been affected by the forces of nature with mans work substantially unnoticeable.

4) has outstanding opportunities for solitude or a primitive and unconfined type of recreation.

5) has at least 5,000 acres or is of sufficient size as to make practicable its preservation and use in an unimpaired condition.

6) may also contain ecological, geological or other features of scientific, historical or educational value.

I do not wish to belabor the fact that development and leasing are totally incompatible in wilderness or primitive areas. Therefore, we are asking you to protect these areas by:

1) EXCLUDING the aforementioned areas from leasing and development

2) prepare an Environmental Impact Statement for the Oregon Canyon lease area. We believe that the National Environmental Policy Act of 1969 requires the preparation of an EIS prior to the leasing of federal lands for geothermal, as well as gas and oil development. We are particularly concerned that this requirement of NEPA be complied with when certain types of unique or environmentally sensitive areas are being considered for development or leasing.

Please include our comments into the EAR.

Sincerely yours,

Colleen Gooding

Colleen Gooding

* The study trip report describes the location of a unique historical site - a site which is literally "untouched". Since this document will be open to public scrutiny, you have my permission to blot out the description.

OWYHEE CANYONS WILDERNESS SUITABILITY REPORT

Antelope Creek - West Little Owyhee

(Bill Eklund)

During September of 1974 the Oregon High Desert Study Group conducted a study trip along a stretch of the main stem of the Owyhee River (South Fork) and two of its tributaries, Antelope Creek and the West Little Owyhee. This report describes that trip and presents our conclusions regarding the wilderness suitability of the area we studied. This trip was the first in a series of trips that we intend to conduct in the Owyhee region of Oregon, Idaho, and Nevada. The vastness of this region and the numerous tributary canyons of the Owyhee River permit only piecemeal surveys for the purpose of determining the wilderness suitability of particular areas within the Owyhee region.

The accompanying map shows the area of study. Our access to the area was from the southwest (U.S. 95), via Rattlesnake Springs and the service road along the stock watering pipeline depicted on the map. Near the junction of the Owyhee River and the West Little Owyhee the pipeline service road (not shown on the map) dwindles to a jeep trail and ends at the canyon rim. It should be noted that the jeep trails shown on the map as crossing the river at this point are at best old jeep trails, passable only with a four-wheel drive vehicle under the best of conditions, and apparently unused recently. Within the canyons the jeep trails are badly washed out and showed no indications of having been used during the 1974 dry season.

Accompanied by Bill Schneider of the Vale District BLM office, our party left a vehicle at the end of the pipeline road and entered the canyon on foot. We spent three days studying the area on foot. Our route is shown in orange on the accompanying map. We explored the Owyhee River canyon downstream to Antelope Creek, then up Antelope Creek and its tributary, Twin Springs Gorge. From our base camp near the confluence of the West Little Owyhee and the South Fork we also travelled upstream along the Owyhee [redacted] Finally, we hiked up the West Little Owyhee and climbed out of the canyon east of Sacramento Hill.

OBSERVATIONS

We were all thoroughly impressed by the beauty of this canyon region. Vertical canyon walls of pinkish-brown rhyolite rise to heights of hundreds of feet throughout the area, with pinnacles and deeply cut tributaries adding to the uniquely scenic character of the canyons. The terrain of the canyon floors ranges from broad, sandy washes along the South Fork to narrow, boulder-strewn gullies in the Little West Owyhee canyon that are impassable except on foot. The smaller tributaries are no less spectacular than the larger ones. Twin Springs Gorge and Toppin Creek are spectacular gorges offering an outstanding recreational potential to the desert hiker. The larger canyons of Antelope Creek, West Little Owyhee, and the South Fork of the Owyhee River are all ideally suited to desert hiking and camping.

Within the canyons we found no evidence of any recent substantial activities of man. As mentioned above, the jeep trails into the canyons are badly washed out and are not maintained. [redacted] did not observe any buildings or other substantial artifacts of man along our route. A few cattle and several remnants of fences were the only signs of man's activities in the canyons in recent times.

We observed only a very limited portion of the range along the rim of the canyons. In the areas we were able to see, however, we saw only very limited signs of man's activities. Earthen stock ponds and a few jeep trails seem to be fairly common, but are not so obtrusive as to be incompatible with primitive or wilderness classification.

[redacted]

In view of the rapidly increasing incidence of looting of archaeological sites throughout the West in recent years, we strongly advise that these sites be protected by whatever means are available. In view of our conclusions regarding the de facto wilderness character of this region, we would suggest that primitive designation of this area also be considered as an effective administrative action to protect these sites. We believe that primitive designation of these canyons is justified by the de facto wilderness character of the region and would also serve to enforce the spirit of the Antiquities Act of 1906.

Wildlife is abundant throughout the area. During our approach to the area we observed a herd of pronghorn antelope, a loggerhead shrike, a burrowing owl, and other more common species. Within the canyon the common birds we observed included kingfishers, mergansers, brewer's blackbirds, Say's phoebes, and canyon wrens. Higher up on the canyon walls chukars were often heard and occasionally seen. Several golden eagles were seen along the rims of the canyons. Tracks of a Sanhill crane were tentatively identified in the mud close to the river. Two sparrow hawks and a dipper were seen in Antelope Creek.

Other sightings in the canyons included several mule deer, a coyote, and six rattlesnakes. Most spectacular was the sighting by one of us of a mature cougar along Antelope Creek.

CONCLUSIONS

It is our opinion that virtually all of the area seen by us on this trip, as well as some undetermined areas that we were unable to examine directly, consist of de facto wilderness which should be designated as a primitive area. The canyons themselves, from "rimrock to rimrock," are uniquely scenic and offer excellent wilderness recreation opportunities. Water is plentiful, campsites readily available, and the winding canyons offer outstanding scenic routes to the hiker or horseman. Further, there are no competing uses of the canyons which would be incompatible with primitive area designation. There are no timber or significant mineral resources in the canyons, and the limited use of the canyon floors for grazing would not conflict with primitive area designation. According to the criteria adopted by the Oregon High Desert Study Group for determining wilderness suitability, the canyon regions readily qualify for primitive area designation by the Bureau of Land Management. If the BLM Organic Act is enacted as introduced in Congress, this area should be considered for Wilderness Area classification by Congress.

The accompanying map depicts in yellow the boundaries of the area we have tentatively proposed to be designated as a primitive area. In addition to the canyons, as defined by "rimrock to rimrock," we have included a buffer zone of varying width along the canyon rims. Several factors should be considered in determining the width of these buffer zones.

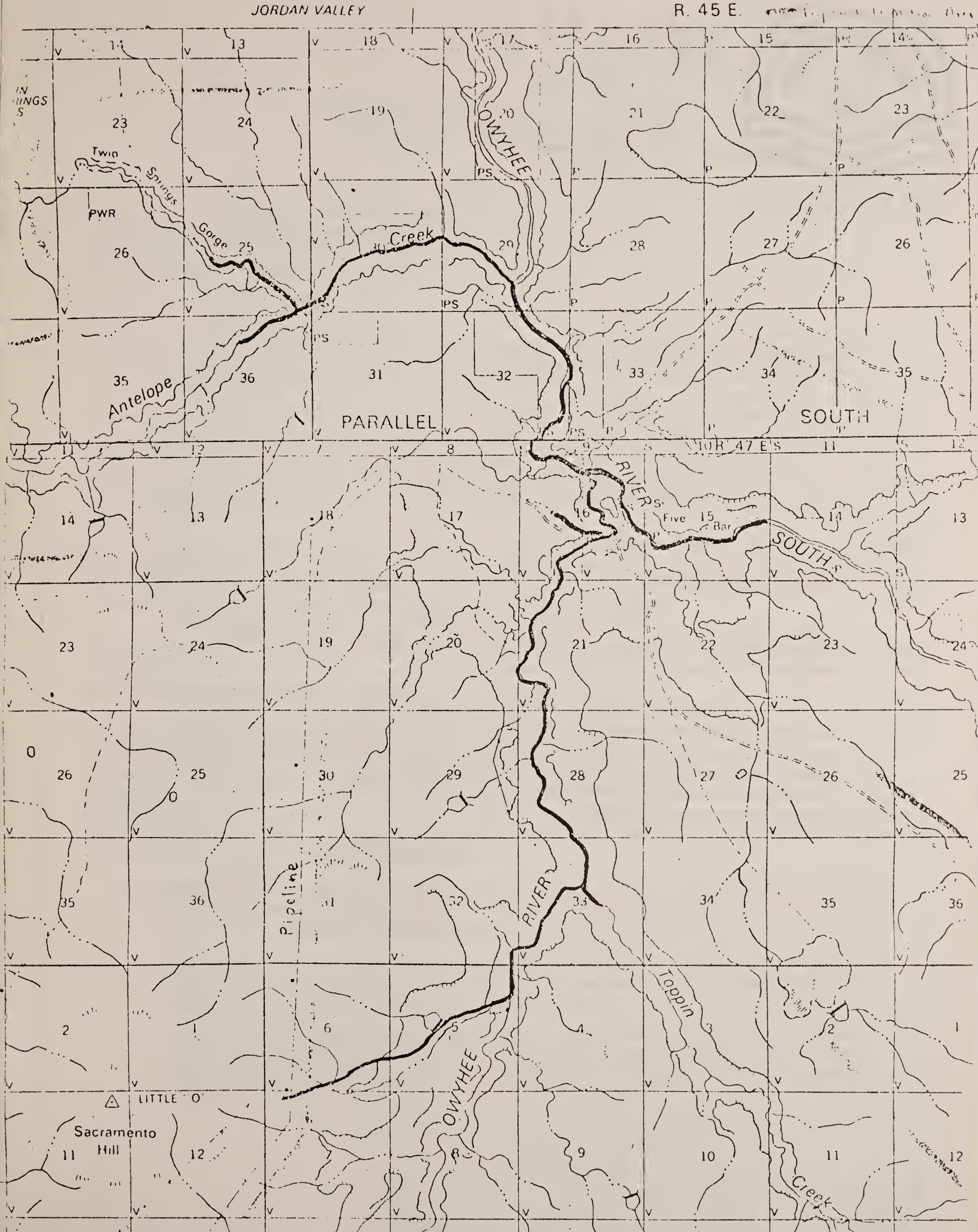
First, natural access points along the canyons should be surrounded by wide buffer zones to discourage unlawful vehicular access and to prevent excessive vehicular use of the rim areas immediately adjacent to the access points. Natural access points will tend to become entry points for hikers and horseman. Vehicular congestion at roadheads at the edge of the primitive area can be alleviated if the roadheads are set well back from natural access points.

Secondly, wildlife within the canyons require a certain amount of rangeland along the canyon rims. We noted that the presence of only a few hikers in the canyons would cause wildlife such as deer and coyotes to seek refuge by climbing out of the canyons and onto the range. A minimum buffer zone everywhere along the rim would protect this habitat of some of the canyon wildlife.

Thirdly, sites within the canyons which have particular historical or archaeological value should be protected by a wide buffer zone. Primitive area designation of the canyons would help to protect these sites by keeping vehicles out of the canyons, but where the canyons are relatively narrow it will also be necessary to discourage access from the nearby rims. Without a wide buffer zone, these sites would be readily accessible by vehicular approach to the nearby rims.

Finally, there are undoubtedly areas on the adjacent rangeland that qualify for primitive area designation in their own right. One example might be the area between Toppin Creek and the West Little Owyhee canyons, an area that is relatively inaccessible and surrounded by canyons in three directions. Although we have not been able to study such areas yet, we believe that these areas should be considered carefully for primitive designation.

Again, this is a preliminary report which will be augmented by our future studies in the Owyhee region. Our proposals are based on the studies we have made as of January, 1975. During the 1975 season we expect to return to the Owyhee region to make more extensive studies, both in Oregon and Idaho. A comprehensive report and proposal will be written at that time.


JORDAN VALLEY
R. 45 E.
Twin
Springs
Gorge
PWR
Creek
OWYHEE
PS
Antelope
PARALLEL
SOUTH
10 R 47 E S
RIVER
Five
Bar
SOUTH
Pipeline
RIVER
Toppin
Creek
OWYHEE
LITTLE
Sacramento
Hill

COLUMBIA GROUP

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SEP 17 1976
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

September 14, 1976

Mr. Fearl M. Parker
District Manager
Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

Re: 3210 (Oregon Canyon EAR Area)

Dear Mr. Parker:

Thank you for your letter of August 23, 1976 inviting The Sierra Club's comments in the above captioned matter.

In that your letter contains absolutely no information on The Oregon Canyon project it is difficult to make any sort of meaningful comment. I would, however, ask that before The Bureau proceeds any further it prepare an Environmental Impact Statement (EIS) in accordance with NEPA.

Sincerely,

Peter C. Davis

PCD:pam

Pacific Northwest Chapter
SIERRA CLUB
2637 S.W. Water Street· Portland, Oregon 97201· (503) 222-1963

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9-9-76 SEP 13 1976

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

Mr. Frank M. Parker, District Manager,
Bureau of Land Management,
P.O. Box 700,
Vale, Oregon. 97918

Dear Mr. Parker:

Reference your August 23, 1976, letter, File 3210 (Oregon Canyon EAR Area.) I certainly appreciate receiving this notice.

I have not made an on-the-ground review of the EAR area shown on the map. But I am certainly encouraged that just perhaps movement is being made relative to geothermal development. The nation-wide slow pace makes me suspect there is a built in reason which will be removed when it becomes obvious that oil reserves are becoming exhausted.

One reason for this feeling is the way the oil companies are drilling and tying up geothermal wells. Another, is the five volume "Environmental Statement for the Geothermal Leasing Program". It is certainly a good thing a similar set of books was not compiled in the begining for oil drilling.

Let me hasten to point out that safeguards are necessary when dealing with earth resources. But after all, the five volumes indicates to me that the Washington Office of the Interior Department got carried away.

I have been to the developed geothermal fields in Mexico and New Zealand. Also, I have attended several geothermal seminars sponsored by state, private, and federal agencies. I have been the General Public Representative, Geothermal Resources Council. I have visited the Interiors' geothermal test center at the Salton Sea. I certainly am not an expert in the accepted sense of the words in the geothermal field. My personal interest (not shaded by a financial interest) draws me to the following conclusions:

> Geothermal resources in the United States have a tremendous potential for power and other heat uses. This would be realized if the resources were allowed to be freely developed and not shackled.
>
> Reinjection of spent water and steam is a must. It should be a prerequisite requirement in any bid. The heated saline water cannot be allowed to mix with northwest surface water.
>
> At New Zealand, the next development site (the drilling is done and the wells are capped) will have reinjection of the water and steam. They, too, are restrained by governmental problems from full development.

THE NELSONS • 1806 N.W. SLUMAN ROAD • VANCOUVER, WASHINGTON 98665

Of all the presently developed and used power sources, geothermal has the least impact "on the environment" and wildlife. The pipeline areas can be developed for grazing and for wildlife habitat. (Keep hunting far away from the pipelines.) Wildlife production and management-and domestic stock production-would have to be built into the land management plan-a part of the bid process.

I will appreciate your keeping me informed on the geothermal developments in this and other areas of Oregon.

Respectfully yours,

HOWARD E. NELSON

cc: Interested Persons

RECEIVED
SEP 3 1976
DEPARTMENT OF THE INTER
…AU OF LAND MANAGEME…
Vale, Oregon

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
P. O. Box 700
Vale, Oregon 97918

IN REPLY REFER TO
3210
(Oregon Canyon
EAR Area)

AUG 23 1976

Mr. G. E. McBroom
Western Division Manager
Idaho Power Company
Payette, Idaho 83661

Dear Mr. McBroom:

The Vale District office of the Bureau of Land Management is in the process of writing separate environmental analysis reports on the effect of geothermal leasing and development and leasing for oil and gas resource development on Federal lands within the area outlined on the enclosed map.

If you have any comments on the environmental effects of either type of leasing and development, or suggestions on mitigating measures that should be taken to protect the environment during geothermal or oil and gas development, please submit them in writing, to the Vale District Manager at the above address by September 20, 1976.

Sincerely yours,

Fearl M Parker
Fearl M. Parker
District Manager

Encl: (1)
Ore. Canyon Index Map

9/1/76

Mr. Parker:
Thank you for the opportunity to comment.
The area involved does not include any of our present service area, however the Pacific Power & Light Co. do have a planned transmission line near the northern boundary. Our Boise office sent a copy of your letter and map to them.

Thanks again
G E McBroom,

STATE OF OREGON 1859

OREGON STATE HIGHWAY DIVISION

Region 5 Office

P. O. Box 850 ... La Grande, Oregon 97850 ... Phone 963-3177

ROBERT W. STRAUB
GOVERNOR

F. B. KLABOE
Administrator and
State Highway Engineer

September 1, 1976

Mr. Fearl M. Parker, District Manager
USDI, Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

RE: 3210 (Oregon Canyon EAR Area)

The Oregon State Highway Division has considered the effects of oil and gas leasing and development on Federal lands as outlined on the map enclosed with your letter of inquiry regarding subject matter, and can see no adverse effects upon our property as a result of this activity. We would, however, like to point out that we do have material sources in this area and would not want this to hamper our operation of these material sources.

Also, we do expect all laws and regulations relevant to highway matters to be complied with.

Thank you for the opportunity to comment on this.

Sincerely,

W. E. Schwartz
Regional Engineer

By [signature]

Bob Aldrich
Regional Office Engineer

cc R. L. Schroeder
John Oakes
C. K. Ansell

ROBERT W. STRAUB
GOVERNOR

DEPARTMENT OF ENVIRONMENTAL QUALITY

1234 S.W. MORRISON STREET • PORTLAND, ORE. 97205 • Telephone (503) 229-5395

RECEIVED
AUG 30 1976
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

August 27, 1976

Mr. Fearl Parker, District Manager
Bureau of Land Management
P.O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

This letter replies to your letter of August 23 requesting our comments on environmental effects of geothermal or oil and gas leasing or development. The enclosed letter copy describes our major concern -- that a comprehensive Environmental Impact Statement (EIS) be prepared prior to any large scale development of these resources.

In reviewing two previous Bureau of Land Management Environmental Analysis Records on proposed oil and gas leasing, we found no assurance that a comprehensive EIS would be prepared prior to major resource development. Can you provide such assurance?

Sincerely,

LOREN KRAMER
Director

Enclosure

3210

P.O. Box 700
Vale, Oregon 97918

AUG 31 1976

Mr. Loren Kramer, Director
Dept. of Environmental Quality
1234 Southwest Morrison Street
Portland, Oregon 97205

Dear Mr. Kramer:

Thank you for your letter of August 27, 1976 regarding environmental analyses and environmental statements which pertain to geothermal or oil and gas leasing or development. I understand your concern regarding the affects of energy development upon the environment. I hope that this letter will clarify some of our procedures for you.

One of our first actions upon receipt of a lease application for oil and gas or geothermal energy is to analyze the environmental impacts of issuing the lease. This analysis is done in general terms assuming that the lease has been issued and a commercial field located. These assumptions provide us a basis for analyzing environmental impact. The typical end product we have experienced from this stage of analysis has been identification of areas that should not be leased because of unique environmental considerations, areas that can be leased with a no-surface occupancy stipulation or, areas that can be leased with standard stipulations or special stipulations less stringent than no surface occupancy. If the analysis points out significant environmental impacts, an environmental impact statement may be required before the issuance of any leases.

If it seems proper to lease and no environmental statement is indicated by the environmental analysis the lease would be issued. Before the lessee could undertake any exploratory work that would significantly disturb the surface he would be required to provide a Plan of Operation to the U.S. Geological Survey. The Geological Survey would review this plan for technical adequacy and would prepare another environmental analysis to assess the environmental impacts of the specific operations set forth for the lease area. This Bureau would participate in preparation of this environmental analysis. If the analysis determined that environmental impacts resulting from this plan of operation would be significant, an environmental impact statement would be prepared before any on-the-ground work proceeded. If the environmental analysis determined that environmental impacts would not be significant, permits could be issued for the lessee to proceed with his exploratory work.

If a commercial field were discovered, the lessee would be required to provide the U.S. Geological Survey with a Plan of Development for that field. This plan would also be reviewed for technical adequacy and the environmental impacts of the proposed development would be reviewed through a third environmental analysis. An environmental statement could be indicated if the impacts of the proposed development were significant.

You can see that each step from letting of the lease through development of the field is thoroughly analyzed for environmental impacts. Each successive analysis can be in more detail than the proceeding one as the proposed action being analyzed is more detailed than the proceeding one. While any of the environmental analyses may indicate the need for an environmental impact statement, there is no guarantee that a statement would be produced for any of the three stages discussed. There are too many variable factors that have to be considered for us to give any blanket assurances that a comprehensive environmental impact statement would be prepared before issuance of leases for oil and gas or geothermal energy.

I hope this has clarified our procedures for you somewhat. If you have any further questions feel free to contact me.

Sincerely yours,

/S/ FEARL M. PARKER

Fearl M. Parker
DISTRICT MANGER

PAPWORTH:sm

DIVISION OF STATE LANDS

1445 STATE STREET • SALEM, OREGON • 97310 • Phone 378-3805

August 26, 1976

United States Department of the Interior
Bureau of Land Management
P. O. Box 700
Vale, OR 97918

Gentlemen:

Because we expect interest in leasing oil and gas and geothermal resources on Federal land in the Oregon Canyon EAR area to be limited, we are not able to offer extensive comments.

You are already aware of the endangered species endemic to this area. Water quality control will be an important aspect of your EAR because of these species.

Any deep exploration program will develop further information about the other mineral commodities which occur in this region. We hope that it will be possible to obtain early release of data found to be non-proprietory.

We appreciate the opportunity to participate in your review.

Sincerely,

Leonard G. Wilkerson

Leonard G. Wilkerson
Minerals Leasing Specialist

vw

cc: Burton P. Lewis
Range Manager

Union Geothermal Division

Union Oil Company of California
1250 Coddingtown Center, P.O. Box 6854
Santa Rosa, California 95406
Telephone (707) 542-9543

union 76

August 25, 1976

Fearl M. Parker
District Manager
Bureau of Land Management
P.O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

Your letter of August 23, 1976 was received in our Santa Rosa District Office and has been forwarded to Mr. Neil Stefanides at our Los Angeles Head Office. Mr. Warren Smith of our Santa Rosa Environmental Office has also been given a copy. Their response will be forthcoming.

Very truly yours,

UNION OIL CO. OF CALIFORNIA

Dennis S. McMurdie (l.)

Dennis S. McMurdie
Head Geologist

DSM/ljl

cc: Neil Stefanides
Warren Smith

RECEIVED
AUG 27 1976
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

Daily Argus Observer
Post Office Box 130
ONTARIO, OREGON 97914

Bureau of Land Management
Vale, Oregon
Att: Pearl Parker

Dear Mr. Parker:

I have confered with Mr. Fran McLean on the analysis reports being developed on the effects of geothermal leasing of the area along the Nevada-Oregon border and near Oregon canyon.

Our feelings coincide on the matter.

We have no objection to geothermal exploration or to drilling for oil. However, we'd like to see someone get to work on it. Leases which run indefinitely or those which are extended do not seem to us to be in the best interest of this area or of Oregon.

Although we are very interested in protecting the environment, we'd like to see some exploratory work done soon. Perhaps the rules are too stringent to allow a company to explore the resource.

Sincerely,
Chris
Chris Moore, editor

RECEIVED
AUG 26 1976
DEPARTMENT OF THE INTER
BUREAU OF LAND MANAGEME
Vale, Oregon

Offices Also in Payette, Idaho

Wilderness River Outfitters
And Trail Expeditions, Inc.
P. O. BOX 871 — PHONE (208) 756-3959
SALMON, IDAHO 83467

October 13, 1976

FearlM Parker
Bureau of Land Management
P.O.Box 700
Vale, Oregon 97918

Dear Fearl:

Thanks for your letter asking for comments on the proposed developments in the Owyhee Desert.

While this area is not a wilderness or even roadless it does provide very unique type of country side. I think at the present the Owyhee desert is being "multiple use managed" with livestock, grazing, recreation, and mining.

I am uncompromisingly opposed to leases proposed in this area for oil, gas, or geothermal development.

In this desert country a drilling rig would be visible for a very long distance and I see no reason for the distruction of the scenic values of the Owyhee Desert to try to quench the apparently un satisfiable thirst of our country for natural resources.

Sincerely,

Joe

Joe Tonsmeire

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Portland Field Office
727 N.E. 24th Avenue
Portland, Oregon 97232

Reference: ES

September 21, 1976

MEMORANDUM

To : District Manager, Bureau of Land Management, Vale Oregon

From : Field Supervisor, Fish and Wildlife Service, Portland, Oregon

Subject: 3210 (Oregon Canyon EAR Area)

In response to your letter of August 23, 1976 concerning the environmental effects of geothermal and oil and gas development in the Oregon Canyon Area, and possible mitigating measures, we submit the following information for your consideration.

The Oregon Canyon Area provides valuable habitat for several species of fish and wildlife, including sage grouse, pronghorn, native populations of rainbow trout, and native and introduced populations of the Alvord cutthroat trout--a subspecies which is endemic to Oregon. The collared lizard and leopard lizard are found within the area, and are both listed as rare by Dr. Robert M. Storm in Endangered Plants and Animals of Oregon, published by the Agricultural Experiment Station, Oregon State University. None of these species are on either the State or Federal list of threatened or endangered species at the present time.

Many of the environmental impacts of either geothermal or oil and gas development would be similar. These would include the loss of habitat and increased disturbance of wildlife due to the construction of roads and drill pads, the possibility of contaminating surface waters with geothermal fluids or oil, which may be toxic to fish and other aquatic organisms, and the possible loss of birds which may fly into any powerlines required by these developments.

Some of these impacts are reversible to a certain extent. Roads and drill pad locations can be reseeded when they are no longer necessary, and sumps may be filled in and reseeded.

Some impacts would be irreversible, however. Any degradation of the water quality of Twelvemile, Antelope, Whitehorse, or Willow Creeks would likely doom the Alvord cutthroat trout inhabiting these streams.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Likewise, the rainbow trout in McDermitt, Oregon Canyon, Tenmile, and Antelope Creeks as well as the Little Owyhee River, would be unable to survive any substantial degradation in water quality.

Since trout streams are relatively rare in southeastern Oregon they are quite valuable and would be very difficult, if not impossible, to replace. We believe that mitigation would not be possible and recommend that the watershed draining into Twelvemile, Antelope, Whitehorse, Willow, Oregon Canyon, and Tenmile Creeks, not be leased, either for geothermal or oil and gas development. McDermitt and Antelope Creeks, and the Little Owyhee River should be protected by a buffer zone of a distance to be mutually agreed upon by the Bureau of Land Management, Fish and Wildlife Service, and the Oregon Department of Fish and Wildlife. We look forward to working with your District on this matter.

We recommend that critical habitat which is essential for the survival of a population or species be identified and protected by buffer zones or other measures such as a stipulation of no surface occupancy. Such habitat would include sage grouse strutting grounds, mule deer winter range, pronghorn kidding grounds, raptor nesting areas, and waterfowl breeding areas.

Unstable soils with a high potential for erosion should be identified and protected by measures which would keep surface disturbance to an absolute minimum and require reseeding with native vegetation as soon as possible.

We appreciate the opportunity to comment on this proposal. If we can be of further assistance please contact us.

John W. Kincheloe

DEPARTMENT OF FISH AND WILDLIFE

OFFICE OF THE DIRECTOR

1634 S.W. ALDER STREET • • PORTLAND, OREGON • • 97208

ROBERT W. STRAUB
GOVERNOR

RECEIVED
SEP 23 1976
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

September 20, 1976

Mr. Fearl M. Parker
District Manager
Bureau of Land Management
Post Office Box 700
Vale, Oregon 97918

Dear Mr. Parker:

Reference is made to your request for comments on the environmental effects of geothermal and oil and gas resource leasing and development in the Oregon Canyon area. Our comments are brief since we understand our local biologists have already been in contact with your staff. We urge the following points be carefully considered during preparation of the environmental analysis reports.

1. Twelvemile, Antelope, Whitehorse and Willow Creek drainages be excluded from surface occupancy because these streams contain the Alvord trout which is a unique species. This fish is not officially listed as rare on any state or federal list, although a good case could be made for placement on such a list.

2. McDermitt Creek, Oregon Canyon Creek, Tenmile Creek, Antelope Creek and the Little Owyhee River contain populations of wild rainbow trout. Consideration should be given to removing these streams from surface occupancy to protect these wild fish stocks which are in short supply in Oregon.

3. Although conclusive evidence is lacking, we are confident that both the collared lizard and leopard lizard, which are listed as endangered species (Special Report 206, Oregon State University, 1966), are found within the boundaries of the study area. We also believe the banded ground snake is established in the Owyhee (Little and South Fork) River Canyons.

4. Within the study area exists the full compliment of terrestrial wildlife endemic to this general area of Oregon. Important game species include mule deer, antelope, sagegrouse and chukar partridge. Our local wildlife biologist has or will discuss specific concerns with your staff.

5. The U. S. Fish and Wildlife Service recently published a document titled, Geothermal Handbook, which describes the biological consequences associated with all phases of geothermal resource development. It also describes some means of wildlife compensation and habitat improvement. We feel the publication covers many of the general concerns we would have for both geothermal and oil and gas resource development.

We appreciate the opportunity to comment on this activity. If more information is required, please let us know.

Sincerely,

Ted Fies

TED FIES
STAFF BIOLOGIST
ENVIRONMENTAL MANAGEMENT SECTION

cc: Mr. Vic Masson, Department of Fish and Wildlife, Hines
Mr. Sherry Horton, U. S. Fish and Wildlife Service, Portland