OR-030-7-32

ENVIRONMENTAL ASSESSMENT RECORD FOR PROPOSED NON-COMPETITIVE GEOTHERMAL AND OIL AND GAS LEASING IN THE NORTHERN MALHEUR RESOURCE AREA

VALE DISTRICT
OREGON

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

APR 1978

United States Department of the Interior

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

IN REPLY REFER TO
1791 (030)

June 5, 1978

Dear

The Vale District has written an environmental assessment record (EAR) for proposed non-competitive geothermal, oil and gas leasing in the Northern Malheur Resource Area. This environmental assessment covers over 2.3 million acres in northern Malheur County, and small segments in adjacent Baker, Grant and Harney Counties.

Interest is shown for exploration for geothermal energy within the area, and past interest has been shown for oil and gas exploration.

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 northern Malheur County. 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 may 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 Vale District Office.

Sincerely yours,

Fearl M. Parker

Fearl M. Parker
District Manager

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Bureau of Land Management

CLEARINGHOUSE NOTIFICATION

(OMB Circular A-95 Program)

6/6/1978
Date

TO: (Name & address of each clearinghouse to which this notice is directed.) 1/

Clearinghouse Executive Dept.
Intergovernmental Relations Div.
306 State Library Bldg.
Salem, Oregon 97310

IDA-ORE Regional Planning &
Development Association
25 West Idaho Street
Box 311
Weiser, Idaho 93672

FROM: (Name & address of originating BLM office & signature by office representative.)

BLM District Manager
Vale District
P.O. Box 700
Vale, Oregon 97918

Fearl M. Parker
Signature

APPLICANT IDENTITY: (If other than BLM)

SUBJECT OF NOTICE. (Briefly describe the proposed development, program activity, plans or studies, or proposed use of resources in terms that will give an impression of size, magnitude, purpose and other aspects that will aid in understanding. Include cost data if available.

An Environmental Assessment Record (EAR) for proposed leasing of federal geothermal resources and federal oil and gas resources in northern Malheur County, Oregon. Small adjacent segments of Baker, Grant and Harney Counties are also included.

Approximately 2.3 million acres are within the EAR area.

The EAR is written to include all land belonging to the federal government within the EAR area and those private lands to which the federal government owns the mineral estate.

(OVER)

LOCATION. (Identify proposal location by county, drainage, township, range, section, river reach, or distance from major landmarks as appropriate.)

Northern Malheur County, Oregon and small fragments of adjacent counties.

TIMING OF PROPOSAL. (If applicable, estimate when action may occur, project contacts offered, on-the-ground activity commenced, or when proposal will be effected.)

Following public review of the EAR and analysis of any comments received concerning it, leases will be issued to qualified applicants.

RELATIONSHIP TO OREGON COASTAL MANAGEMENT PROGRAM. (Check either block 1a, 1b, or 1c below and either 2 or 3. If the proposal will not be consistent with the CZMP, a separate justification statement should be submitted with this notice.)

1. This proposal is located:
(a) on Federal lands outside the Coastal Zone /x/
(b) on excluded Federal lands in the Coastal Zone /_/
(c) on non-Federal lands in the Coastal Zone /_/

2. This proposal will not cause significant (a) changes in the manner in which waters, lands, and other coastal resources are used, (b) limitations on the range of uses of coastal zone resources; or (c) changes in the quality of coastal resources. Consequently, it does not directly affect the coastal zone and a consistency determination is not required. /x/

3. This proposal will directly affect the Coastal Zone and a consistency determination is required. To the best of our knowledge, this proposal is in accord with goals, guidelines, and objectives of the CZMP and to the maximum extent practicable it will be undertaken in a manner consistent with the program. /_/

1/ Distribution Copies. For State Clearinghouse notification, send eight copies; for notices being directed to any of the areawide clearinghouses, send two copies.

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I. INTRODUCTION

Over the years, there has been considerable interest in exploration for geothermal energy sources and for oil and gas deposits in the Northern Malheur Resource Area of the U. S. Bureau of Land Management (BLM) Vale District, Oregon (Fig. 1). This area is situated almost entirely in the northern half of Malheur County, Oregon but includes small adjacent segments of Baker, Grant and Harney Counties. Since this region is relatively uniform in many aspects, it was decided to prepare a single Environmental Assessment Record (EAR) for geothermal and for oil and gas leasing and to evaluate the impacts of subsequent activities related to resource exploration and development upon the environment of the area.

For the sake of brevity, the Northern Malheur Resource Area will be hereinafter referred to simply as the EAR area.

There are over 2.3 million acres in the EAR area. An additional 182,379 acres, centered primarily about the City of Vale, have been previously covered by three EARs for geothermal leasing and a single EAR for oil and gas leasing and are not covered by this document. These documents (U.S. Bureau of Land Management, 1974, 1975, 1976 and 1977) may either be examined or purchased from the BLM Oregon State Office, Portland or the Vale District Office, Vale, Oregon.

To date, there have been 46 applications for geothermal leases in the EAR area covering a total of 93,721.30 acres (Fig. 1). There are no oil and gas leases currently pending in the EAR area, but unforseen changes in the national or international economic situation or shifts in the world political structure could renew an interest in oil and gas resource exploration, and possible development providing economically exploitable resources are located in the EAR area.

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

Since neither geothermal nor oil and gas resources within the EAR area are respectively situated in any Known Geothermal Resource Area (KGRA) or any Known Geologic Structure (KGS), the leasing of the above cited Federal or private lands falls 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.

II. 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 USGS 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 2,354,761 acres in the EAR area. Of this total, 1,762,050 acres are under Federal control, 522,366 acres are privately owned, the State of Oregon owns 70,298 acres, and Malheur County owns 47 acres. Of the Federal acreage, about 61,890 acres are under various withdrawal classifications. Sucker (or Succor) Creek State Park covers approximately 1,880 acres of the State acreage.

The mineral estate in the EAR area falls into several classifications. These are summarized as follows:

- Federally owned land and mineral estate.
- Federally owned land with privately owned mineral estate.
- Privately owned land and mineral estate.
- Privately owned land, Federally owned mineral estate.
- State owned land and mineral estate.

In some instances, the mineral estate ownership of the Federal government is fragmented; i.e., the government may own either oil and gas resources but no other mineral, or it may own all minerals except oil and gas.

Details of the mineral estate 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 A SUMMARY OF EXPLORATORY 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°F per hundred feet of depth, or 27°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°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°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° to 600°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°C and is generally completed at depths where temperature exceeds 120°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° to 400°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.

<u>Development of Geothermal Resources</u> - 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 2 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 contrast, 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 3).

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 preceed 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 oil 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 4 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.

(a) 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.

(b) 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 gas 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 non-metal 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 oil field 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 5 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 holes 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 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.

III. 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

The climate of the area is temperate, and is controlled by the location which is east of the Cascade Mountains. Typical summers are dry and warm, and winters dry and cold.

Average annual precipitation ranges from 8.76 to 11.35 inches (Table 2a). The greatest amounts of precipitation occur during the months of November through February. A second peak period of precipitation runs in the EAR area during the months of May and June. However, it should be pointed out that much of the precipitation that falls during the November-February period occurs in the form of snowfall, especially in the higher elevations.

January is the coldest month of the year, and July usually the hottest (Table 2b). Average annual temperatures range from 48.8^{o} F at Beulah to 52.5^{o} F at Owyhee Dam with respective mean January temperatures of 26.2 and 30.9^{o} F and July temperatures of 72.0 and 73.7^{o} F. Recorded extremes range from -14^{o} F at Rockville to 104^{o} F at Juntura and Ontario (Table 2c).

The number of frost-free days ranges from 51 at Rockville to 184 at Nyssa.

According to Robert W. Fujimoto of the U.S. Geological Survey (personal communication), relative humidity remains fairly stable during the winter and fluctuates during the summer. Winter values at 4:30 AM range between 82 and 92% and at 4:30 PM between 75% and 85%. Summer values range from 77 to 87% at 4:30 AM and drop to 25 to 30% at 4:30 PM. During the warmer part of the day in July, humidity may drop to 10 or 20%.

About 70 to 80% of surface water evaporation occurs between May 1 and September 30. Measurements taken during this period show an average evaporation rate of 94.4 cm at the Malheur Experimental Station near Ontario and a rate of 116.8 cm at Warm Springs Reservoir.

General wind trends are from west to east. Local wind directions, especially low velocity winds (0-12 mph), are controlled by valley walls, mountain slopes, and other topographic features.

The entire area has air of high quality. There are no indications within or adjacent to the EAR area which contribute significantly to air pollution.

Water

Surface Water - The two major rivers in this region are the Malheur River and the Owyhee River. Within the area of the EAR, the Malheur generally flows west to east, and joins the Snake River north of Ontario, Oregon. Major tributaries of the Malheur within the geographical boundaries of the EAR are Bully Creek, Willow Creek, and the North Fork Malheur River. The Owyhee River flows south to north, and joins the Snake River south of Nyssa, Oregon.

According to the Oregon Department of Environmental Quality (1975), "most of Oregon's water quality problems are directly associated with deficiencies in water quantity." With respect to the current established water quality standards in Oregon, both the Malheur and Owyhee Rivers exhibit substantial partial or fulltime noncompliance of temperature, turbidity, and suspended solids parameters. This occurs mainly during low flow periods.

Seasonally high turbidity measurements are due to land runoff and irrigation return flows. High temperatures are not due to heated effluent discharges, but rather from solar radiation heating diminished flows.

Average annual discharge measured at three gaging stations is summarized in Table 3. Note that discharge values for the Owyhee River are obtained below Owyhee Dam, and do not reflect quantities of water which have been diverted from the reservoir to regions outside the river basin. Tables 4a and 4b summarize minimum and maximum flows for the last five years.

Low flow augmentation of the Malheur River would help improve the water quality of this region. A proposal has been made to divert some water flowing into the Malheur Lake Basin (a closed basin without any natural outlets which adjoins the Malheur River Basin) to a reservoir which would be situated between the Malheur River and Malheur Lake Basins. This water would then be used to increase flows and water quality for either basin (Lovell, et al., 1969a).

Ground Water - Shallow ground water is recharged annually from precipitation and infiltration. Due to the low precipitation rates in this area, ground water is not abundant, and occurrences are localized and utilized mainly for irrigation. In general, wells within this region produce less than 100 gallons per minute (West, 1975). Notable exceptions occur in gravelly alluvium along the Snake River, and in the Idaho Formation. The cities of Nyssa and Ontario have wells which produce more than 1,000 gallons per minute from 40 foot thick gravels, and wells at a sugar refinery at Nyssa produce 200 to 300 gallons per minute from the underlying Idaho Formation (Newcomb, 1960).

Table 5 outlines the results of a chemical analysis performed on two wells located within two and one half miles of each other, and to depths of 160 feet (Dowell Well) and 265 feet (Crosby Well). Both of these wells were drilled entirely within sedimentary beds. It is evident that the producing zones are isolated.

Mariner, et al. (1974), discusses the chemical characteristics of selected hot springs in Oregon. Three such springs are located within the area of interest, namely Mitchell, and Beulah Hot Springs, and an unnamed hot spring near Little Valley. Table 6 summarizes some of the findings.

Present demand for water in the Malheur River basin is higher than the amount naturally available. More than one-half of the water stored in Owyhee Reservoir is diverted to the Malheur River basin (Oregon State Water Resources Board, 1969).

Cow Valley (T.15S., R.40E., and vicinity) had been declared a Critical Ground Water Area by the state in 1956 due to declining ground water levels (Bartholomew, et al., 1973). Since this declaration and resultant controls placed on ground water pumpage, withdrawals have stabilized to a point equal to the recharge, approximately 4,000 acre-feet per year. As long as ground water use remains below this figure, it is expected that the ground water table will remain stabilized (Bartholomew, et al., 1973).

Topography

The EAR area covers three geomorphic zones: the southern portion of the Blue Mountains, the eastern-most extension of the High Lava Plains and the northern portion of the Owyhee Upland (Fig. 6).

The terrain rises in elevation westward from Ontario, Oregon to the western margins of the EAR area in a fan-shaped manner.

Elevations range from around 2,000 feet near the Snake River to mountainous plateaus about 5,000 feet and isolated peaks above 6,000 feet along the western margin. The most notable of the latter are Castle Rock (elevation 6,780 ft.) and Ironside Mountain (elevation 7,685 ft.).

The major drainages of the area include the Malheur, Owyhee, and Snake Rivers. The Owyhee and Snake Rivers form the extreme eastern boundary of the area. The Malheur River bisects the area from west to east. North of the Malheur River the major mountains and valleys lie along a northwest to southeast axis while those south of the Malheur River lie in a northeast to southwest direction.

North of the Malheur River and west of Cottonwood Mountain and the Brogan, Harper communities, the terrain is characterized by high ridges and plateaus subdivided by deep canyons and numerous drainages. There is very little tillable terrain. The area, north of the Malheur River and east of Cottonwood Mountain and the communities of Harper and Brogan, is characterized by relatively large drainage basins and valleys with lesser ridges and canyons. This area contains the bulk of the agricultural rowcrop lands within Malheur County.

South of the Malheur River the land is characterized by flat to gently sloping valley floors in the vicinity of Vale and Ontario but rolling and rough foothills rise to high plateaus in the west and southern portion of the EAR area.

The topographic characteristics have a variety of effects on resource management. Climatical conditions, as influenced by topography, have the most overall effect. For example, as a result of elevational and climatical differences, the phenology of plant species can vary one to two weeks, or more, within the EAR area. Varying vegetative associations, as a result of exposure and climatic conditions, can be found within the area. An example would be the conifer vegetation found on northern exposures at the higher elevations of Castle Rock. The high, wind exposed ridge tops throughout the area often support a stiff sagebrush - Sandberg bluegrass association while the slopes and drainage bottoms support a big sagebrush - bluebunch wheatgrass association. These vegetative differences as well as soils, raw sediments, slope, and exposure collectively influence livestock management, watershed, and wildlife habitat.

The terrain, due to slope or rockiness, limits use in many areas. An example would be limited access to both sides of Owyhee Lake and the South and North Forks of the Malheur. This directly effects any water oriented recreation, and results in high use of existing points of access. In addition, livestock movement and use is severely limited in areas of rimrock, talus slopes and excessively steep slopes.

Soils

The data presented in Figures 7 and 8 and Tables 7 and 8 was compiled from studies conducted in 1969 by the Oregon State Water Resources Board (Lovel, et al., 1969a, 1969b). The soil type unit designation in the Table refers to the map issued by Lovell, et al., (1969a, 1969b) and summarizes soil features by physiographic area for the northern and southern portions of the EAR area.

Geology

General - The EAR area extends across segments of several geologic provinces: Blue Mountains along the northern margin, the Owyhee Upland and High Lava Plains in the western and central area, and the Snake River Basin in the eastern and southern regions (Figure 9). Each province contains characteristic features and geologic history differing significantly from those of adjacent areas. However, since there are also features and geologic history common to the entire region, boundaries between provinces are indistinct and arbitrary.

The Blue Mountains consist of a complicated series of ranges and intervening valleys that trend northeast from near Prineville in northcentral Oregon into western Idaho. The province is a broad uplift consisting of a complex assemblage of Paleozoic and Mesozoic igneous and metamorhpic rock. Remnants of Tertiary and Quaternary volcanic and sedimentary rocks, similar to those in surrounding provinces lie unconformably above the pre-Tertiary core of the Blue Mountains.

Much of the metallic mineral wealth of eastern Oregon occurs in the Blue Mountains. Granitic instrusions in the late Mesozoic caused intensive metamorphism and recrystallization of older rocks. Several pulses of batholithitic emplacement along with major folding, faulting and uplift afforded several opportunities for metallic mineral formation. Gold, silver, copper, cobalt, molybdenite, sheelite, manganese, stibnite, and quicksilver are some of the minerals known to occur in the Blue Mountains.

Only a portion of the southern flank of the Blue Mountains occurs in the area; the major portion of the province lies to the north. Therefore, only a small portion of the metallic mineral wealth of the Blue Mountains occurs in the EAR area. The boundary between the Blue Mountains and Basin and Range provinces is taken as the southern limit of pre-Tertiary rock exposures.

The Owyhee Upland and High Lava Plains provinces within the EAR area are characterized by thick sequences of Tertiary volcanic and non-marine sedimentary rocks. Basalt, rhyolite, ash flows and tuff constitute the majority of volcanic rocks. Sandstone, shale and conglomerate derived largely from erosion of local highlands interfinger with the volcanics.

Physiographic features in the area consist of high lava plains, moderately dissected uplands and deep canyons which slowly merge south of the area into fault block mountains and broad graben valleys of the Basin and Range Province. The EAR area is located at the northern extremity of the Basin and Range Province where its structural features are complicated by interaction with structural features of the nearby Blue Mountains and Snake River Basin. Faults in the northern part of the area generally trend northwest-southeast, parallel to structures in the Blue Mountains and the western end of the Snake River Basin. In the southern portion of the area, faults generally trend north-south. The majority of faults contain steep dips and are visible because of topographic breaks near the fault lines. Movement has been sporadic throughout Tertiary and Quaternary time. Although this region is now seismically less active than surrounding regions, minor earthquakes in or near the EAR area have been recorded.

Mineral deposits of demonstrated or potential economic importance in the Owyhee Upland and High Lava Plains portion of the EAR area are largely non-metallic deposits related to volcanic and tectonic processes. Sand and gravel derived from hard volcanic rocks occur in alluvium and terraces along major streams of the area. Crushed lava rock has been developed for local needs near transportation routes, but is present throughout the region. Decorative dimension stone is scattered throughout the area, but is largely unused because of long distances to markets. Diatomite is interlayered with lake beds and tuffaceous sediments in the Harper Basin near the middle of the area. Semiprecious stones occur throughout the area. Possibilities for petroleum discovery occur in deeply buried basins adjacent to the western margin of the Snake River Basin. Geothermal resources occur in several portions of the area where higher than normal subsurface temperatures occur.

The Snake River Basin forms a belt across southern Idaho, barely extending into the eastern portion of the EAR area. It was formed in late Cenozoic time by deposition of sedimentary and volcanic rocks into a subsiding basin formed by downwarping and downfaulting.

The western margin of the Snake River Basin is usually considered to be the western edge of the Snake River Valley. In the EAR area this area is underlain by Quaternary alluvial deposits. However, structural features of the Snake River Basin continue westward into

Owyhee Upland. Based on structural evidence, the boundary between the two provinces appears further west near the town of Vale. Since petroleum and geothermal reservoirs are known in the Snake River Basin, there is a possibility that similar trends continue an unknown distance into the western portion of the EAR area.

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 (see Figs. 7 and 8, refer to Tables 7 and 8). The characteristic reverse rotation causes the development of hummocky topography, which locally has permitted the formation of small ponds. 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 record (since 1841), 34 earthquakes 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 10, 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 Zones 1 and 2 where slight to 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 - Gold, diatomite, sand and gravel, crushed rock, and building stone represent the significant forms of mineral production in the EAR area. However, there has been considerable interest in these resources, including geothermal energy and oil and gas. Interest in other resources such as mercury and sodium has declined, but may increase in the future when their recovery becomes economically feasible. The following narrative describes the current status of these resources.

1. Minerals

   a. Asbestos - An indentified subeconomic resource area exists in Sec. 12, T.14S., R.42E., not suitable for commercial development.
   b. Bismuth - An identified subeconomic resource area occurs in Sec. 12, T.20S., R.43E.; no production.
   c. Building Stone - Identified subeconomic areas and identified reserves include the following:
      Sec. 15, T.15S., R.41E.
      Sec. 5, T.18S., R.43E.
      Sec. 17, T.26S., R.43E.
      Secs. 3 and 4, T.23S., R.42E.
      The first three locations are mining claims, the latter is the site of a material sale for buff to pink banded rhyolite.
   d. Cinders - An identified subeconomic resource occurs in Sec. 20, T.20S., R.44E.; production data unknown.
   e. Chromium - An identified subeconomic resource area occurs in Sec. 12, T.14S., R.42E.; production data unknown.
   f. Diatomite - An identified reserve area is located near the towns of Harper and Westfall. The area known as the Harper Mining District trends from slightly south of the Malheur River northwest to a few miles beyond the town of Westfall. Production is scheduled to start June 1977.
   g. Dolomite - An identified subeconomic resource area exists in Sec. 3, T.15S., R.43E.; production data unknown.

h. Gold - The northern portion of the area is classified as an undiscovered resource area for gold. Identified subeconomic resource areas include the following:
    Secs. 13, 14, 23-26, 36, T.13S., R.40E.
    Secs. 3 and 4, T.14S., R.40E.,
    Secs. 16-21, 28-33, T.13S., R.41E.
    Secs. 5-6, T.14S., R.41E.
    Secs. 7-8, 17, 19-20, T.14S., R.42E.

i. Mercury - Identified subeconomic resource areas include the following:
    Secs. 15, 21-22, 27, T.15S., R.45E.
    Sec. 16, 21-22, 27-28, T.17S., R.43E.
    Sec. 13, T.20S., R.43E.

    Current activity and production status unknown.

j. Pozollan - Identified subeconomic resource areas include the following locations:
    Secs. 33-34, T.19S., R.43E.
    Sec. 3, T.20S., R.43E.
    Sec. 28, T.15S., R.44E.

    Current activity and production status unknown.

k. Rock - Identified subeconomic resource areas and identified reserves occur throughout the EAR area. Current activity varies, depends upon local needs, generally for highway construction.

l. Sand and Gravel - Identified subeconomic resource areas and identified reserves occur throughout the EAR area; also occurs naturally along most rivers and streams as terrace, flood plain and channel deposits. Current activity is variable, depends on local needs.

m. Semiprecious Stones - Identified subeconomic resource areas occur at the following areas:
    Sec. 8, T.26S., R.43E.
    Sec. 8, T.23S., R.42E.
    Secs. 5 and 8, T.22S., R.44E.
    Sec. 17, T.21S., R.43E.
    Sec. 15, T.21S., R.44E.

    Current activity and production status unknown.

n. Sodium and Potassium - An undiscovered sodium and potassium resource area occurs in Secs. 4-9, T.17S., R.45E. Current production activity and activity data unknown.

o. Oil and Gas. - There has been some oil and gas leasing activity in the EAR area in past years, but as of this writing, there are no oil and gas lease applications pending. 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 at Blue Mountain south of the EAR area and drilled to a depth of 8,414 feet, proved to be unsuccessful (Fig. 5, 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.

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 raise 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 portion of the EAR area, are under non-competitive geothermal lease application.

3. Water. Surface water resources in the EAR area consist primarily of the Malheur and Owyhee Rivers, tributaries of the Snake River, and their tributaries, many of which are intermittent along parts of all of their respective courses. There are four large reservoirs in the area and numerous small reservoirs constructed by either the BLM or private interests. The four large reservoirs are the Owyhee Reservoir (impounded by the Owyhee Dam, U.S. Bureau of Reclamation), Beulah (or Agency Valley) Reservoir, Warm Springs Reservoir, and Malheur Reservoir. Many of the smaller impoundments in the EAR area are characterized by small reservoirs, usually less than two acre-feet, are designed for livestock and wildlife.

   Numerous wells throughout the EAR area tap ground water sources and supplement surface water supplies. Most of the small reservoirs and wells are used for livestock and wildlife.

   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 dominant vegetative type in the EAR area is the big sagebrush (Artemisia tridentata) - grass association. The grass most commonly associated with the sagebrush type is bluebunch wheatgrass (Agropyron spicatum). Other grasses commonly associated with the sagebrush type are Idaho fescue (Festuca idahoensis), squirreltail (Sitanion hystrix), Sandgerg's bluegrass (Poa secunda), needlegrass (Stipa spp.), wild rye (Elymus spp.) and cheatgrass (Bromus tectorum).

Common shrub species that occur in this area in addition to big sagebrush, include low sagebrush (Artemisia arbuscula), stiff sagebrush (Artemisia rigida), rabbitbrush (Chrysothamnus spp.), greasewood (Sarcobatus vermiculatus), bitterbrush (Purshia tridentata), squaw apple (Peraphylum ramosissiumum). Important shrub species that occur in lesser quantities include snowberry (Symphoricarpos spp.), serviceberry (Amelanchier alnifolia), mountain mahogany (Cercocarpus ledifolius), and spiny hopsage (Grayia spinosa).

A wide variety of forbs are found in the area. Some of the more common species include phlox (Phlox spp.), buckwheat (Eriogonum spp.), pepperweed (Lepidium spp.), tumble mustard (Sisymbrium spp.) Russian thistle (Salsola kali), yarrow (Achillea spp.), Scotch thistle (Onopordum acanthium), hawksbeard (Crepis spp.), Buttercup (Ranunculus spp.), and lupine (Lupinus spp.).

The big sagebrush-grass association occurs from the lowest through the highest points of elevation within the resource area. Big sagebrush reaches its greatest stature on north slopes and on deep soil sites along well defined drainages. The abundance and distribution of the grasses associated with the shrub types also vary with regard to slope, elevation and exposure.

Areas of low sagebrush (Artemisia arbuscula) - grass association and stiff sagebrush (Artemisia rigida) - grass association occur at intermediate and high elevations. Grasses commonly found in these associations are Sandberg's bluegrass (Poa secunda) and Idaho fescue (Festuca idahoensis). These associations are primarily on ridge tops that have a shallow, rocky soil. A well defined edge can be found where these associations meet the big sagebrush-grass association, due to the differences in soil type and depth.

In the north and west portions of the resource area a number of tree species may be observed. Most of these are found at higher elevations where sufficient moisture is present to sustain them. These include cottonwood and aspen (Populus spp.), willow (Salix spp.), Juniper (Juniperus spp.), Ponderosa pine (Pinus ponderosa), and Douglas Fir (Pseudotsuga menziesii).

Certain areas within the EAR area have been chemically treated for brush control or mechanically seeded to crested wheatgrass (Agropyron cristatum) (Table 9). These seedings and brush controls are being reinvaded by big sagebrush and rabbitbrush in some areas.

Two species of endangered plants, as published in the Federal Register, are known to exist in the EAR area. These are Hackelia cronquistii; and Collamia macrocalyx. Hackelia cronquistii can be found on the diatomaceous earth deposits that are located south of the town of Westfall. There are no confirmed findings of Collomia macrocalyx on public lands in the EAR area.

In addition to the above, the U.S. Fish and Wildlife Service has added the following species to the rare, threatened and endangered list of species which may be in 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.

A letter from the U.S. Fish and Wildlife Service also presents data on rare and endangered plant species in the EAR area and a letter from the Oregon Natural Heritage Program lists unusual plant communities and geological sites (Appendix F).

Several outlier areas occur in the EAR area. One occurs in the northeast portion of the area on what is called "Lone Pine Ridge".

It consists of a small, isolated stand of ponderosa pine, with the closest stand of ponderosa pine being thirty miles away. Another occurs just south of the town of Vale. The outlier here contains several plants of hairy grama grass (Bouteloua hirsuta). It is felt that the seeds for these plants were mixed in with crested wheatgrass seed and subsequently introduced onto this site.

A third outlier area occurs just south of the town of Westfall, in which the species is white sage or winterfat (Eurotia lanata). This is the northern most occurrence of white sage known in Malheur County.

Riparian vegetation occurs along the major perennial streams within the EAR area. Riparian vegetation also occurs around some of the reservoirs which are fenced. Willows (Salix spp.), mock orange (Philadelphus lewisii), and chokecherry (Prunus spp.) are three of the major shrub species that make up the riparian vegetation. Numerous species of meadow grass and forbs may also be found. The potential for riparian vegetation to occur along perennial streams, intermittent streams, and reservoirs where it does not currently occur is very high if water levels or streamflows remain relatively constant. It is presently limited due to livestock pressure in the above mentioned areas.

Wildlife

The fauna of the EAR area is typical of the big sagebrush-grass (Artemisia-Agropyron) association. A list of amphibians, reptiles, birds, and mammals may be obtained from the BLM District Office, Vale, Oregon. A portion of the area is irrigated farmland which provides an additional diversity of mesic habitats. The valley quail (Lophortyx californica) and the Chinese or ring-necked pheasant (Phasianus colchicus) are two common game birds in the irrigated areas.

A sport fishery is supported by the Malheur, Owyhee and the Snake Rivers as well as the numerous reservoirs which are scattered throughout the area. This fishery is supported by smallmouth bass (Micropterus dolomieui), black crappie (Pomoxis nigromaculatus), bluegill (Lepomis macrochirus), rainbow trout (Salmo gairdneri), cutthroat trout (S. clarki), and Dolly Varden (Salvelinus malma). Several of the reservoirs in the EAR area are stocked with many of these species by the Oregon Department of Fish and Wildlife.

Numerous species of reptiles and amphibians are found in the EAR area. The most abundant of these include the Great Basin spadefoot toad (Scaphiopus intermontanus), collared and leopard lizards (Crotaphytus spp.), fence lizards (Sceloporus spp.), Great Basin gopher snake (Pituophis melanolencus), and the Great Basin rattlesnake (Crotalus viridis). One species of amphibians, the spotted frog (Rana pretiosa) is on the threatened species list for the State of Oregon.

Many species of birds inhabit the EAR area. These include numerous species of songbirds, birds of prey (raptors), in addition to the above cited game birds. Several species of migratory waterfowl frequent rivers and reservoirs during the autumn and spring months. Three species of birds known to occur in the EAR area are considered to be either endangered or threatened. These species and their status are as follows:

Golden Eagle (threatened in Oregon).
Bald Eagle (threatened nationally).
Pergenine Falcon (endangered nationally).

Mule deer (Odocoileus hemionus), pronghorn antelope (Antilocarpa americana), Rocky Mountain elk (Cervus canadensis) are the major mammal, as well as the chief game, species in the EAR area. Other species include insectivores, bats, rodents (including rabbits, squirrels, gophers, mice, muskrats and porcupines), carnivores (including coyotes, foxes, bears, weasels, mink, badgers, skunks, otter, cougar and bobcat), and bighorn sheep. One species, the grey wolf (Canis lupus) is considered to be threatened in Oregon. A single wolf was collected within the subject area in the 1970's.

There are several areas in the EAR area considered to be critical deer winter habitat (Figure 11). These are located in the vicinity of Malheur Reservoir, in the area west of Bully Creek, and along the upper Malheur Reservoir and the North and South Forks.

Large herds of feral or wild horses are located in the western portion of the EAR area. At last count, their numbers totaled 1,593. These herds have the capability of increasing their numbers by 20%-25% annually.

Livestock

Grazing by domestic livestock occurs throughout the EAR area on both Federal and private land. Table 10 summarizes the acreage and number of Animal Unit Months (AUMs) in the allotments in the area. The recognized grazing season in the allotments generally extends from April 1 through November 15, however, grazing use on private rangeland and any Federal range fenced in with it may occur in any month of the year. Authorized grazing use in 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 seedings, many miles of fence and numerous stock water developments have been constructed over the past 30 years. Table 9 summarizes the various types of range improvements and seeding projects in the EAR area.

Ecological Interrelationships

Hydrologic Cycle - The hydrologic cycle is depicted in Figures 12 and 13 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 12.

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 14. 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 microorganisms (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 cristatum, 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. Table 9 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 only a few human inhabitants on Federal land in the EAR area, however, human evidence is very common. The EAR area surrounds the City of Vale and includes Ontario, Nyssa, Adrian and several small rural communities lying in the western portion. A large amount of private land in the Vale-Ontario-Nyssa area and in the lower Malheur River and Willow Creek drainages is in cropland or pasture, the majority under irrigation.

Recreational Values

There is a significant amount of recreational activity in the EAR area. Major recreational pursuits include off-road vehicle use around the hills surrounding Vale, Ontario and Nyssa. Other evidence of off-road vehicle use may be seen from major Federal, State and County roads throughout the EAR area. There is a cross-country motorcycle course in the hills northwest of Vale.

The Malheur, Owyhee and Snake Rivers and many of the reservoirs in the EAR area support sport fisheries of varying quality. Species which are taken include rainbow and cutthroat trout, Dolly Varden, black crappie, smallmouth bass and bluegill. Many of these species are stocked in reservoirs located on private or Federal lands by the Oregon Fish & Wildlife Department.

The most important game species in the EAR area include pronghorn antelope, mule deer, sage hen and chukar partridge. Elk may be found in isolated areas around Castle Rock and Ironside Mountain. Deer populations are presently increasing following a decline in numbers, especially in the lower elevations. Waterfowl hunting is restricted to the Snake, Malheur and Owyhee Rivers and to the larger reservoirs in the area.

The upper Owyhee River above the Owyhee Reservoir supports an increasing float-boating recreational sport. In 1975, there were 2785 user-days of this activity which grew to 3690 user days in 1976.

There are scattered areas of semi-precious gemstone deposits throughout the area. Thundereggs have been found in the Sucker (Succor) Creek area in large numbers and in small numbers along other watercourses in the EAR area. Occasional pieces of petrified wood have been found, but there are no known concentrations.

Educational and Scientific Values

There are numerous localities in the EAR area which have unique scenic values. The Owyhee River from the Duck Valley Indian Reservation in Idaho to the Owyhee Reservoir in Malheur County, Oregon is being studied by the U.S. Bureau of Outdoor Recreation for a National Wild and Scenic River designation. The Honeycombs, the North Fork of the Malheur River, Cedar Mountain, Red Butte and the Owyhee River above Morcum Dam are potential wilderness study areas. A road inventory prior to identification of wilderness study areas is now being conducted in the EAR area.

There are many points of historical interest in the EAR area. These include stage station ruins, abandoned townsites (often marked only by cemetaries), military campgrounds, homestead ruins, and abandoned mine sites which are remnants of pioneer days as well as the Owyhee Dam, the World War II Japanese detention camp site and the Tom Goodwin burial site which are of more recent times.

Perhaps one of the most significant items of historical significance is the Oregon Trail which extends from Nyssa north and west to Vale, and then north to Farewell Bend on the Snake River near Huntington, Oregon for about 45 miles (Fig. 15). Another branch, the Dalles Military Road, extended north and west from Vale, along the Willow Creek watershed, to the Dalles, Oregon.

A complete listing of historic and other cultural sites in the EAR area may be obtained at the BLM District Office, Vale, Oregon. Many of these sites are situated on private lands.

The remoteness of much of the EAR 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 big sagebrush-grass association. 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 geologic survey work and for paleontological and archaeological exploration.

The full extent and importance of paleontological and prehistoric archaeological sites in the EAR area are unknown since no intensive professional inventory has been completed. Numerous sites have been located in inventories completed for the U.S. Bureau of Land Management (1974) and by David Chance in the area south of Cow Creek in 1968. There is a good probability that additional sites will be found in Malheur County (Ruebelman, 1975), a fact which is now being verified by current BLM inventories. Many sites potentially qualify for the National Register of Historic Places.

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. Gold was first discovered in Mormon Basin in the northwest part of the county in the Spring of 1863. Soon afterward, the first two large stock ranches were established in Jordan Valley in the east central part of the county.

In the fall of 1863, Jonathan Keeney built a small log house at the Malheur River ford on the Oregon Trail just south of the present site of Vale. In this cabin Keeney conducted a wayside inn for the accommodation of emigrants, miners, and freighters. The historic old emigrant road, forming a link in the line of travel between Independence, Missouri and the Willamette Valley of western Oregon, entered Malheur County near the mouth of the Boise River, crossed the Malheur River at Keeney's cabin, and left the county by way of Willow Creek and Tub Springs north of Vale (Fig. 15).

In 1870, L. B. Rhinehart purchased the Keeney Station and in 1872 built a stone house. This old land mark, known as the "Old Stone House" is still standing. For years it was the only hostelry in this portion of the country. Until 1883, the Old Stone House occupied the site of the future town of Vale in solitary peace.

The Malheur River, Willow and Bully Creek Valleys, all tributary to Vale, became well settled and the little town grew to be an important trading center. The impetus given the town by its selection as the temporary County Seat in 1887 was considerable and many new business enterprises were added. The selection of Vale as the permanent County Seat by the general elections of 1888 and 1890 not only established the permanency of the town, but also strengthened it commercially.

By 1900, Vale had a population of about 130. It possessed a newspaper -- The Malheur Gazette, a bank -- The First Bank of Vale, a schoolhouse and one church -- The Methodist Episcopal Church. In addition, there were numerous business enterprises, including the only flouring mill in Malheur County -- The Vale Milling Company. The citizens of Vale and the surrounding country determined to present the county with a much needed courthouse. A two-story stone structure was completed on the site of the present courthouse in the Fall of 1902.

Until 1900, Malheur County possessed an excellent stock range of immense proportions. With increasing population and settlement of the county, the range gradually failed to support the stock grazing upon it and stock raising declined. The farming industry began growing in importance in the early 1880's in Malheur County.

In 1883, two important irrigating canals were built; the Owyhee canal, which distributed water from the Owyhee River in the immediate valley, and the Nevada canal which distributed water from the Malheur River in the lower Malheur Valley. These two canals had a significant impact on the community, contributing to make farming a profitable industry long after the stock industry passed into minor importance.

The Oregon Short Line Railroad was also a major influence in the development of Malheur County in the 1880's. A station was established at Ontario in 1884, which rapidly became an important shipping point as a result. It was more accessible from the stock ranges of Malheur, Grant and Harney Counties. The establishment of this trade center made the development of agriculture and other resources not only possible, but highly profitable.

Since 1900, the town of Vale has had a steady growth and has reached a population of 1,705. This growth is based on the development of the farming industry, primarily due to irrigation, and an increase in numbers of related agribusinesses. A general increase in population and a population shift from rural to urban living are nationwide trends which are responsible for the growth of Vale and Ontario and of Malheur County.

Social Background - Malheur County, like the nation in general, is undergoing a population shift from rural to urban living. Vale and the nearby towns of Ontario and Nyssa have shown large population increases while the county as a whole has not. There has been a considerable emigration from the county, especially in the 24-44 year age group. There is also an annual influx of several thousand migrant farm laborers during the summer harvest season.

The population of Malheur County is approximately 85 percent caucasion. Nearly 10 percent of the people are Spanish-surnamed, primarily Mexican-Americans. Japanese-Americans comprise close to four percent of the population. Included in the caucasion group is another ethnic group which has maintained its own separate identity within the local community are the Basques.

The Basques first came to eastern Oregon in the 1880's, settling in the area between Ontario and the Steens Mountains, on southward, where raising sheep was the main industry. Many were eventually able to acquire land and herds of their own. A large number of Basque ranches were established along Jordan Creek in the southern part of Malheur County.

The Basque way of life is rapidly disappearing. Many young Basques do not speak the Basque language. Their lifestyle and values are more Americanized. Members of the younger generation no longer restrict themselves to the agricultural pursuits of their parents, or limit social contacts to the Basque community (Kressman and Yturri, 1938).

There are a little over 900 Japanese American people now living in Malheur County, mostly around Ontario. Prior to 1940, there had only been 20 to 30 families, but during World War II, close to 4,000 Japanese people were evacuated from the coast to detention camps in the county. In 1946, when they were allowed to return to the coast, the number dropped to approximately 2,000 (personal communication: George Iseri, Ontario, Oregon - March 6, 1974).

He stated that approximately 75 percent of the Japanese Americans in Malheur County work in agriculture, and most of these own their own land. Many Japanese Americans in recent years have joined inter-ethnic rather than ethnic cooperatives, and are taking prominent roles in the affairs of local communities. One part of the Japanese culture very actively maintained is the Ontario Buddhist Church. With a congregation of about 900 people, it draws its membership from a large radius in Oregon and Idaho.

The population of Mexican American 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 large percentage are United States citizens, approximately 30 percent being citizens of Mexico with permanent resident visas. Many Mexican-Americans in the county speak little or no English. They continue to live in a culturally segregated environment where the Spanish language is the main form of communication.

Social and Economic Situation - Malheur County has a current population of approximately 24,100 people. Most of the population, about 75%, lives within the EAR area and will be directly affected by geothermal or oil and gas developments. Most of the population is concentrated along the Snake, Malheur and lower Owyhee River valleys. The main towns of Ontario, Nyssa and Vale are in the agricultural area. In 1974, the population of Ontario was 7,700, Nyssa was 2,735, and Vale was 1,705. Nearly 40 percent of the people live in or near Ontario.

The county is largely dependent on agriculture, livestock production being the highest single contributor to the economy. Other agriculture products are dairying, sugar beets, potatoes, onions, and corn. The food processing plants at Ontario and Nyssa are dependent on the local agriculture. Ontario is the major trade center for Malheur County.

According to the 1970 census, Malheur County was the third poorest county in the state, but is currently estimated to be the second poorest. Grant Morgan Association statistics indicate that nearly 4,600 people, about 20 percent of the total population, are living at or below the poverty level. The following table indicates the annual income at which the poverty level is determined:

For Family Of	Non-Farm Residents	Farm Residents
1	$2,000	$1,700
2	2,600	2,100
3	3,300	2,800
4	4,000	3,400
5	4,700	4,000
6	5,300	4,500
7	5,900	5,000
over 7	add $600 for each person	add $500 for each person

Most housing is owner occupied. Rentals in Ontario, Nyssa and Vale are very scarce. The area is served by two hospitals, the County Hospital at Nyssa and Holy Rosary Hospital in Ontario. One doctor and a dentist serve Vale. Six doctors and two dentists serve Nyssa. Ten dentists and 19 physicians serve Ontario.

ATTITUDES AND EXPECTATIONS

Local Attitudes and Expectations

Due to shortages of manpower and funds, it was not possible to conduct a comprehensive survey of attitudes and expectations held by the general public. In order to get some concept of public opinion, interviews were conducted with several local businessmen, news media personnel and government officials in the Vale-Ontario-Nyssa triangle. The following narrative is based on information gathered in these interviews for this EAR and previous EARs pertaining to geothermal or oil and gas exploration issued by this office.

Vale - Attitudes in Vale were described as basically supportive of the status quo. People interviewed felt that in the past, conservative attitudes have discouraged and impeded commercial and industrial development in Vale. The rate of development is increasing, with local support, but continues to be limited.

According to the people interviewed, Vale citizens support strong local government and local control of economic development. They are concerned about the effects that rapid growth in population and/or development might have on the quality of life in their community. Those interviewed felt that most people living in Vale enjoy the rural style of life and wish to maintain it in their community.

The people interviewed felt that Vale would support an approximate growth rate of 5 percent, which would mean a growth in population of about 100 people. They also felt that the people of Vale would oppose heavy industry that was noisy or polluting, and would prefer small industry, varying in size from 20-30 to 30-100 employees.

Those interviewed reported that Vale supported the construction of Treasure Valley Community College, as well as the development of the West Park Plaza shopping center, although local business people were initially opposed to the shopping center. Both the college and shopping center are located in Ontario.

Nyssa - According to the people interviewed in Nyssa, public attitude there has supported planned development, a steady consistent growth pattern at a moderate rate. The development of an industrial park has promoted the growth of light and agriculture related industry in Nyssa. The people interviewed felt that industries such as Albertsons Feed Yard and the Amalgamated Sugar Company have brought stability to the whole irrigated valley area. Migrant workers are also seeking jobs in these industries more and more as the demand for farm labor decreases due to expanding farm automations.

People in Nyssa have not supported the Treasure Valley Community College, in the opinion of those interviewed, because of the increased taxes involved. Voters in Nyssa have consistently defeated TVCC budgets and nearly defeat local school budgets. The general public did support the construction of the West Park Plaza shopping center, although local business people had some reservations about it at first.

According to those interviewed, the people of Nyssa want clean, non-polluting, light industry, preferably related to agriculture. However, some respondents indicated that Nyssa may be forced to attract other types of industry to promote growth and that some people in Nyssa would support a free, open door policy to all new development. In addition, Nyssa is working together with Ontario to explore the possibilities of establishing a dry land port authority which would encompass the entire irrigated agricultural area, greatly enhancing industrial-commercial development.

The people interviewed felt that Nyssa would benefit the most from the growth of small industries in the range of 50 to 150 employees, stating that the people of Nyssa are very concerned about the stability of their local economy and would oppose any industry large enough to dominate the whole economic structure of the community.

<u>Ontario</u> - The people interviewed in Ontario felt that public attitudes there had undergone a change in recent times. They indicated that in the past Ontario has had an erratic growth rate, some areas of development not keeping pace with others, an effective pressure group often being the determining factor. Those interviewed expressed the opinion that public attitudes in Ontario now supported more balanced development with diversification in industrial, commercial and residential growth.

According to the individuals interviewed, the people of Ontario were divided over the issue of building Treasure Valley Community College, mainly because of the taxes involved. However, support for the college has grown since its completion. The people interviewed also indicated the development of West Park Plaza shopping center received the support of the general public, in spite of some initial opposition from downtown business people. The shopping center has brought in considerably more trade to the downtown business district which has off-set loss of some business to the shopping center. With the addition of West Park Plaza, Ontario draws from a trade area in Oregon and Idaho with a population of over 50,000 people.

Whereas in the past Ontario has encouraged any size and type of industrial development, according to those interviewed, public attitudes have shifted in favor of clean, non-polluting industries, particularly those related to agriculture. They also prefer labor intensive industries that create more jobs for local people rather than bringing in outside employees.

The people interviewed felt that Ontario has a great potential for industrial development, which may be expanded even more through the possible development of a dry land port authority in cooperation with Nyssa, as mentioned previously.

Public Attitudes and Expectations Toward BLM

According to the people interviewed, public attitudes and expectations of BLM management and activities are very positive. The people of Vale like having the BLM office in town which they see as a business that does not take resources out of the community but adds to the community. All of the people interviewed in Vale, Nyssa, and Ontario supported BLM in its multiple use concept. The general public, with some exceptions, supports BLM management policies.

This has been a change from public attitudes previous to the Vale Project in the early 1960's. At that time, public attitudes towards BLM were very negative. The success of the Vale Project has apparently had a significant positive effect on public opinion.

Those interviewed indicated that people throughout the valley 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 county, city and Federal government programs which provide for open space. Quality of open space is more important than quantity of open space.

Public Attitudes and Expectations to Geothermal and Oil and Gas Developments

Based on the information gathered in interviews, representatives of local governments and the general public in Vale, Ontario and Nyssa are supportive of geothermal and oil and gas resource developments and they feel that their communities will benefit from the developments. It appears that the general public is better informed technically on oil and gas resource development than on problems associated with other resource developments, such as geothermal steam.

However, the failure of past drilling attempts in Malheur County to locate any economic reserves of oil or gas has installed a general attitude of pessimism among many local people towards the possibilities of economic discoveries by future operations. Some people believe that the possibility of any economic discovery is remote at best. They base this on the fact that previous drilling activities have resulted in only minor shows of oil or gas.

Several private landowners have been approached by oil company representatives concerning possible leasing of their property for oil and gas development. Attitudes have ranged from absolute refusal to acceptance of leasing.

Many people have heard and read about the proposed leasing of Public Lands for oil and gas resource developments. However, most are not aware of what geothermal or oil and gas development activities would mean to them or what the processes involved would entail.

LOCAL REGULATORY STRUCTURES

Land Use Planning

The following information was obtained by interview from people in city and county government agencies in Vale, Nyssa, and Ontario.

1. Acceptability of Planning Within the Local Population

   a. City Planning

      The cities of Nyssa, Vale and Ontario all have city planning commissions. In general, the people of these cities accept and support land use planning. The cities recognize there has to be some type of zoning and planning to have an orderly growth. However, vested interest groups still oppose it.

      According to the people interviewed, the cities of Nyssa and Vale appear, at the present, to have enough land use planning to carry them through. The people of Nyssa are very interested in land use planning. The planning commission is becoming more active and responsive to land use planning. In the past, land use planning and zoning ordinances lacked enforcement; therefore, they were not followed like they should have been. This encouraged a minimum effort to be put forth toward any future land use planning. The City of Ontario has had a tendency to look at land use planning as a necessary nuisance but a favorable balance is beginning to emerge in the community.

b. County Planning

Land use planning in Malheur County is less than four 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 people in the county do not see the need for land use planning and resent outside people coming into the area to tell them what the land can be used for.

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 are for county planning providing it is not too restrictive. The people are recognizing it is necessary and are accepting it.

2. Present Comprehensive Land Use Plans, Zoning Ordinances, Building Codes, and Oil and Gas Ordinances

a. Comprehensive Land Use Plans (Appendix C)

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 April 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 of Oregon objectives. The County was forced to take action or the State of Oregon would step in and do the Comprehensive Land Use Plan for them.

b. Zoning Ordinances

On approximately June of 1973, Malheur County did develop a County Zoning Ordinance. The Malheur County Court adopted the zoning ordinance and it was filed on record August 17, 1973, in the public records (Microfilm Inst. 148901). The zoning ordinance still has to be reviewed and accepted by the State of Oregon.

The Public Lands involved within the EAR area fall under the following zones of the County Zoning Ordinance: Exclusive Public Farm Use (F-1), and General Farm Use (F-2). The private lands adjoining the lands are zoned for Exclusive Farm Use (F-1), and General Farm Use (F-2) on the zoning maps that accompany the proposed ordinance. See Appendix D for zoning ordinance.

Several additional zones are situated in the EAR area, primarily on private lands in the vicinity of Vale, Ontario, Nyssa and rural communities. These include Rural Residential (R-1), Commercial (C-1, C-2), Industrail (M-1) and Planned Development (P-D). Other zones, primarily in rural areas, include Open Space (OS), Rural Recreational (R-2), Scenic Waterway (SW) and Flood Plain (FP).

Under Exclusive Farm Use (F-1), and General Farm Use (F-2), conditional uses are permitted for mineral exploration, mining and processing. The conditional use reads as follows: "Operations conducted for exploration, mining and processing of geothermal resources as defined by subsections (4) of ORS 552-010, aggregate and other mineral resources as other subsurface resources" (See page 9 of Malheur County Zoning Ordinance). Therefore, oil and gas resource exploration and development is permitted under conditional uses with the approval of the Malheur County Planning Commission. According to the Malheur County Planners and District Attorney, any company wishing to conduct mineral exploration and development on private lands must submit their plans to the Malheur Planning Commission for approval.

The western portion of the EAR area falls under two separate classifications: Forest Zone (T-1) in Grant County and Agricultural Rural Zone (A-1) in Harney County.

c. 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 county, both 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, 1973 Edition, as amended, Uniform Building Code - effective on July 1, 1974.

d. 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.

e. 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 and F-2). 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.

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 structure, and enforcement by local 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.

An analysis of local governmental entities are as follows:

1. County Government

The majority of the people interviewed indicated the people desire a change in the type of county government. These changes vary from "Home Rule" type of county government, to the addition of several county commissioners (perhaps a total of 5 to 7), to the present existing county government structure. They indicated people feel they are not being properly represented and the county government structure does not produce but tends to be involved in today's crisis and only gets by with a minimum amount of effort. Because of the growing complexity of county government, people feel it should be managed more professionally. However, there is a minority of people who feel no change is necessary in the present county government structure.

As for making land use plans and planning decisions, the interviews indicated people feel the county is slow in reacting and implementing the plans and the personnel who are involved in the making of planning decisions should be more knowledgeable or take time to be more knowledgeable. They indicated other people feel the county needs a group of people to keep the county personnel, who are making decisions, informed of alternative choices and decisions. While other people feel land use planning is still too new, the county personnel have not obtained a feel for it, and additional time will be required to get the planning worked out and implemented. After the county personnel get their feet on the ground, they will do an adequate job.

The interviews indicated a majority of people feel the county does not have an adequate planning staff, and the land use planning and implementation is deficient. Others felt that the positions are available but the county does not offer enough money to hire good qualified personnel. A minority group felt the county has an adequate staff to implement planning but planning is still too new and it will take time to get it worked out.

According to the Malheur County Planner, Land Use Planning is new in the county and the county is in the process of implementating and enforcing the land use plans and ordinances. He recognizes the planning staff is presently inadequate in manpower and funds to meet the demand of implementation and enforcement. He indicated that to have an adequate staff, the county needs one planner, one assistant planner, and two inspectors. Presently, there is only one planner who is in charge of planning, drafting and inspection.

The interviews indicated the majority of people feel the county is willing and capable of enforcement of land use plans and zoning ordinances but, because of limited manpower and funds, the enforcement is weak. They feel the county has the information available but tends not to follow through on enforcement, or, only makes a token effort. Others feel the county is willing and capable of enforcing land use plans and zoning ordinances but fails to disqualify itself 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.

2. City Governments

a. Vale

Vale has a mayor and a city coordinator type of city government. It is similar to city manager type of government, except the city coordinator is personally involved in several different jobs, such as, recorder-city clerk and municipal judge. There are various opinions whether the city of Vale has the right type of governmental structure to make planning decisions. The people interviewed stated a majority of people feel it is not working adequately because adequate zoning ordinances have not been developed and/or perhaps followed, and not property enforced. A minority group of people feel the present situation is working adequately, and they do not see a need for a change. Those who feel the structure could be improved say positions are available within the city governmental structure but inadequate salaries hinder the hiring of qualified personnel. Some of the planning services are contracted out and the Southeast Council of Government (now defunct) was relied upon for assistance on occasions.

The interviews indicated that many people feel the city of Vale has the willingness and capability to enforce existing city ordinances but the enforcement tends to be weak in some areas. Zoning ordinances sometimes are not properly enforced because city officials fail to disqualify or separate themselves in conflict of interest decisions and issues.

b. Nyssa

Nyssa has a mayor and city manager type of government. There are various opinions as to whether the city of Nyssa has the right type of governmental structure to make planning decisions. The interviews stated some people feel that under the present situation, the city does not have an adequate type of government structure because the staff and goals need to be changed. However, there are others who feel the present government structure is adequate.

The city of Nyssa presently has a very limited staff to plan, implement plans, and enforce plans in a proper manner, according to the Nyssa City Manager. He indicated the city could not handle land use planning on a large scale basis. The city of Nyssa has the capability to enforce the land use plans and ordinances but no leadership was expressed to carry out the enforcements. According to the Nyssa City Manager, he would like to see the city upgrade their zoning ordinances and land use plans and establish some long range goals.

He indicated that in the past, zoning ordinances and land use plans lacked enforcement. Therefore, the local use plans and ordinances were not followed like they should have been. The city was getting by with a minimum of effort.

c. Ontario

Ontario has a mayor and city manager type of government.

All the people interviewed felt the city of Ontario has the right type of governmental structure to make planning decisions. According to the Ontario City Manager, the city of Ontario has an adequate staff to plan, implement plans, and enforce plans in a proper manner. However, there are those who feel perhaps the city may be slow in preparing and implementing plans.

The city of Ontario has the capability to enforce the land use plans and ordinances. According to the Ontario City Manager, land use plans and ordinances are very strongly enforced. He also stated there have been very few requests for rezoning in Ontario.

Need for Additional Ordinances and Land Use Planning

The majority of the people interviewed felt the county and city of Vale should definitely develop detailed ordinances for geothermal and other mineral resource 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. A few were unaware that any ordinances existed at all.

Those people who are knowledgeable and involved in land use planning and development of ordinances felt very definite about developing mineral resource ordinances while those who were not knowledgeable were opposed to any more ordinances. The people's concern spurred the Malheur County Planning Department to initiate and develop Oregon's first County Geothermal Ordinance on June 19, 1974 and may lead to the formulation of other mineral resources.

According to the Malheur County Planner and District Attorney, mineral resource development is included in the present Malheur County zoning ordinance. Mineral resource 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 oil and gas resource exploration and development on private lands must submit their plan to the Malheur Planning Commission for approval.

IV. 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 smaller communities of the EAR area, such as Adrian, Harper, and Juntura.

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.

<u>Exploration and Test Drilling</u>

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, and 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 while 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 abundant 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.

Industrial and metallic values are not likely to be adversely affected by development of oil, gas or geothermal resources. Energy development will increase the need for non-metallic mineral products such as sand, gravel, common fill and crushed rock. The environmental impacts of increased usage of natural construction materials could be locally significant.

Oil and gas reserves could possibly be discovered and developed in conjunction with the geothermal resources and other mineral resources. Geothermal exploration will complement oil and gas exploration and will add new geologic data that may be applicable to the discovery of other mineral resources.

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 power-plant 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 structural 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 work force size 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 Ontario-Vale-Nyssa area. If housing becomes a serious problem, workers may have to resort to living in temporary quarters or commute to the EAR area from various points in Idaho, 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 other construction areas, if not properly controlled, 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 Malheur and Owyhee Rivers 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 need 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. However, some soil type units are known to contain components of montmorillonite clay and are scattered throughout the EAR area. Strata with a significant monmorillonite content may be prone to slumping or mass wasting on exposed slopes and cuts where subjected to repeated cycles of wetting and drying.

Excessive cuts into the toes of slopes could trigger slope failures.

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 in 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(h) 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 Sec. 18, U.S. BLM Form 3200-21 (Geothermal Resources Lease) 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 shall be installed where drainages cross roads. Water bars shall be installed as necessary to prevent erosion.
2. The slope of cut banks and fill slopes shall be designed not to exceed safe angles.
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(d). 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. Require more stringent noise control measures if exploration or development occurs within 0.5 miles of a populated area. 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. Water requirements and plans for water use will be submitted with each appropriate plan of operation. Existing water rights, the needs of fish, wildlife, grazing animals, riparian vegetation and other users must be considered in the plan.
2. Comply with Federal and state water quality standards.
3. Waste waters will not be discharged into live streams or fresh water aquifers. Waste waters may be reinjected into the producing reservoir or other permeable zones that will not cause degradation of water quality in fresh water aquifers.
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 mineral extraction.

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 in each plan of operation. Federal and State wildlife management agencies may offer advise to the supervisor and authorized officer regarding mitigating measures for wildlife and wildlife habitat. The lessee may be denied access to or occupancy of small tracts of land containing significant wildlife habitat.

The lessee may be required to replace lost or damaged habitat areas. Replacement habitat may be on or off the lease site, depending on specific circumstances.

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. Designs are available for examination in the Vale, Oregon BLM District Office. 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. Noise suppressing mufflers must be installed on vents to minimize the adverse effects of operational noise on wildlife.

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 (BLM Form 3200-21). A more specific special stipulation has been developed and is routinely attached to each lease. This stipulation is displayed as Appendix G.

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. Vegetation and soil cover is removed, in cuts and fills for roadbeds, soil erosion and siltation occur during construction and, to a lesser degree, 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 operations, 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 water courses, 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 EAR area and adjacent areas, 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 communities of Vale, Ontario, or Nyssa 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 than 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 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.

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°F, 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 many areas. In some instances, wildlife species such as ground squirrels, starling, housefinch, and blackbilled magpie may benefit from development activities.

Reduction of ORV use in some areas 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 southeast 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 11 and 12 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 product 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 -	Wyoming	7	Blowouts -	Wyoming	2
	Oklahoma	2		New Mexico	4
	Mississippi	1		Colorado	2
		10		Utah	1
				California	1
					10

Table 13 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 do 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 roads 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 road 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 in other regions 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 other developed areas.

   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.

   Subsidence 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 10 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 land 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 "sluice-outs" 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 generally form on slopes with gradients less than 50%. They commonly occur when the toe of a hill is removed. 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. Accidents such as explosions, fires, spills, leaks, and blowouts could reduce vegetative cover over small 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 as the subsurface pressures become known.

Erosional impacts resulting from 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 later erosion because of the loss of vegetative cover and temporary soil sterilization.

During the abandonment of a field, it will not be possible to reclaim all disturbed sites to their condition prior to development. As a result, erosion rates might be higher or lower than they were before oil and gas were discovered. If mud pits were not properly reclaimed, they might be breached after field abandonment.

Improperly abandoned roads could create additional erosion problems.

<u>Land Use</u> - 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 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 hundreds 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.

<u>Water</u> - 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 clays 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 because groundwater moves at very slow rates; often less than several inches a day. 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 abandonment, 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 fewer 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 plant 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.

Plant 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 and land use practices. Oil and gas exploration, development and production activities could cause sediment loads to exceed those attributable to natural processes and reduce or increase sediment loads due to land use practices. Most natural sediment is transported during high stream flows due to intense summer storms. Sediments created by land disturbance activities frequently occur at lower flows in response to snow melt and local storms.

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 reservoirs. 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 impairing 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 spores, 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 low in most portions of the EAR area because of low rainfall.

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.

<u>Terrestrial Wildlife</u> - 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 reservoirs, 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.

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 do 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 impacts may be anticipated as a result of drill site preparation, access road construction, pipeline construction, and tank battery construction.

Additional adverse impacts 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 residnets became less oriented toward local cultural and historical values and more oriented toward extra-community events.

<u>Landscape Character and Aesthetics</u> - 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 sagebrush - grass 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 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, decomposer 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.

Unstable slopes are not always 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 rainfall.
- Inclusion of facilities to control drainage, such as 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 precautions were not taken in the design and construction of roads, pipelines, well sites, and other 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 scarified, 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 are 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 size, weight, and volume of necessary traffic.

- 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 reservoirs 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 numbers and dimensions of roads, pipelines, trails, test wells, and other facilities to the minimum 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 (Page 40) 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 reservoirs, 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 oil 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 of 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.

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.

Ditches and waterbars should be implemented to remove water from roads 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. Cut 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 furthers 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 often investigations 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 "C" quality scenery with excellent ("B" quality) scenery situated in the hill country of the northern, western and southern margins. Outstanding ("A" quality) scenery is situated along the Owyhee Reservoir and River and in the vicinities of Ironside Mountain and Castle Rock.

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 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 on 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 several sites of potential historic values, several sites of archeological and paleontological significance are known to exist in the EAR area as a result of a survey currently being conducted by the BLM Vale (Oregon) District Office.

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 northern 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, urban, and timber uses.

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.

5. Forestry. Forest production is centered in the northwest area of the EAR area and is of minor production.

   The residual impacts of preliminary investigation and exploration activities on timber production generally would be minor and limited primarily to a temporary setback in timber production on relatively small areas. There ordinarily would be time to harvest timber from oil field sites before the development phase. After abandonment, most areas could be reforested except in cases of severe accidental oil spills, saline water contamination, soil compaction, or soil loss. It might not be possible to entirely restore some areas to their original productivity.

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.

Terrestrial 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 energy 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 original 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.

Wildlife - 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.

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. 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 slides 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.

ANALYSIS OF THE ALTERNATIVE

Denial of geothermal or oil and gas leasing on Public Lands within the analysis area might be considered an alternative to the proposed action. However, considering the nature of the laws and regulations pursuant to which geothermal or oil and gas lease applications are made, denial requires cause, and denial for cause assumes an objective evaluation. Such is one purpose of this environmental analysis -- to ponder 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 national resource lands.

2. Off-site impacts, primarily socio-economic in nature, could be affected by the no leasing alternative only if economic sources of geothermal energy or of oil and gas are assumed. Using these assumptions, 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, oil and gas development could proceed on private lands.

4. A no lease decision could conserve possible geothermal or 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 geothermal or oil and gas operations.

5. A decision not to lease, especially for oil and gas, would encourage producers to turn to other energy sources to meet the nation's growing demand.

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 inefficient or over-development of the private lands with the possible multiplication of on-site environmental impacts.

V. PERSONS, GROUPS, AND GOVERNMENT AGENCIES CONSULTED

The following local people or agencies were consulted concerning geothermal and/or oil and gas resource exploration and development in northern Malheur County:

George Iseri
Manager, Iseri Realty Agency
Ontario, Oregon 97914

Rev. Shinryo Sawada
Ontario Buddhist Temple
Ontario, Oregon 97914

Sola Stalez
Librarian, Vale Elem. School
Vale, Oregon 97918

Howard Ego
City Coordinator
Vale, Oregon 97918

Robert Harrod
Supervisor, Malheur Co.
Intermediate Educ. Dist.
Vale, Oregon 97918

Jim Grant
Manager, Idaho Power Co.
Vale Office
Vale, Oregon 97918

Jerry Auyer
Publisher & Editor
Malheur Enterprise
Vale, Oregon 97918

Alford Pottorff
Malheur County Planner
Malheur County
Vale, Oregon 97918

Oregon Wildlife Commission
Ontario, Oregon 97914

Henry Schenider
City Manager
Nyssa, Oregon 97918

Dirick Nedry
Publisher & Editor
Gate City Journal
Nyssa, Oregon 97913

Don Young
President, Nyssa Branch
U.S. National Bank
Nyssa, Oregon 97913

Francis McLean
Publisher
Daily Argus Observer
Ontario, Oregon 97914

Roy Probasco
KSRV
Ontario, Oregon 97914

Jack Collins
City Manager
Ontario, Oregon 97914

Frank Yraguen
Malheur County Dist. Attorney
Vale, Oregon 97918

In addition, BLM personnel of the Vale District have, during the past four 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. Gelogical 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.

- One member of the Vale District visited the Los Alamos Scientific Laboratory Hot Dry Rock Geothermal Energy Development Project at Fenton Hill in the Valles Caldera, New Mexico to observe drilling procedures, environmental protection measures and gather data on all aspects of the project for future reference.

- 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.

VI. 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 behond 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 northern Malheur area. Replies were received from 12 parties. Copies of our letters, the lists of persons to whom they were sent, and the replies can be found in Appendix F.

VII. 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
Edwin G. Dimick - Soil & Water Specialist
Gerald A. Meyer - Recreational Specialist
Barry Cushing - Manager, Northern Malheur Resource Area

VIII. 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 northern Malheur County 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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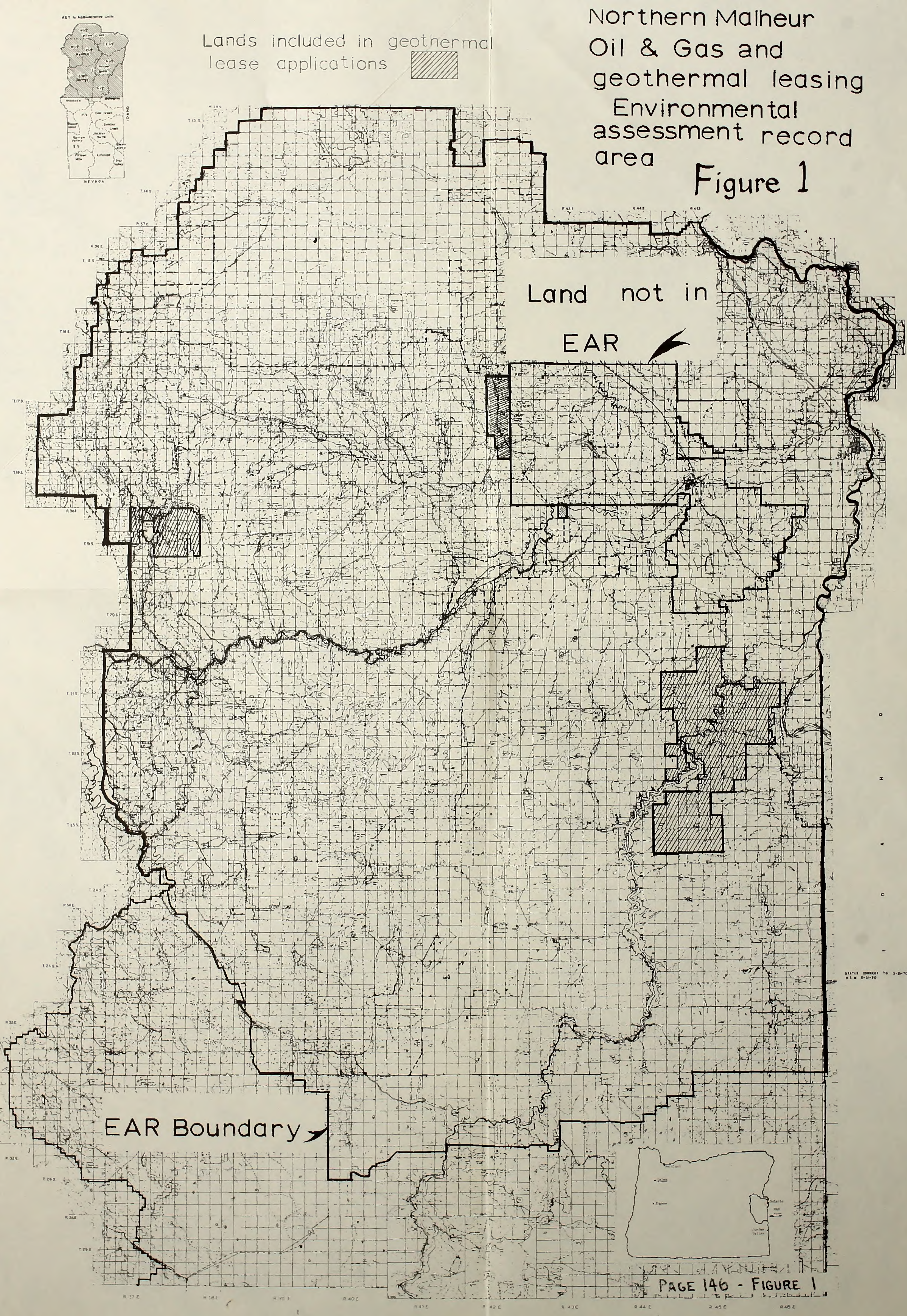


Northern Malheur
Oil & Gas and
geothermal leasing
Environmental
assessment record
area
Figure 1
Lands included in geothermal
lease applications
Land not in
EAR
EAR Boundary
PAGE 146 - FIGURE 1

FIGURE 2

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 Crystalisation
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
188		Neal Hot Spr (sur. temp.)	Intens De-Icing Operations
176	80		Space Heating Greenhouses by Space Heating
162	70		Refrigeration by Low Temperature
158		Mitchell Butte Hot Spr	
140	60		Animal Husbandry Greenhouses by Combined Space and Hotbed Heating
122	50		Mushroom Growing Balneological Baths
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 (arrow spanning approx. 200 °C down to 100 °C)

Water (arrow spanning 20 °C up to approx. 120 °C)

Temp. Range of Conventional Power Production (bracket spanning approx. 180 °C to 140 °C)

Figure 2

FIGURE 3. Sequence of operations in an oil and gas field.

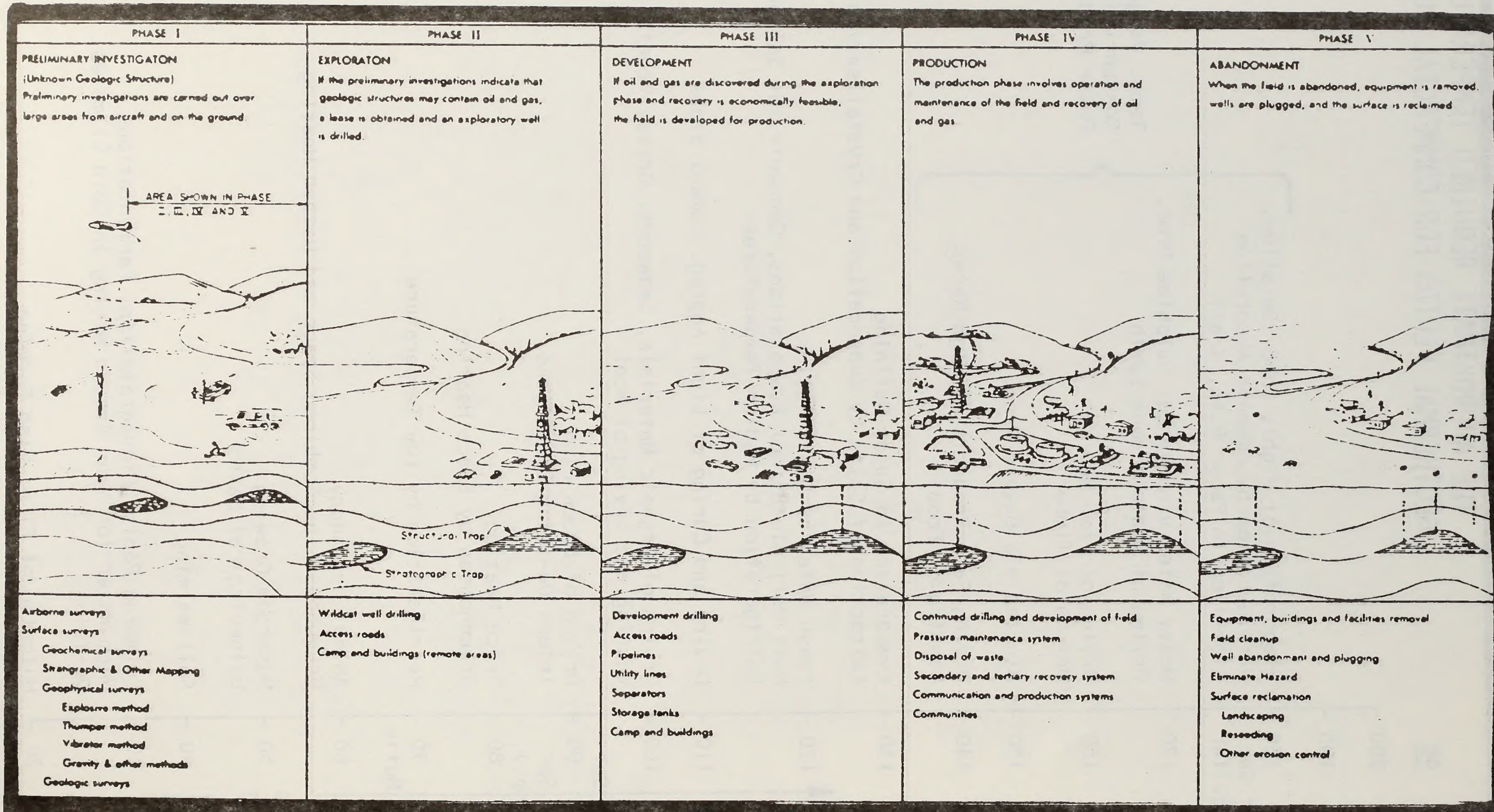
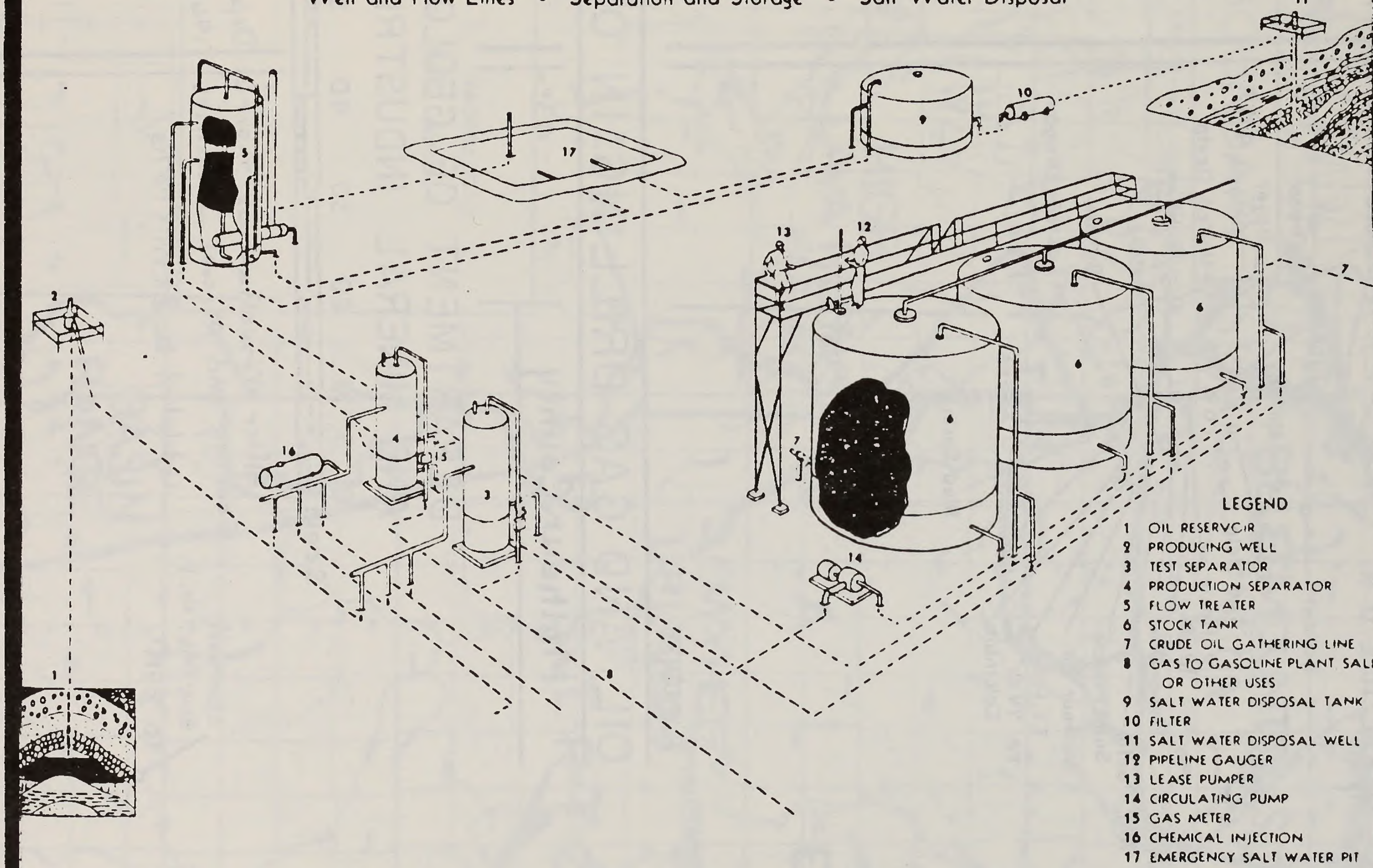


Figure 3

FIGURE 4. **FLOWING OIL PRODUCTION**

Well and Flow Lines • Separation and Storage • Salt Water Disposal



FACILITIES IN A FLOWING OIL FIELD

Figure 4

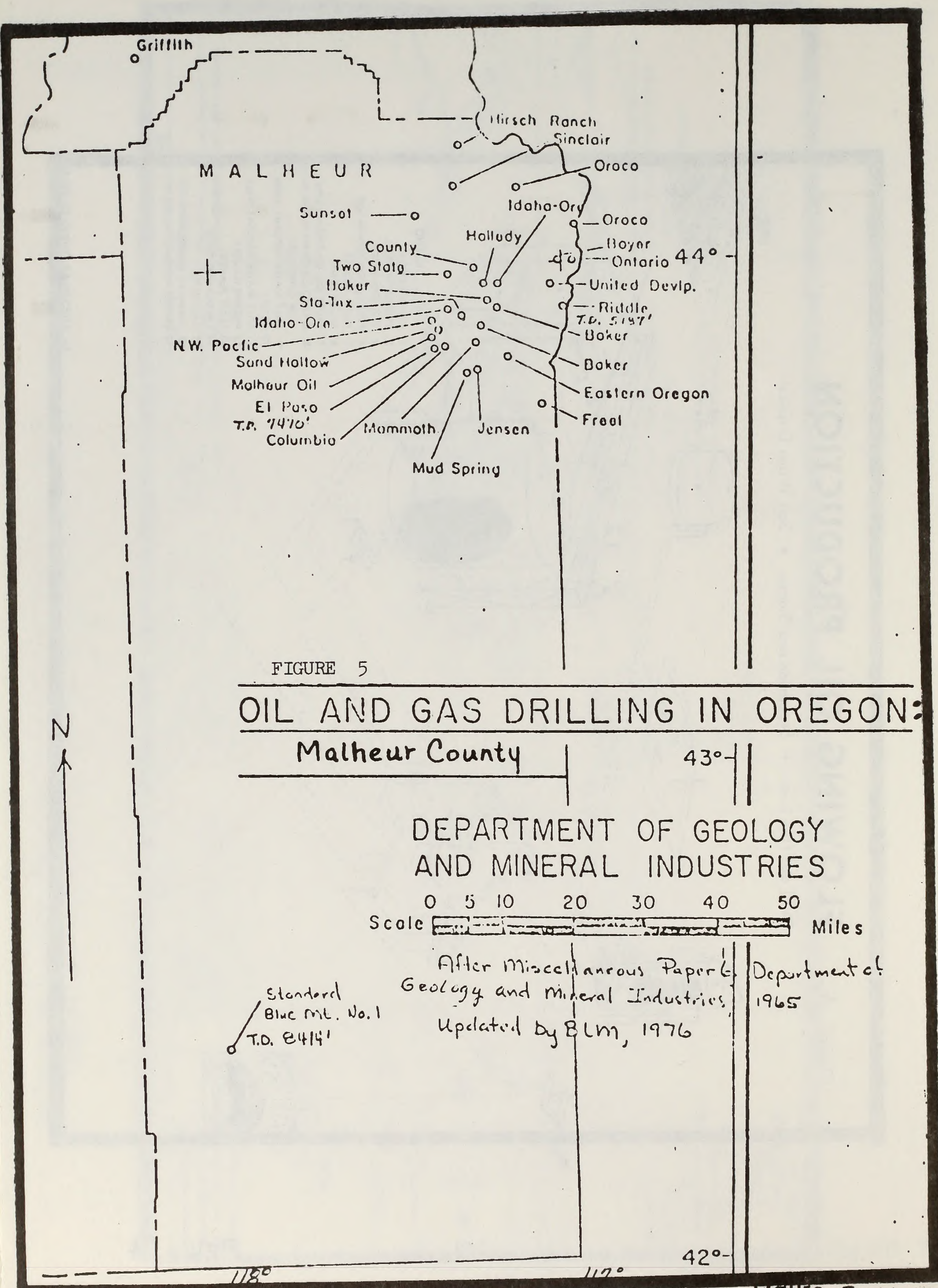


FIGURE 5

OIL AND GAS DRILLING IN OREGON:

Malheur County

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

Scale 0 5 10 20 30 40 50 Miles

After Miscellaneous Paper 6, Department of Geology and Mineral Industries, 1965
Updated by BLM, 1976

Figure 5

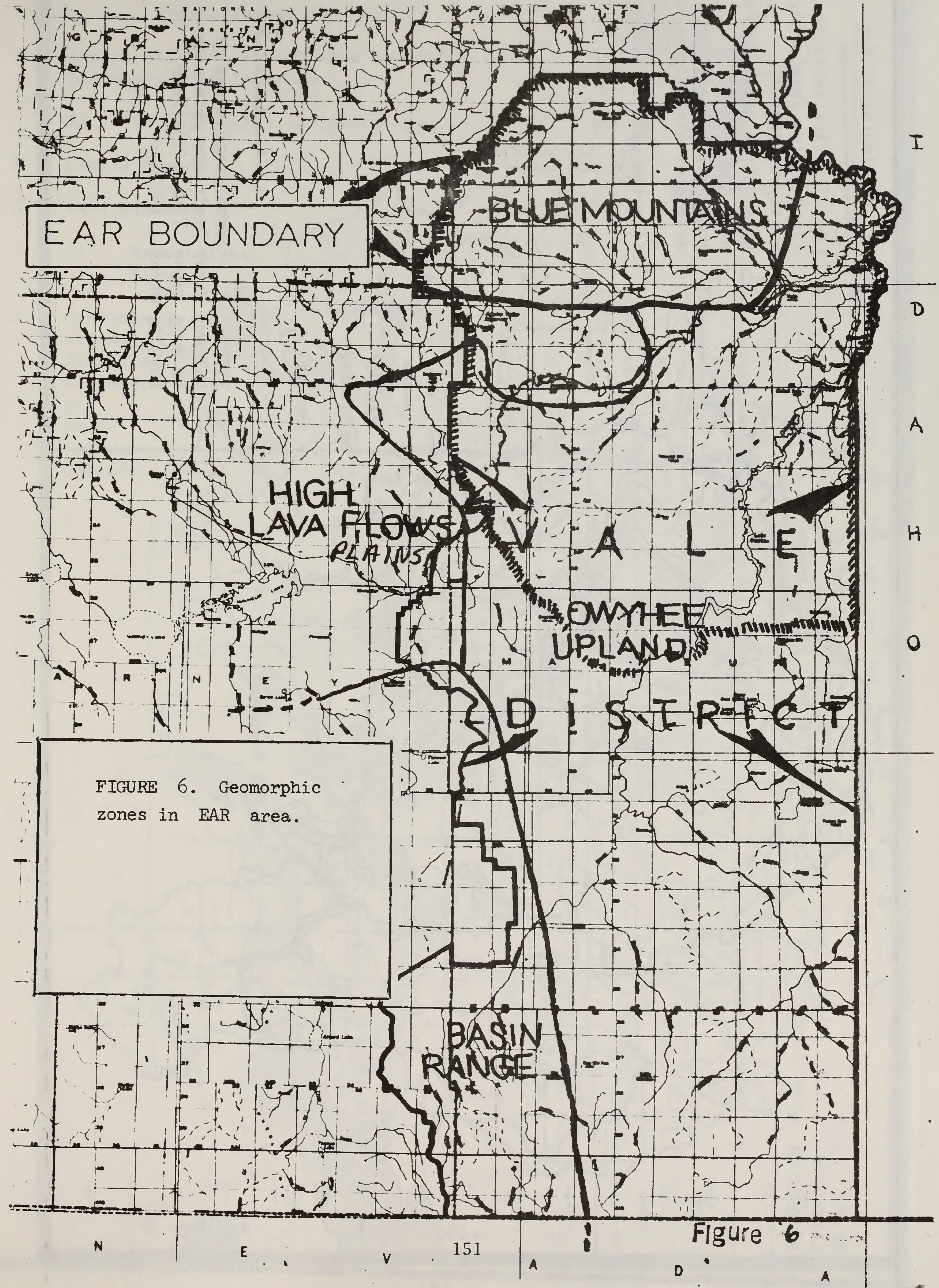
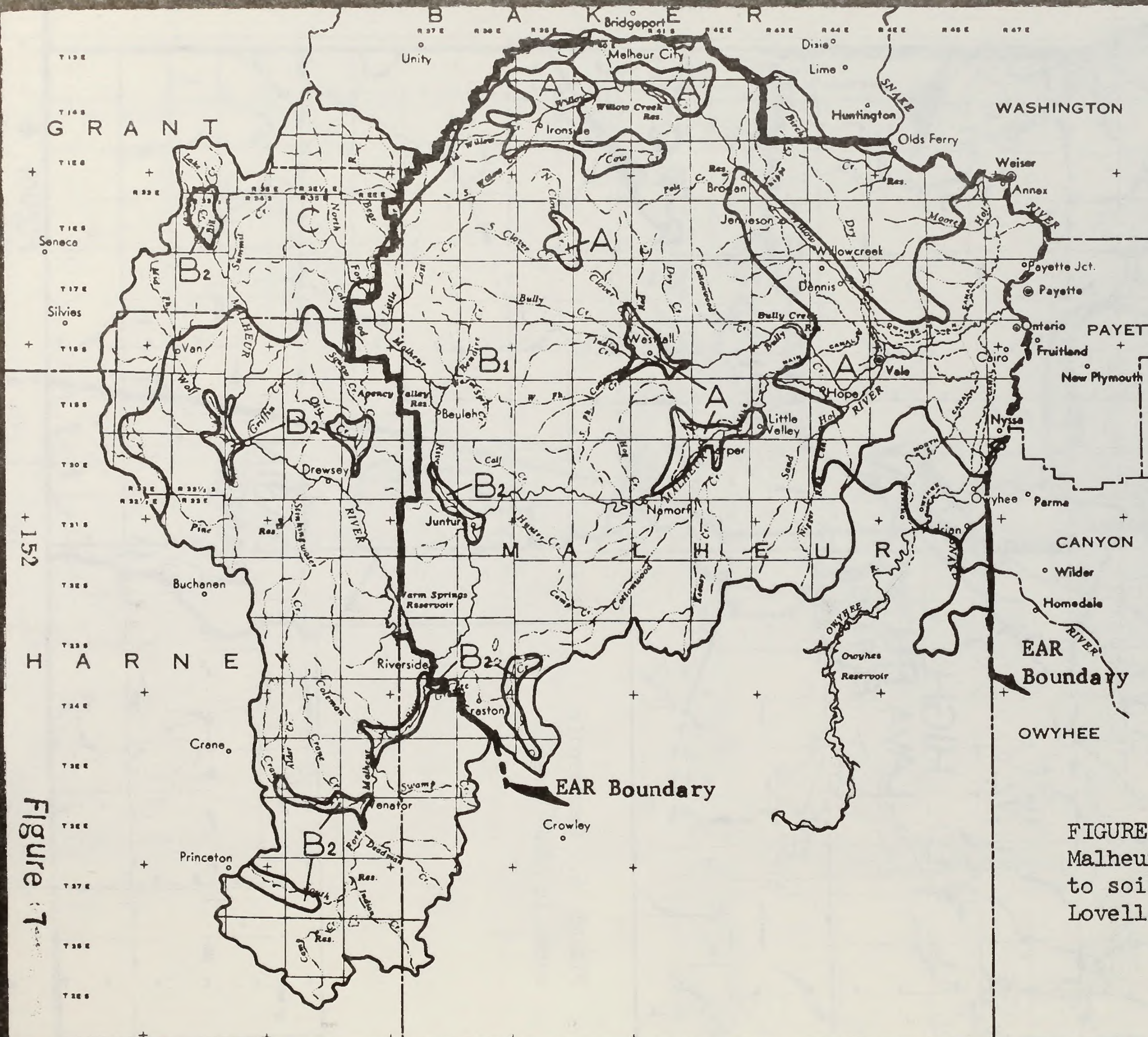


FIGURE 6. Geomorphic zones in EAR area.



Legend to Physiographic Map

A low elevation terraces and flood plains (semiarid, mostly irrigated)

B^1 grass-shrub uplands (semi-arid rangelands)

B^2 small bottomlands and basins at higher elevations (semi-arid)

C forested uplands (subhumid)

FIGURE 7. Physiographic map of Malheur River Basin for reference to soil types (Table 7) (From Lovell, et al., 1969a).

Figure 7

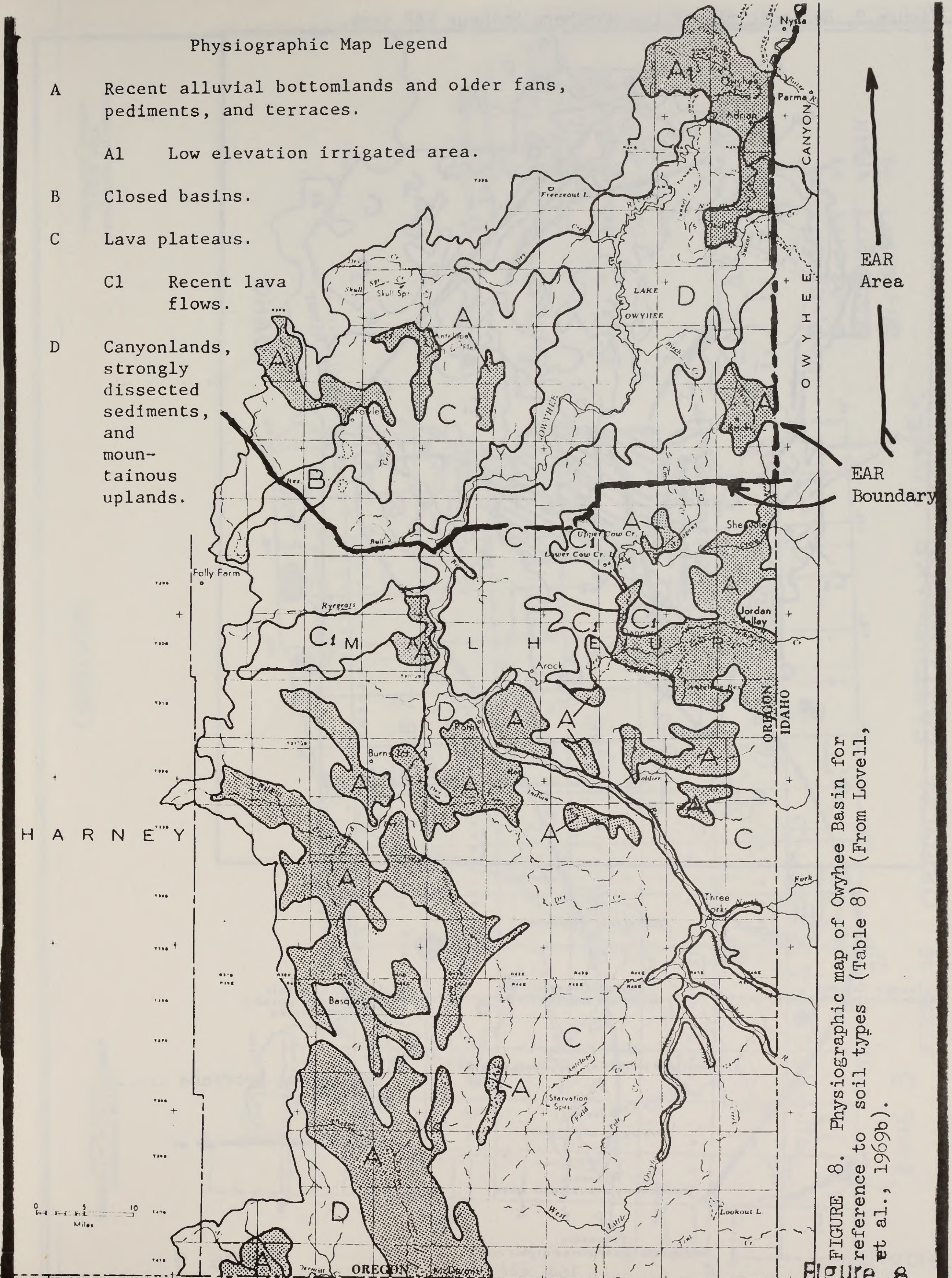
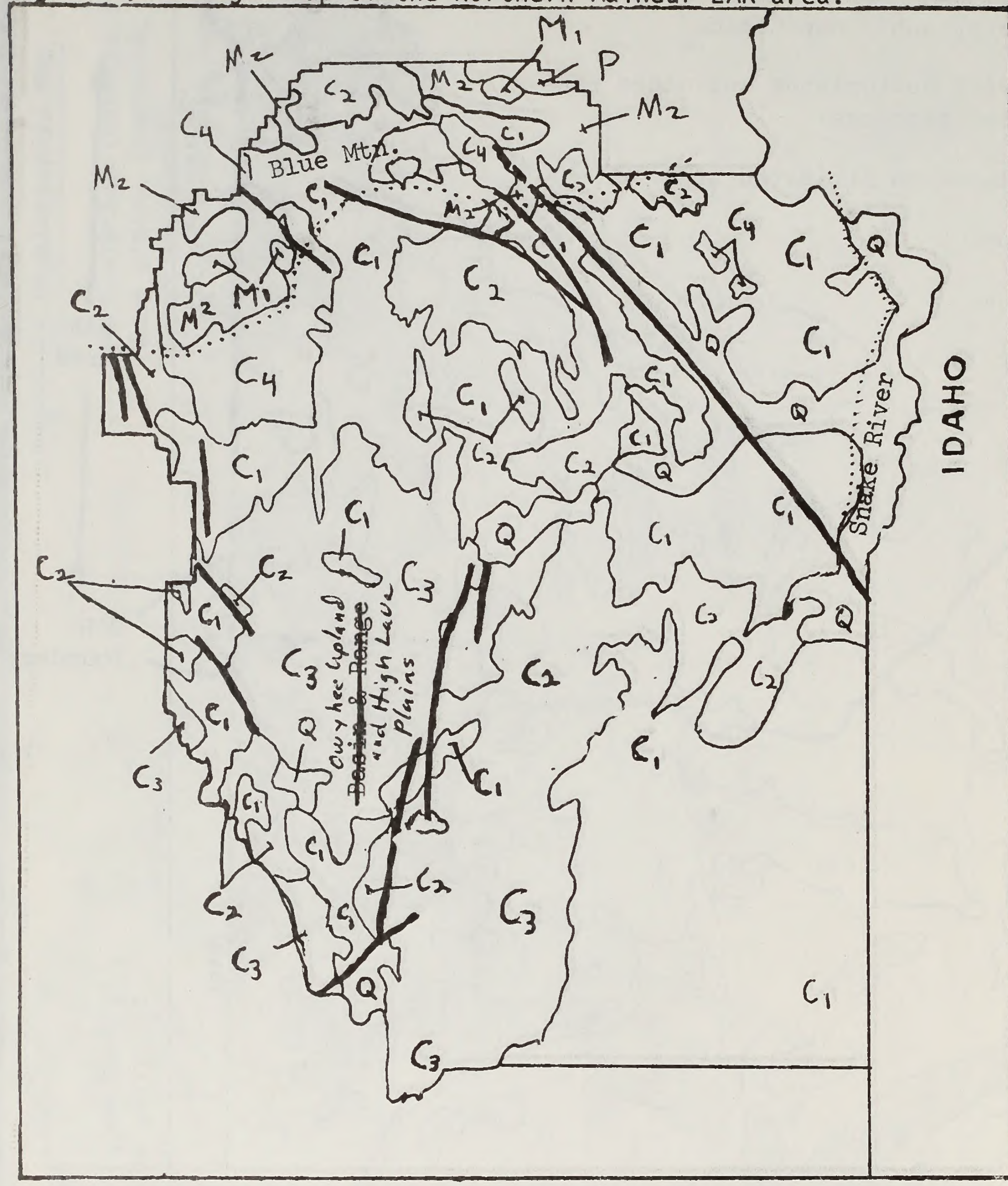


FIGURE 8. Physiographic map of Owyhee Basin for reference to soil types (Table 8) (From Lovell, et al., 1969b).

Figure 9, Geologic map of the Northern Malheur EAR area.



Q

Quaternary alluvium

C_1

Younger Cenozoic nonmarine sedimentary rocks

C_2

Younger Cenozoic basalt and andesite flows

C_3

Younger Cenozoic sedimentary and volcanic rocks; undivided

C_4

Older Cenozoic volcanic and nonmarine sedimentary rocks

M_1

Mesozoic intrusive granitic rocks

M_2

Mesozoic sedimentary and volcanic rocks

P

Paleozoic sedimentary and metamorphic rocks

Geological province .....

Fault

Figure 9

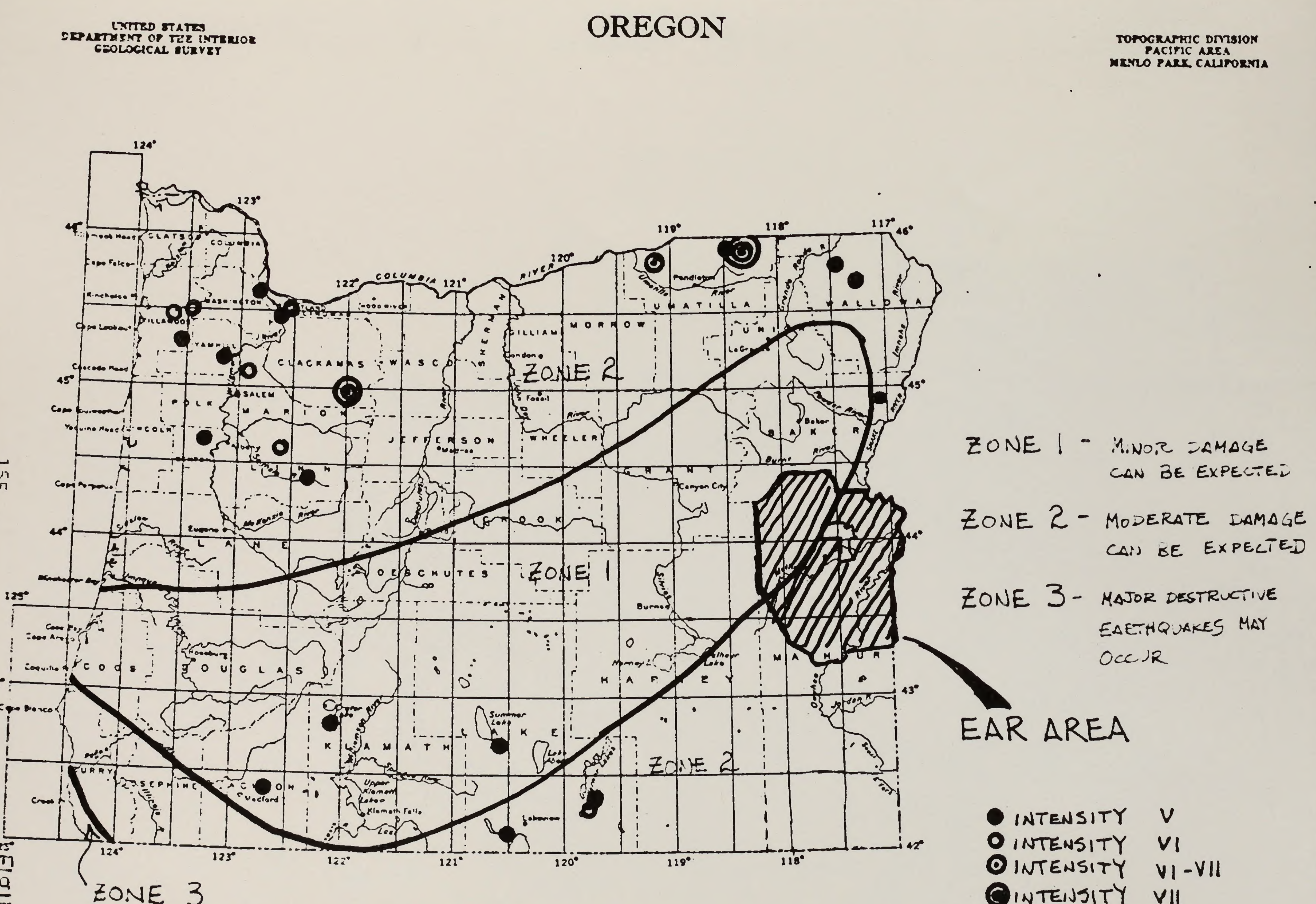
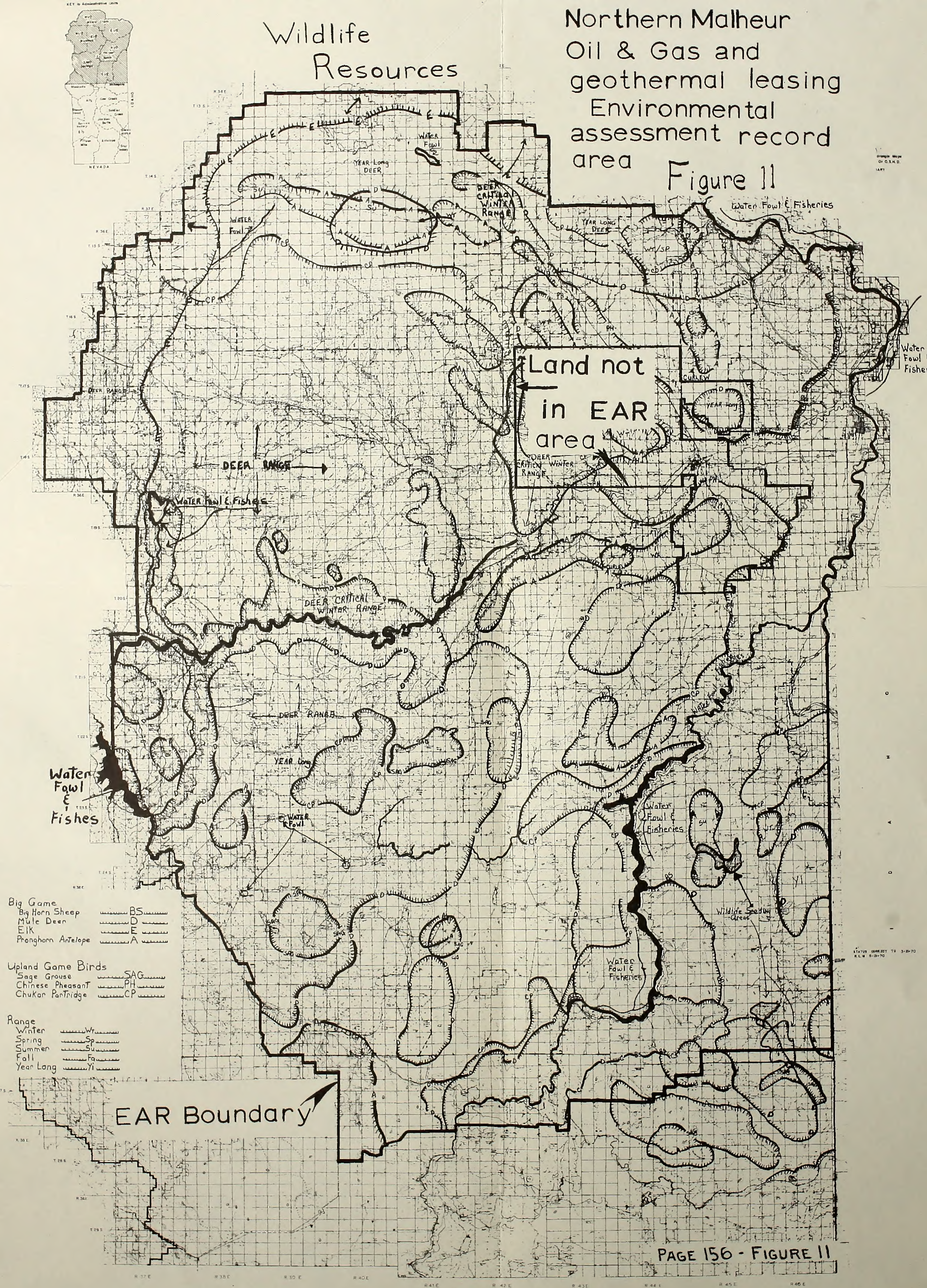


FIGURE 10 OREGON EARTHQUAKE ZONES

TAKEN FROM EARTHQUAKE INFORMATION BULLETIN, MAY-JUNE, 1976, VOLUME 8, NUMBER 3

Figure 10



Wildlife
Resources
Northern Malheur
Oil & Gas and
geothermal leasing
Environmental
assessment record
area
Figure 11
Land not
in EAR
area
DEER RANGE
Water Fowl & Fishes
DEER CRITICAL WINTER RANGE
Water Fowl & Fishes
Water Fowl & Fisheries
Big Game
Big Horn Sheep BS
Mule Deer D
Elk E
Pronghorn Antelope A
Upland Game Birds
Sage Grouse SAG
Chinese Pheasant PH
Chukar Partridge CP
Range
Winter Wr
Spring Sp
Summer Su
Fall Fa
Year Long Yl
EAR Boundary

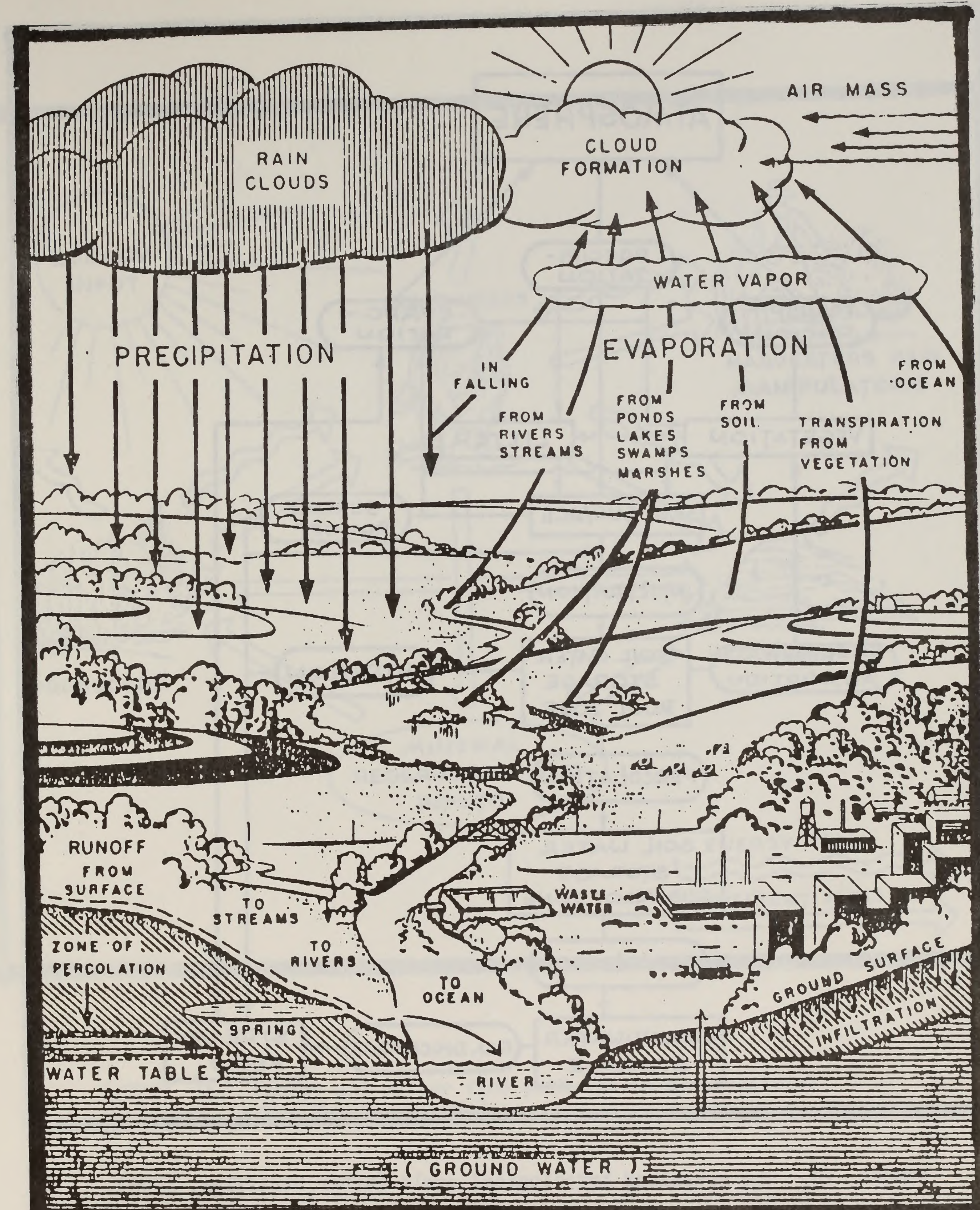


FIGURE 12. Schematic hydrological cycle.

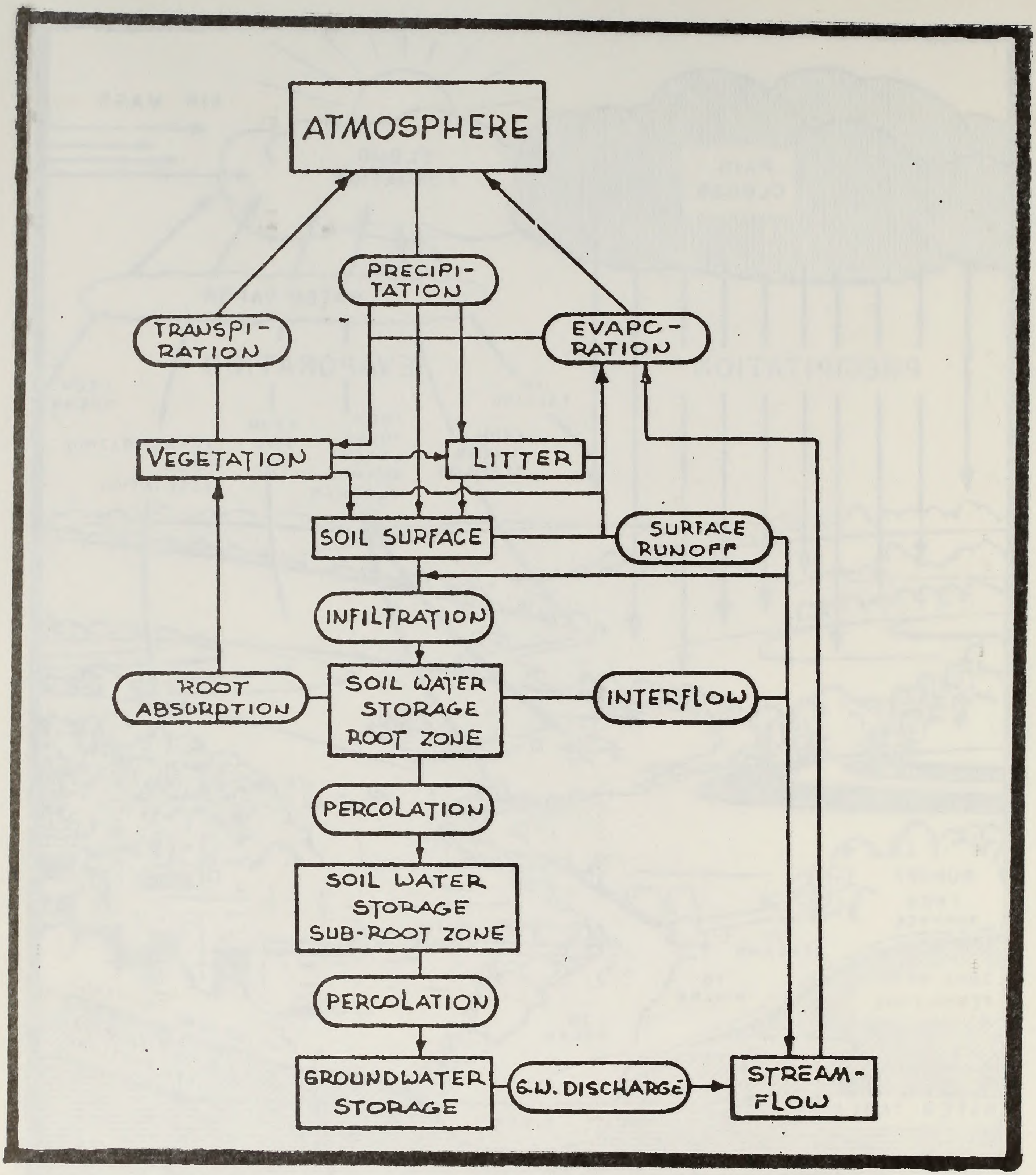


FIGURE 13. The grassland hydrological cycle (after Striffler, 1969).

Figure 13

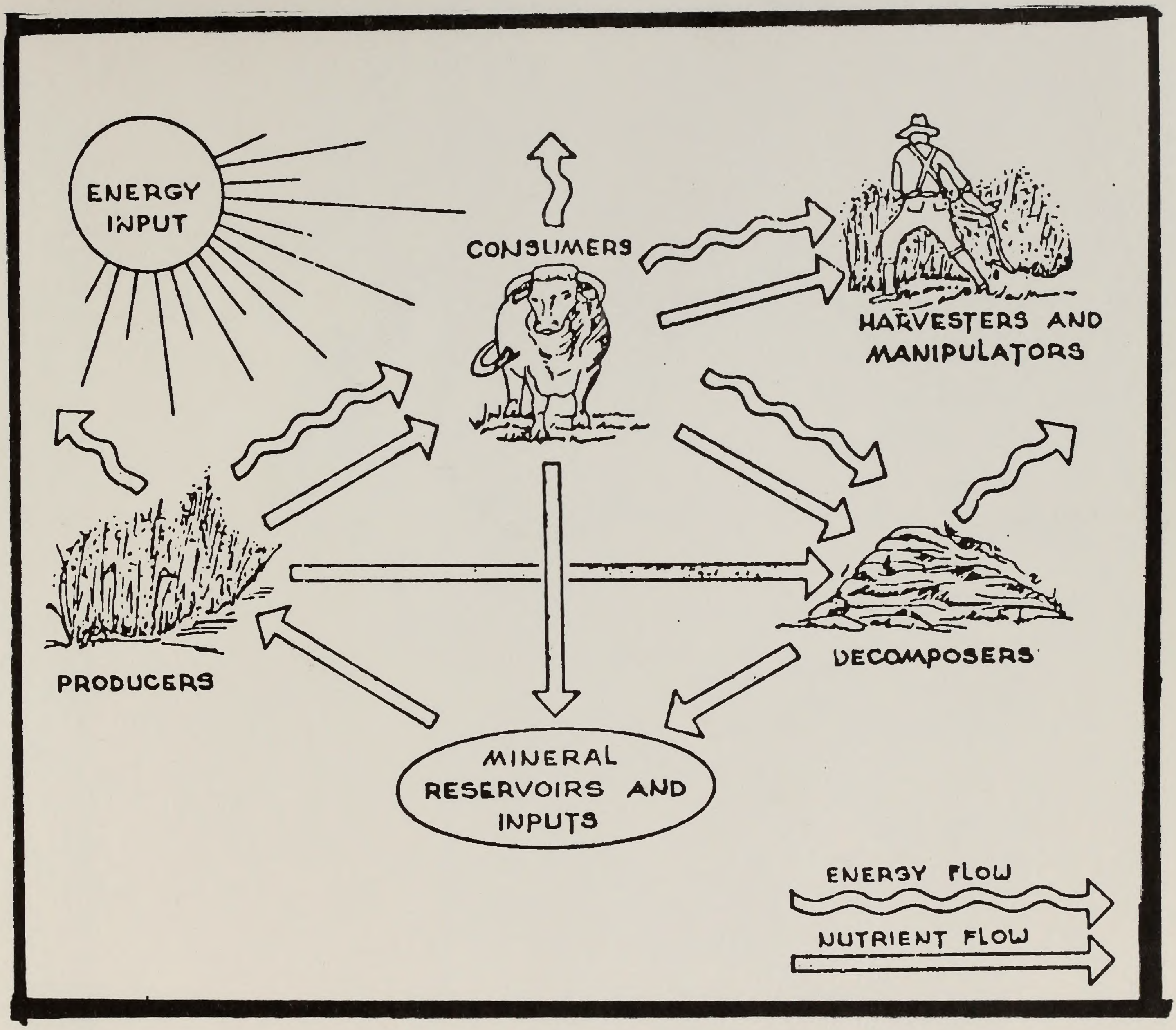
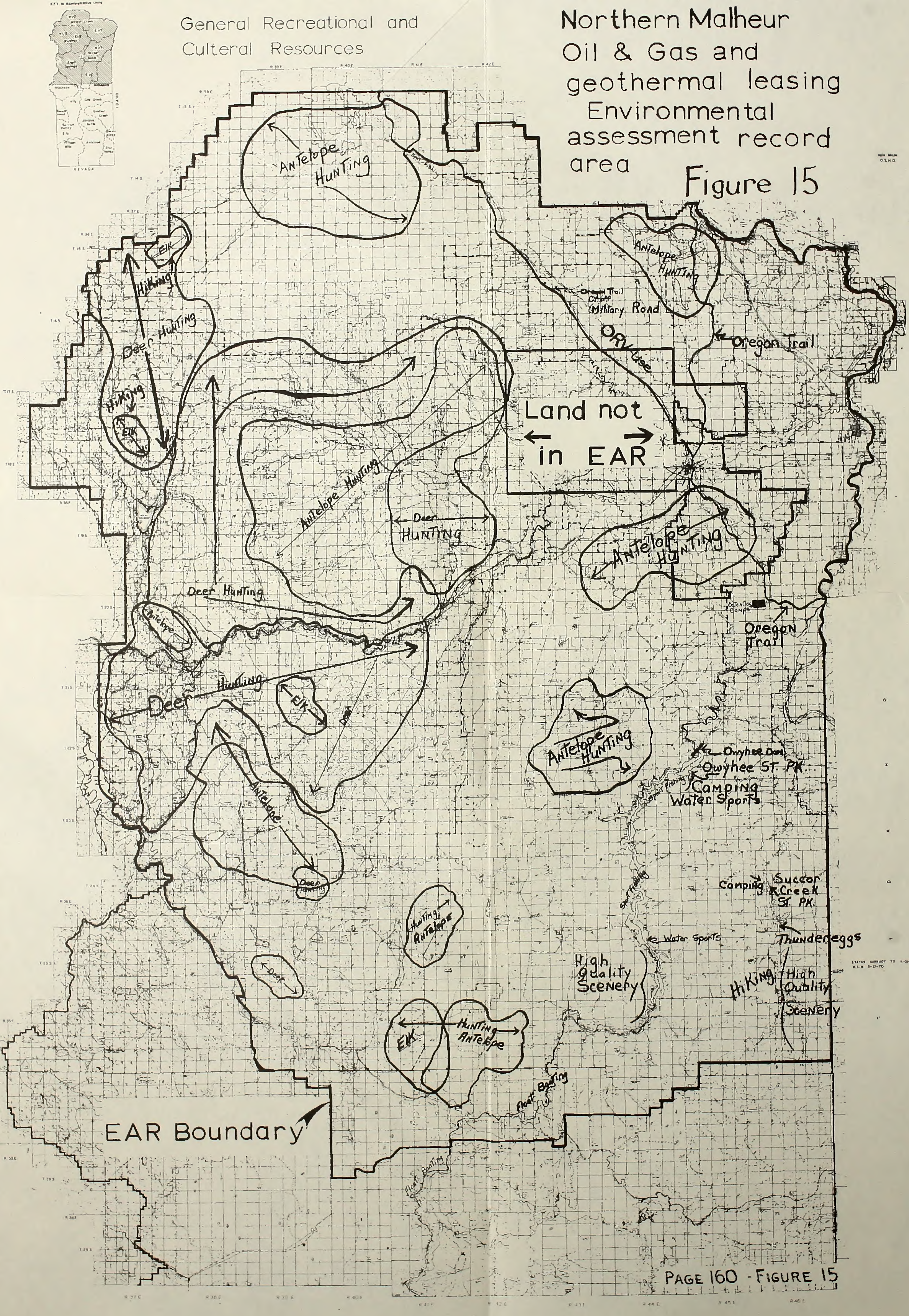


FIGURE 14. Energy and matter flow pathways in a terrestrial ecosystem (after Van Dyne, 1969).



General Recreational and Culteral Resources
Northern Malheur Oil & Gas and geothermal leasing Environmental assessment record area
Figure 15
Antelope Hunting
Elk
Hiking
Deer Hunting
Antelope Hunting
Oregon Trail
Military Road
ORV Use
Oregon Trail
Land not in EAR
Antelope Hunting
Deer Hunting
Deer Hunting
Antelope Hunting
Antelope
Oregon Trail
Deer Hunting
Elk
Antelope
Deer Hunting
Antelope Hunting
Owyhee Dam
Owyhee ST. PK.
Camping
Water Sports
Camping
Succor Creek ST. PK.
Thundereggs
Water Sports
High Quality Scenery
Hiking
High Quality Scenery
Hunting Antelope
Deer
Elk
Hunting Antelope
Float Boating
EAR Boundary

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 and 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., 45E. 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.
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_2S odor.
Mud Spring	Gas occurrence	Sec. 29, 20S., 45E. Elev. 3000'.	1909	--	Cold spring from which a "copious quantity" of odorless, inflammable gas issued.

Table 1

Company	Well Name	Elevation and Location	Date	Depth	Remarks
Sand Hollow	Oil Occurrence	West bank at Sand Hollow Sec. 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	320'	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_2S odor. Oil films noted in bailing water.
Eastern Oregon Oil Co.	Well No. 1	Sec. 12, 20S., 45E.	1909-1910	815'	Cable tools. Reported oil shows
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. See gas analysis Table No. 1.
Sunset Oil Co.	?	About 12 miles Northwest of Vale.	1919	500'	
Northwestern 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 Southwest of Vale. Sec. 19, 19S., 44E. Elev. 2500'.	Before 1938	1260+	

Table 1 -Cont'd-

Company	Well Name	Elevation and Location	Date	Depth	Remarks
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_2S odor. ~~See Analysis Table No. 1.~~
Idaho-Oregon Prod. Co.	Elvera-Recla No. 1	South of Vale. SE¼ sec. 9, 19S., 44E. Elev. 2332'.	1950	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.
El Paso Nat. Gas Co.	Federal-Spurrier No. 1	South of Vale. NE¼ sec. 5, 20S., 44E. 360'S. of N. line & 550'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. Oreg. Land Co. No. 1	Willow Creek. SW¼ Sec. 15, 16S., 44E. 660'N. of S. line & 1980'E. of W. line. Elev. 2640'.	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.41E. Malheur County		8414TD	Abandoned August 8, 1973.

Table 1 ·Cont'd·

TABLE 2a. Mean monthly and annual precipitation (inches) for five stations in the EAR and adjacent areas (modified from U.S. Dept. Commerce, National Oceanographic and Atmospheric Administration climatological data).

Station	Yrs. of record	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Beulah	43	1.54	1.06	0.83	0.64	1.16	1.18	0.31	0.37	1.36	0.90	1.35	1.58	11.35
Malheur Exp. Br. Sta.	29	1.30	1.01	0.74	0.71	1.17	0.92	0.10	0.39	0.42	0.81	1.16	1.20	9.93
Nyssa	37	1.26	1.04	0.76	0.75	1.08	0.96	0.11	0.37	0.47	0.85	1.20	2.00	10.13
Owyhee Dam	41	0.95	0.77	0.64	0.66	1.22	1.11	0.16	0.32	0.53	0.66	0.87	0.93	8.76
Vale[1/]	77	1.19	0.91	0.67	0.67	1.15	0.90	0.12	0.40	0.60	0.77	1.03	1.10	9.41

[1/] not in EAR area

Table 2a

TABLE 2b. Mean monthly and annual temperature (^{o}F) for five stations in the EAR and adjacent areas (modified from U.S. Dept. Commerce, National Oceanographic and Atmospheric Administration climatological data).

Station	Yrs. of record	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Beulah	27	26.2	32.7	39.1	47.7	56.0	62.9	72.0	72.1	61.5	49.8	37.7	30.0	48.8
Malheur Exp. Br. Sta.	34	27.7	34.7	42.2	50.8	59.4	66.8	75.1	72.4	62.8	50.9	38.6	31.3	51.0
Nyssa	36	28.4	34.9	42.1	50.9	59.2	66.8	75.8	72.6	62.7	50.8	39.1	31.9	51.3
Owyhee Dam	39	30.9	37.8	44.1	51.9	59.6	66.1	73.7	72.1	64.9	53.8	41.4	34.3	52.5
Vale1/	71	28.0	34.9	42.1	50.4	57.1	66.0	74.5	71.5	61.8	50.6	38.9	31.7	50.8

1/not in EAR area

Table 2b

TABLE 2c. Maximum and minimum temperature extremes (°F), and frost-free days for 11 stations in the EAR and adjacent areas (modified from U.S. Dept. Commerce, National Oceanographic and Atmospheric Administration climatological data).

Station	Yrs. of record	Temperature extremes (°F) High	Low	Frost-free days
Beulah	27	101	1	137
Ironside 2W	18	98	-5	101
Juntura 9ene	14	104	4	100
Malheur Exp. Br. Sta.	34	103	-5	165
Nyssa	36	101	1	184
Ontario KSRV	28	104	-5	75 2/
Owyhee Dam	39	100	5	172
Riverside 2E	11	97	1	100
Rockville 5N	14	97	-14	51 2/
Vale 1/	71	102	-2	101
Westfall 4NNW	19	101	0	74 2/

1/ not in EAR area

2/ possible typographic error in original data

Table 2c

Table 3.- Runoff Characteristics

Stream	Location of Gage	Drainage Area sq. mi.	Average Annual Runoff ac-ft/yr	Average Annual Runoff inches/yr	Years of Record
Malheur R.	Little Val. Nr. Hope	3,010	146,300	.91	26
Bully Cr.	Warm Springs Nr. Vale	539	31,590	1.10	18
Owyhee R.	Below Owyhee Dam	11,160	259,400	.44	43

Table 4a.- Peak Flow Discharge

Stream Gage	Discharge Measure	Peak Discharge by Water Year					
		1970-71	1971-72	1972-73	1973-74	1974-75	Period of Record
Malheur	cfs	8620	4660	1820	2380	3320	12,300
	cfs/mi^2	2.86	1.55	0.60	0.79	1.10	4.09
Bully C.	cfs	5070	884	2990	2170	6990	12,800
	cfs/mi^2	9.41	1.64	5.55	4.03	12.97	23.75
Owyhee R.	cfs	14,900	14,700	3170	7550	6340	22,900
	cfs/mi^2	1.34	1.32	0.28	0.68	0.57	2.05

Table 4b.- Low Flow Discharges

Stream Gage	Discharge Measure	Low Flow Discharge by Water Year					
		1970-71	1971-72	1972-73	1973-74	1974-75	Period of Record
Malheur	cfs	34	6.8	17	16	19	6.8
	cfs/mi^2	.011	.002	.006	.005	.006	.002
Bully C.	cfs	0.80	0.20	0.20	no flow	0.65	
	cfs/mi^2	.001	.001	.001	.001	.001	no flow
Owyhee R.	cfs	2.8	2.7	2.4	1.8	2.2	
	cfs/mi^2	.001	.001	.001	.001	.001	no flow

Tables 3 & 4

Table 5.

Analyses of water from sedimentary beds
[Chemical constituents in parts per million]

Well	31/41-25G1 (Crosby well)	31/41-14H1 (Dowell well)
Date sampled	10/30/58	10/30/58
Date analyzed	11/24/58	11/24/58
Silica (SiO_2)	52	60
Calcium (Ca)	195	0
Magnesium (Mg)	82	0
Sodium (Na)	885	148
Potassium (K)	19	2.6
Bicarbonate (HCO_3)	392	224
Carbonate (CO_3)	0	47
Sulfate (SO_4)	1,620	36
Chloride (Cl)	254	18
Nitrate (NO_3)	257	.4
Dissolved solids:		
Calculated	3,510	422
Residue on evaporation	3,580	435
Hardness as $CaCO_3$:		
Total	620	0
Noncarbonate	298	0
Specific conductance (micromhos at 25°C)	4,560	638
pH	7.5	9.1
Color	0	5

From R.C. Newcomb, 1961

TABLE 6. Hot Springs Chemical Analysis

Location	Beulah Hot Springs SE¼ Sec. 2, T.19S, R.37E.	Mitchell Hot Springs NE¼ Sec. 12, T.21S, R.45E.	Unnamed Hot Springs near Little Valley NW¼ Sec 30, T. 19S, R.43E.
Temperature (^{o}C)	60	62	70
pH	7.56	8.69	8.71
Specific Conductance **	1,090	559	740
Silica (Sio_2) *	170	94	115
Calcium (Ca) *	24	4.6	3.2
Magnesium (Mg)*	.2	<.1	<.05
Sodium (Ma) *	200	110	160
Potassium (k) *	6.0	1.6	3.2
Lithium (Li) *	.24	.03	.11
Bicarbonate (HCO_3) *	161	72	127
Carbonate (CO_3) *	1	3	1
Sulfate (SO_4) *	290	130	110
Chloride (C1) *	55	28	74
Fluoride (F) *	4.7	10.4	6.8
Boron (B) *	4.7	.49	4.7
Flow (1pm)	50	60	550
Best est. Termal aquifer temperature	86°C	119-145°C	72°C

** Specific conductance measured in micromhos at 25° C

* Measured in parts per million

From Mariner, et al., 1974

TABLE 7. Key to soils of the Malheur Drainage Basin in relation to physiographic areas[a] (see Figure 7) (after Lovell, et al., 1969a).

Map area	Soil series or unit
A. Low elevation terraces and flood plains (mostly irrigated)	
Nearly level recent alluvial flood plains, fans, and low terraces	
<u>Surface color and subsoil texture</u>	
Deep, well drained soils[b]	
Moderately dark, silt loam	Powder
Moderately dark, silt loam	(Gi)
Dark, silt loam	Jett
Light, silt loam (diatomaceous)	Bully
Light, loamy sand	Feltham
Light, silt loam	Garbutt
Alkali, somewhat poorly drained soils	
Light, silt loam	Umapine
Light, silt loam (moderately deep over hardpan)	Stanfield
Alkali, poorly drained soils	
Moderately dark, silty clay loam	(Ki)
Moderately dark, silty clay loam	(Sm)
Broad, nearly level to rolling terraces	
<u>Depth and subsoil texture</u>	
Soils without hardpan	
Deep, silty clay loam	Greenleaf
Deep, silt loam	Nyssaton
Soils with hardpan (depth to pan indicated)	
Moderately deep, silt loam	Nyssa
Moderately deep, silty clay loam (alkali)	(Ma)
Moderately deep, silty clay loam	Virtue
Shallow, silt loam	Frohman
Shallow, silty clay loam (stony)	Gacey
Shallow, loam	Unit 55
Shallow, clay loam-clay	Unit 56

TABLE 7. (continued)

Map area	Soil series or unit
B_1 Rolling to hilly grass-shrub uplands	
Soils over weakly or nonconcolidated old sediments	
Deep, clay loam	Encina
Moderately deep, clay loam	Unit 60
Moderately deep, silty clay	Poall
Shallow over hardpan, silty clay	(Bi)
Moderately deep, clay loam	Brogan
Deep, silt loam (wind deposited)	Unit 79
Deep, sandy loam (wind deposited)	Unit 51
Soils on fans derived from old sediments (deep, light colored)	
Silty clay loam, (alkali)	(mc)
Clay Loam	(Sp)
Soils over shale	
Moderately deep, silty clay	Locey
Deep, loam	(Bs)
Soils on fans derived from shale	
Deep, clay loam	Morfitt
Soils over quartz diorite	
Moderately deep, loam	(Pe)
Soils over basalt, tuff, and rhyolite Light colored, shallow, stony soils[b/]	
Subsoil texture	
Loamy, very stony	Ruckles
Loamy, very stony	Unit 75
Loamy, very stony (very shallow)	Bakeoven
Loamy, (very shallow and rocky)	Unit 77
Clayey, very stony	Unit 76
Clayey, somewhat stony	Unit 76L
Clayey, extremely stony	Unit S76
Dark colored soils at higher elevations and on north slopes	
Moderately deep, silty	Unit 82
Shallow, loamy to clayey (very strong)	Unit 83
Very shallow, loamy (rocky)	Unit 84

Table 7 -Cont'd-

TABLE 7. (continued)

Map area		Soil series or unit
	Soils on old fans derived from basalt (light colored, very stony soils)	
	Clayey, moderately deep over hardpan	Lookout
B_2	Small stream bottomlands and basins in the uplands	
	Well drained soils	
	Deep, loamy	Unit 1
	Moderately deep over gravel, loamy	Unit 3
	Shallow over basin sediments, silty	Unit 26
	Shallow over hardpan, loamy	(Bg)
	Deep, somewhat poorly drained soils	
	Silty, nonalkali	Unit 10
	Silty, alkali	Unit 43
	Clayey, alkali	Unit 42
	Clayey, nonalkali	Unit 31
	Deep, poorly drained soils	
	Silty, nonalkali	Unit 15
C.	Forested uplands	
	On steep slopes	
	Moderately deep, reddish brown, stony silty clay loam.	Klicker
	(Unmapped portion also includes the loamy Hall Ranch and clayey Hankins series.)	

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a/ Some soils occur in more than one physiographic area. They are listed for the area of their major occurence.

b/ Unless otherwise indicated.

Table 7 -Cont'd-

TABLE 8. Key to soil series and reconnaissance units of the Owyhee Drainage Basin in relation to physiographic areas[a] (see Figure 8) (after Lovell, et al., 1969b).

Map Area	Soil Unit
A. Recent alluvial bottomlands and older fans, pediments, and terraces	
Nearly level recent alluvial fans and bottomlands	
Well drained soils	
Deep	
Silt loam[b]	Garbutt, (Gi)
Silt loam or loam	Unit 1
Sandy loam	Unit 6
Loamy sand	Feltham
Gravelly sandy loam	Unit 2
Clayey, alkali	(Mc)
Shallow	
Loamy over gravel	Unit 3
Loamy over gravel (alkali)	Unit 16
Sandy loam over bedrock	Unit 5
Somewhat poorly drained soils	
Deep, silt loam, alkali	Umapine
Poorly drained soils	
Deep, silt loam-silty clay loam	Unit 15
Nearly level to sloping older fans, pediments, and terraces	
Well-drained, light-colored soils	
Without hardpan	
Deep, silt loam	Nyssaton
Deep, loam-silt loam	Unit 57
Deep, sandy loam, wind deposited	Unit 51
With hardpan (depth to pan indicated)	
Moderately deep, silt loam	Nyssa
Shallow, sandy loam	Unit 50
Shallow, loamy	Unit 55
Shallow, clayey	Unit 56

Table 8

TABLE 8. (continued)

Map Area	Soil Unit
B. Nearly level closed basins or bottomlands	
Well-drained soils underlain by somewhat consolidated sediments	
Silty.	Unit 26
Clayey	Unit 25
Somewhat poorly drained soils	
Clayey	Unit 31
Clayey (silty surface)	Unit 41
Loamy (alkali).	Unit 43
Poorly drained soils	
Very clayey.	Unit 30
C. Grass-shrub covered lava plateau uplands (basaltic, rhyolitic and tuffaceous bedrock)	
Shallow, light-colored stony soils[c/]	
Loamy, very stony	Unit 75
Loamy, extremely stony.	Unit S75
Loamy, somewhat stony	Unit 75L
Loamy, (very shallow and rocky)	Unit 77
Clayey, very stony	Unit 76
Clayey, extremely stony	Unit S76
Clayey, somewhat stony	Unit 75L
Deep, wind-deposited, light-colored soils	
Loam-silt loam	Unit 79
Recent, bare lava flows	Unit 99
D. Canyonlands, strongly dissected sediments, and mountainous uplands	
Moderately dark colored soils at higher elevations	
Moderately deep, loam silt loam	Unit 82
Shallow, loamy to clayey, very stony.	Unit 83
Very shallow, loamy, rocky.	Unit 84
Light colored soils on soft sediments.	
Moderately deep, fine loamy or silty.	Unit 60

Table 8 -Cont'd-

TABLE 8. (continued)

Map area	Soil Unit
Miscellaneous land units	
Soft raw sediments, sloping to moderately steep . .	Unit 94
Soft raw sediments, steep (badlands)	Unit 98
Steep rockland (cliffs, escarpments, talus slopes).	Unit 96
(Units 75 and 76 on steeper slopes are included in these map areas.)	

a/ Some series and units occur in more than one physiographic division. Soils are indicated in the division of their main occurrence.

b/ Textures given refer to subsoils. c/ Unless otherwise indicated.

Table 8 ·Cont'd·

TABLE 9. SUMMARY OF RANGE IMPROVEMENTS IN THE NORTHERN MALHEUR EAR AREA

Improvement Type	Number of Projects	Remarks
Reservoirs	521	1,365,437 cu. yds.
Springs	434	
Wells	21	
Pipelines	37	Total length 167.2 miles. 185 new waters
Guzzlers	12	
Seedings	61	112,415 acres
Brush Controls	29	155,153 acres
Fences	373	Total length 1351.7 miles plus 21 enclosures
Corrals	4	
Cattleguards	220	
Truck Trails	43	Total length 308.9 miles

Table 9

TABLE 10. GRAZING ALLOTMENTS IN THE NORTHERN MALHEUR EAR AREA

Number and Name	EAR Acres Total	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Operations
0101 Alkali Spring	72,851	8,289	--	13
0102 Cottonwood Mtn.	36,439	4,606	--	7
0106 Jamieson	432	130	--	1
0107 Grove Road	4,593	820	--	1
0108 Golden Eagle Mine	2,201	188	--	1
0109 Bridge Creek	480	48	--	1
0110 Reserviour Butte	12,100	2,215	--	1
0111 Lyman Creek	2,820	248	--	1
0112 Ironside Mtn. West	4,644	664	--	1
0113 Boston Horse Camp	2,307	740	--	1
0114 Ironside Mtn. East	15,860	1,052	--	1
0115 Cow Valley	30,521	4,206	--	1
0116 East Moores Hollow	5,002	635	--	1
0117 Becker Creek	8,898	3,989	--	1
0119 Lost Valley	5,530	1,457	--	1
0120 Boswell Spring	6,084	487	--	1
0121 Middle Willow Creek	3,223	304	--	1
0122 Sheep Corral Creek	8,602	1,043	--	1
0123 Wickiup Gulch	5,692	418	--	1
0124 Bridge Bulch	4,070	728	--	1
0125 Phipps Creek West	3,139	291	--	1

TABLE 10. GRAZING ALLOTMENTS IN THE NORTHERN MALHEUR EAR AREA

Number and Name		EAR Acres Total	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Operations
0127	Thorn Flat	3,858	1,074	--	1
0129	Dry Gulch	2,105	342	--	1
0130	Malheur City	9,844	2,601	--	1
0131	Baldy Mtn.	14,201	2,318	--	1
0133	Kinett	2,657	541	--	1
0134	Juniper Mtn.	2,799	403	--	1
0135	Dry Creek	3,958	1,484	--	1
0136	King Field	3,412	305	--	1
0137	Phipps Creek (East)	3,370	493	--	1
0138	Boulder Creek	5,271	1,252	--	1
0139	Phipps Creek (North)	6,299	1,303	--	1
0140	Cottonwood Creek	1,441	179	--	1
0141	Ferriens Gulch	4,560	771	--	1
0142	Ironside School	1,253	125	--	1
0143	Alden Creek	4,446	680	--	1
0144	Coin Creek	3,600	920	--	1
0145	Bridge Creek (East)	5,550	1,018	--	1
0148	Brogan Canyon	5,516	987	--	1
0149	Wheel Gulch	2,024	203	--	1
0150	Butterfield Springs	5,218	616	--	1
0151	Canyon Creek	1,904	250	--	1
0153	South Willow Creek	6,528	397	--	1

Table 10 -Cont'd-

TABLE 10. GRAZING ALLOTMENTS IN THE NORTHERN MALHEUR EAR AREA

Number and Name		EAR Acres Total	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Operations
0156	Ironside Mtn. (South)	3,807	419	--	1
0157	Stripe Mtn.	5,690	1,108	--	1
0201	Allotment #2	91,582	12,255	--	6
0202	Allotment #3	109,942	15,107	--	6
0203	Allotment #4	64,994	6,702	--	6
0204	Allotment #6	26,008	2,222	--	5
0205	Rail Canyon	26,013	3,040	--	1
0206	De Armond Mtn.	17,508	2,458	--	1
0207	Murphy	29,935	4,383	--	1
0208	Ringe Butte	3,680	876	--	1
0209	Oregon Canal	5,050	83	--	1
0210	Clover Creek	26,100	3,779	--	1
0211	Castle Rock	24,914	3,293	--	1
0212	Butte Tree	2,880	464	--	1
0213	North Fork	1,520	251	--	1
0214	Richie Flat	25,699	6,204	--	1
0215	Little Malheur	5,560	1,014	--	1
0216	Petes Mtn.	5,045	901	--	1
0217	Beulah Reserviour	44,504	9,121	-	1
0219	Malheur River	1,720	440	--	1
0220	Clevenger Butte	9,380	1,090	--	1

Table 10 -Cont'd-

TABLE 10. GRAZING ALLOTMENTS IN THE NORTHERN MALHEUR EAR AREA

Number and Name		EAR Acres Total	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Operations
0221	Lost Creek	9,412	1,716	--	1
0222	Willow Basin	30,851	5,931	--	1
0223	Lava Ridge	14,134	1,759	--	1
0224	Lockhart Mtn.	4,160	415	--	1
0225	Chukar Park	1,080	211	--	1
0226	Cottonwood Creek	3,871	351	--	1
0227	Westfall	800	126	--	1
0228	Scratch Post Butte	7,480	681	--	1
0229	Road Gulch	5,812	646	--	1
0233	Squaw Butte	2,320	467	--	1
0244	Post Creek	4,420	1,231	--	1
0301	Harper Area of Use	152,414	16,002	--	7
0302	Star Mtn.	149,381	19,852	--	6
0303	Crowley	111,880	12,824	--	1
0304	Black Butte	63,964	9,349	--	3
0305	Bridge Creek	13,730	1,613	--	1
0306	Jonesboro	28,210	3,788	--	1
0307	Boney Basin	24,697	4,089	--	1
0401	Keeney Creek	62,462	6,057	--	3
0402	North Harper	33,246	3,292	--	13
0403	Nyssa	75,098	6,972	--	7

Table 10 -Cont'd-

TABLE 10. GRAZING ALLOTMENTS IN THE NORTHERN MALHEUR EAR AREA

Number and Name		EAR Acres Total	Active Grazing Qualif. (AUMs)	Suspended Grazing Qualif. (AUMs)	Number of Operations
0404	Freezeout	118,286	13,467	--	6
0405	Wallrock	105,402	11,870	--	2
0406	Quartz Mountain	106,776	9,015	--	1
0407	Little Valley	16,518	1,364	--	2
0408	Mitchell Butte	2,977	112	--	1
0410	Radar Hill	7,768	705	--	1
0412	Chalk Butte	480	144	--	1
0413	Vale Butte (South)	600	87	--	1
0501	Blackjack	15,810	1,397	--	4
0502	Derrick	3,350	280	--	1
0503	Three Fingers	202,047	20,050	--	10
0504	Spring Mountain	29,137	4,753	--	10
0505	McCain Springs	29,156	4,025	--	9
0506	Henry Allotment	3,180	202	--	1
	TOTAL --------	2,307,832	290,873		205

TABLE 11. 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 plant.
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 11

TABLE 12. 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 12

TABLE 13 - Crude Oil Spills During Oil and Gas Development and Production Activities in Five Western States in 1972

State	Total Reported	Total Barrels Spilled[1]	Average-Number of Barrels per Spill	Wells in Production[2]	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

Table 13

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 Northern Malheur Resource Area 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 zonging ordinance is not included in this reproduction of the Northern Malheur Resource Area 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 8/17/73).

APPENDIX E

GEOTHERMAL ORDINANCE FOR MALHEUR COUNTY

This geothermal ordinance is not included in this reproduction of the Northern Malheur Resource Area 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 6/20/74).

APPENDIX F

Letters soliciting comments on environmental impacts of geothermal and of oil and gas leasing in the Northern Malheur Resource 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 (Northern
Malheur E.A.R.)

Dear Sirs:

-- INVITATION TO PARTICIPATE --

The Vale District Office of the Bureau of Land Management is in the process of writing an environmental assessment record (EAR) on the effects of geothermal leasing and development and the effects of oil and gas leasing and development on federal lands within the areas outlined on the enclosed map, but excluding those lands previously covered by BLM EAR's.

Comments from the public and input from local, state and federal agencies and academic institutions are requested and will be used to aid in the determination of possible environmental impacts as a result of the proposed geothermal and oil and gas leasing programs or subsequent resource development practices. Factors which the EAR will consider include air, land, water, terrestrial and aquatic plants and animals, ecological processes, landscape character, socio-economic interests, and others.

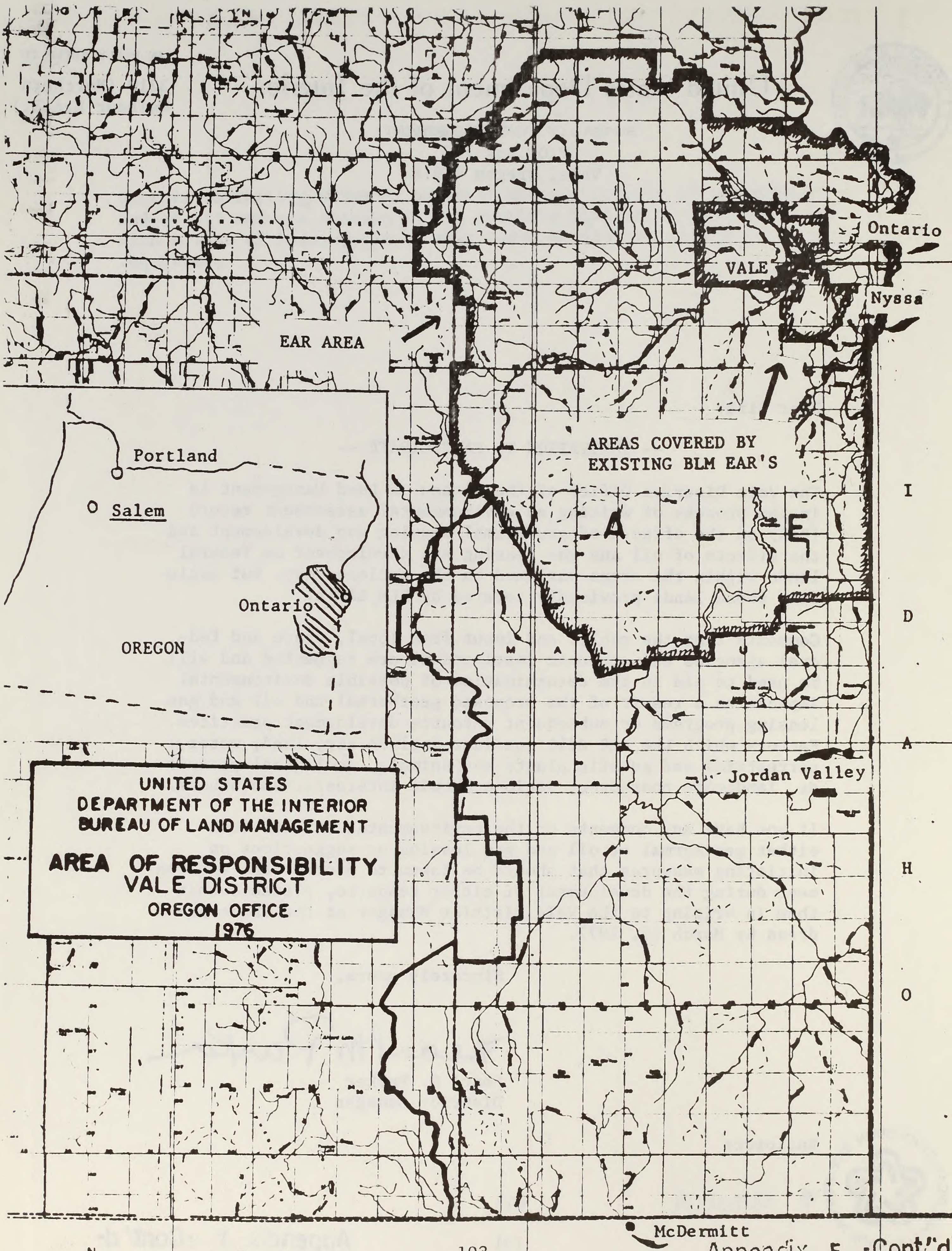
If you have any comments on the environmental effects from either geothermal or oil and gas leasing or suggestions on initiating measures that should be taken to protect the environment during the development of either resource, please submit them in writing to the Vale District Manager at the above address by March 15, 1977.

Sincerely yours,

Fearl M Parker

Fearl M. Parker
District Manager

Enclosure



Appendix F -Cont'd

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American Legion
Harold Ward, Commander
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Malheur County National Farmer's Organization
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Alfred Potterff
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Appendix F - Cont'd-

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Miller Forestn Institute
Dr. Richard Miller, Director
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National Park Service
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Bert L. Cole, Commissioner
Public Lands Building
Olympia, WA 98501

Natural Resources, Department of
Division of Geology & Earth Resources
Ted Livingston
Olympia, WA 98504

Nature Conservancy
Oregon Chapter
1234 N. W. 25th Avenue
Portland, OR 97210

Nevada Association for Progressive Fish & Game Legislation
Russel D. Thodic
685 E. York Street
Sparks, NV 89431

North Board of Control
17 S. 1st
Nyssa, OR 97913

Ontario Basque Club
Dolores Echinia, President
130 S. W. 13th
Ontario, OR 97914

Ontario Heights Grange
Leo Tarhida
Ontario Heights
Ontario, OR 97914

Ontario Study Club
Mrs. Lewis Bean, President
748 S. W. 4th
Ontario, OR 97914

Optimists
Ron McKone
Ontario Heights
Ontario, OR 97914

Oregon Association of Soil & Water Conservation Districts
Stanley R. Christensen, President
Route 1, Box 264
McMinnville, OR 97128

Oregon Cooperative Wildlife
Research Unit, USDI
Bioscience Building
Oregon State University
Corvallis OR 97331

Oregon Environmental Council
Lawrence F. Williams, Executive Director
2637 S. W. Water Avenue
Portland, OR 97201

Oregon Environmental Quality, Department of
P. O. Box 231
Portland, OR 97205

Oregon, Governor of
Robert W. Straub
208 State Capitol
Salem, OR 97310

Oregon High Desert Study Group
Colleen Cooding, Coordinator
Box 25
Saint Paul, OR 97137

Oregon Historical Society
1230 S. W. Park Avenue
Portland, OR 97205

Oregon, State of
Department of Geology & Minerals Industries
Baker Field Office
2033 First Street
Baker, OR 97814

Oregon, State of
Department of Geology & Minerals Industries
Raymond E. Corcoran, State Geologist
1069 State Office Building
Portland, OR 97201

Oregon, State of
Division of State Lands
William S. Cox, Director
1445 State Street
Salem, OR 97310

Oregon, State of
Division of State Lands
20 Agriculture Building
Salem OR 97310

Oregon, State of
Division of State Lands
155 Court Street South
Vale, OR 97918

Oregon, State of
Department of Forestry
2600 State Street
Salem, OR 97310

Oregon State Game Commission
Cecil Langdon
Route 1
Ontario, OR 97914

Oregon State Wildlife Commission
John W. McKean, Director
P. O. Box 3503
Portland, OR 97208

Appendix F -Cont'd-

Oregon Statesman
City Desk
Statesman-Journal Company
Salem, OR 97301

Oregon Student Public Interest
Research Group (OSPIRG)
Steve McCarthy
408 S. W. 2nd Street
Portland, OR 97204

Outdoor Recreation, Bureau of
Pacific NW Regional Office
1000 Second Avenue
Seattle, WA 98104

Pacific NW Forest & Range Experiment Station
P. O. Box 3141
Portland, OR 97208

Pacific Power and Light
920 SW 6th Street
Portland, OR 97208

Packwood, Robert W. (Senator)
6327 New Senate Office Building
Washington, D. C. 20510

Park Improvement Club
Mrs. Barbara Lee
Route 2
Ontario, OR 97914

Payette Municipal Development Corporation
Art Kinney, President
Box 159
Payette, ID 83661

Payette School Board
D. Waine, Chairman
2033 Decker Drive
Payette, ID 83661

Payette Shrine Club
Mr. Cecil McWilliams
338 North 4th
Payette, ID 83661

Phillips Petroleum Company
P. O. Box 752
Del Mar, CA 92014

Pressley, George (Mayor)
372 Clark Street South
Vale, OR 97918

Realty, Baker City
130 S. W. 2nd Avenue
Ontario, OR 97914

Realty, Cunningham
301 A Street East
Vale, OR 97918

Realty, Deely, Inc.
192 SW 3rd Avenue
Ontario, OR 97914

Realty, Flying
Kenneth Johnson
Box 606
Vale, OR 97918

Realty, Grigg & Tax Service
Dick Grigg
Box D
Vale, OR 97918

Realty, Paul Parker
11 S. W. 3rd Avenue
Ontario, OR 97914

Reclamation, Bureau of
John Welch, Realty Specialist
Boise, ID 83724

Reclamation, Bureau of
Central Snake Projects Office
214 Broadway Avenue
Boise, ID 83702

[illegible]
College of Idaho
Caldwell, ID 83605

Register Guard
10th & High Streets
Eugene, OR 97401

Republic Geothermal, Inc.
11843 East Washington Boulevard
Whittier, CA 90606

Reynolds Metal Company
Wilson D. Michell
Assistant Chief Geologist
Richmond, VA 23218

Roehr, Wesley O. (Mayor
1018 N. 6th
Payette, ID 83661

Rotary Club
Jack Frost, President
1286 Frost Way
Ontario, OR 97914

Runnells, John S.
1150 North Lake Road
Lake Forest, IL 60045

Schlapfer, T. A., Regional Forester
Forest Service, USDA, Region 6
P. O. Box 3623
Portland, OR 97208

School, Alameda Elementary
James Calloway, Principal
1252 Alameda Drive
Ontario, OR 97914

School, Cairo Elementary
Nick Eddy
Route 1
Ontario, OR 97914

School, District #1
Brogan, OR 97903

School, District #1
Mrs. Alberta Shook, Principal
Jordan Valley, OR 97910

School District #2
Miss Sandra Mayfield
Rockville Route
Marsing, ID 83639

School, District #8C
Mike Irons
497 S. W. 3rd Avenue
Ontario, OR 97914

School, District #12
Mr. Denzel Weeks
Juntura, OR 97911

School, District #15
Edwin Morgan, Superintendent
604 Cottage Street South
Vale, OR 97918

School, District #26
Walter L. McParland
Nyssa, OR 97913

School, District #29 - Annex
Howard J. Stone
Route #3
Weiser, ID 83672

School, District #42
Mel Wiseman, Principal
Route 2
Vale, OR 97918

School, District #51
McDermitt, NV 89421

School, District #61 - Adrian
Glenn E. Ward
Adrian, OR 97901

School, District #66 - Harper
Lee Matthews
Harper, OR 97906

School, District #81 - Arock
Mrs. Sandra Dowell
Arock, OR 97902

School, Aiken, George Elementary
Robert Patterson
1297 West Idaho Avenue
Ontario, OR 97914

School, Elementary
James Bolton
Adrian, OR 97901

School, Junior High
Don Martin, Principal
Nyssa, OR 97913

School, Junior High
Eugene Bates, Principal
337 S. W. 2nd Avenue
Ontario, OR 97914

School, Lindberg Elementary
482 Southeast Third
Ontario, OR 97914

School, Middle
Frank Deymonaz
Vale, OR 97918

School, Nyssa Elementary
Melvin Munn, Principal
Nyssa, OR 97913

School, May Roberts Elementary
Alvin Hicks, Principal
370 N. W. Eighth
Ontario, OR 97914

School Superintendent
Malheur County
251 B. Street West
Malheur County Courthouse
Vale, OR 97918

School, Senior High
Gene Chester
Nyssa, OR 97913

School, Senior High
Gary Wells
1115 West Idaho Avenue
Ontario, OR 97914

School, Union High, District #1
Eugene Mills
Jordan Valley, OR 97910

School, Union High, District #3
Gerald Cammon, Principal
Vale, OR 97918

School, Vale Elementary
Sole Staley, Librarian
604 Cottage Street South
Vale, OR 97918

Senior Citizens
Erma Sparks
Nyssa, OR 97913

Sierra Club
Middle Snake Group
Jack Warvick
2607 Holden Lane
Boise, ID 83705

Sierra Club
Oregon Chapter
2637 S. W. Water Street
Portland, OR 97208

Snake River Gem Club
O. J. Elliot, President
715 North 6th Street
Payette, ID 83661

Soil Conservation Service
P. O. Box 339
Ontario, OR 97914

Soil Conservation Service
Technical Service Center
701 N. W. Glisan
Portland, OR 97209

Soil Conservation Service
A. J. Webber, State Conservationist
1218 S. W. Washington
Portland, OR 97205

South Board of Control
Homedale, ID 83628

Southeast State Wildlife Commission
Box 8
Hines, OR 97738

Sport Fisheries & Wildlife, Bureau of
P. O. Box 3737
Portland, OR 97208

State Clearing House
Salley Reagan
240 Cottage Street, N. E.
Salem, OR 97310

State Engineer
Chris L. Wheeler
1178 Chemeketa Street, N. E.
Salem, OR 97310

State Highway Division
State Highway Building
Salem, OR 97310

State Highway Division
Environmental Section
Donald R. Byrad, Environmental Director
State Highway Building
Salem OR 97310

State Highway Division
State Parks & Recreation Section
David G. Talbot, Superintendent
Salem OR 97310

State Soil & Water Conservation Commission
Bud F. A. Sylberg, Director
217 Agriculture Building
635 Capitol Street, N. E.
Salem, OR 97310

Survival Center
Curt Kutey
Suite 1, EMU
University of Oregon
Eugene, OR 97403

T. V. Kiwanis Club
Dan Crosswhite, President
606 North 8th
Payette, ID 83661

Thermal Resources, Inc.
39 Broadway, 31st Floor
New York, NY 10006

Thiel, Mary, Manager
Day Care Center for Migrant Children
Adrian, OR 97901

Appendix F -Cont'd-

Times-Herald
P. O. Box 473
Burns, OR 97720

Toastmasters Club
Mrs. LaVerne Sheil
Nyssa, OR 97913

Treasure Valley Motorcycle Club
Steve Shake
Route 1
Fruitland, ID 83619

Treasure Valley Rock & Gem Club
John Waggoner
New Plymouth, ID 83655

U. S. Department of the Interior
Regional Solicitor
P. O. Box 3621
Portland, OR 97208

U. S. Geological Survey
James H. Robinson
Ground-Water Hydrologist
Water Resources Division
P. O. Box 3202
Portland, OR 97208

U. S. Secretary of the Interior
Roy Sampsel, Special Assistant
P. O. Box 3621
Portland, OR 97208

Ullman, Al (Representative)
2410 Rayburn House Office Building
Washington, D. C. 20515

Union Geothermal Division
Courtney Isselhardt, Geologist
Union Oil Company of California
P. O. Box 6854
Santa Rosa, CA 95406

Union Oil Company of California
P. O. Box 7600
Los Angeles, CA 90051

United Press International
Christine Moore
Route 1, Box 215
Vale, OR 97918

Vale Grange
Orville Nichols
Vale, OR 97918

Vale-Warmsprings Irrigation District
318 A. Street West
Vale, OR 97918

Washington State Sportsmens Council
Howard E. Nelson, Secretary
Box 569
Vancouver, WA 98660

Water Resources Board
Fred D. Gustafson, Director
1158 Chemeketa Street, NE
Salem, OR 97310

Waters, George W.
124 Rumson Road
Rumson, NJ 07760

West and Southern Mining Company
Box 831
Weiser, ID 83672

Westberg, Bart, Mayor
Weiser, ID 83672

Wildlife Management Institute
William B. Morse
1617 N. W. Brazee
Portland, OR 97212

Willowcreek Grange
Charles Rettig, Master
Vale, OR 97918

Women's Civic League
Mrs. Millie Phillips
1140 Second Avenue South
Payette, ID 83661

Women's Club of Vale
Mrs. Walter Berkley
Box 174
Vale, OR 97918

Woodward-Clyde-Sherard & Associates
Phillip Birkhahn
346 Kurtz Street
San Diego, CA 92110

Yturri, Frank
Malheur County District Attorney
Vale, OR 97918

Appendix F -Cont'd-

Terry Black
McDermitt,
Nevada 89421

J. A. Daly
Echo River Trips-The Wilderness Co.
6505 Telagraph Avenue
Oakland, California 94609

Joe Fousmeire
Wilderness River Outfitters and
Trail Expeditions, Inc.
P. O. Box 871
Salmon, Idaho 83467

Lucille Gulick
7555 Ashwood Way
Sacramento, California 95822

Dave Helfrich
White Water River Trips
Vida, Oregon 97488

L. R. Kopcinski
P. O. Box 128
Mitchell, Oregon 97750

Vladimir Kavalik
Wilderness Road
1342 Jewell Avenue
Pacific Grove, California 93950

Manager
McDermitt Mine
P. O. Box 101
McDermitt, Nevada 89421

Junerwanda J. Papaéliou
P. O. Box 1601
Sacramento, California 95807

A. E. Pielenz
P. O. Box 4
McDermitt, Nevada 89421

Bob Sevy
Sevy Bros. Guide Service, Inc.
P. O. Box 164
Sun Valley, Idaho 83353

W. B. Schlupe
Land Title Escrow Company
70 S.W. Third Avenue
Ontario, Oregon 97914

Appendix F -Cont'd-

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
NORTHWEST REGION
915 SECOND AVENUE, RM. 990
SEATTLE, WASHINGTON 98174

IN REPLY REFER TO: 3444

RECEIVED MAR 3 1977 U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT Oregon

MAR 1977

Memorandum

To: District Manager, Vale District, Bureau of Land Management

From: Regional Director, Northwest Region, Bureau of Outdoor Recreation

Subject: Northern Malheur E.A.R.

This is in response to your letter of February 15th inviting comment on the effects of geothermal, oil or gas leasing and development on certain lands located in and around the Ontario-Vale area of Oregon.

From the delineations shown on the map that accompanied your letter, the area under consideration for leasing includes a segment of the Owyhee River upstream from Owyhee Reservoir which is currently being evaluated for possible addition to the National Wild and Scenic Rivers System. The study, as provided for in P.L. 90-542, as amended, includes the Owyhee River downstream to the slack water of the Owyhee Reservoir. The study is under the overall direction of this office. Field work has been completed and we expect a draft report and draft EIS to be released for review and comment within a few months. Our tentative findings and recommendations are that the entire 192 miles under study qualify for inclusion in the National System and should be added under BLM and State of Oregon administration.

It is important that any actions to lease lands for geothermal, oil or gas purposes include careful consideration of the possible environmental effects on the study segment of the Owyhee River. In addition, section 9(b) of P.L. 90-542, copy enclosed, stipulates that lands located within one-quarter mile of study rivers are withdrawn from all forms of appropriation under the mining and mineral laws until Congress has had the opportunity to consider them for addition to the National System.

Maurice H. Lundy
Maurice H. Lundy
Regional Director

Enclosure

ECEIVED

MAR 4 1977

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Oregon

State of Washington
Department of ...

March 2, 1977

Fearl M. Parker
District Manager
Bureau of Land Management
U. S. Department of the Interior
P. O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

I am responding to your letter of February 15, 1977, to Governor Ray concerning the Northern Malheur E.A.R.

Because of the location of this project, the State of Washington would appear to have no interest in any resulting environmental impact.

Sincerely,

Wesley A. Hunter
Acting Director

WAH:kb

Appendix F -Cont'd-

RECEIVED

MAR 10 1977

U.S. DEPARTMENT OF THE INTER
BUREAU OF LAND MANAGEMENT
Oregon

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Malheur National Forest
139 N. E. Dayton Street
John Day, Oregon 97845

2820
March 7, 1977

Fearl M. Parker, District Manager
Bureau of Land Management
P.O. Box 700
Vale, OR 97918

Dear Mr. Parker:

I am in receipt of our "Invitation to Participate" in the writing of an E.A.R. on the effects of geothermal leasing and development.

Could you please send me a clear map of that area and those Federal lands involved in this E.A.R.?

It would be helpful to have this map prior to trying to respond to your request by March 15, 1977.

Sincerely,

for Richard C. Dearsby

DAN E. WILLIAMS
Forest Supervisor

6200-11 (1

ROBERT W. STRAUB
GOVERNOR

Department of Transportation

STATE HISTORIC PRESERVATION OFFICE

Parks and Recreation Branch

525 TRADE STREET S.E., SALEM, OREGON 97310

RECEIVED
MAR 10 1977
U.S. DEPARTMENT OF THE INTER
BUREAU OF LAND MANAGEMEN
Vale, Oregon

March 7, 1977

Mr. Fearl M. Parker
District Manager
Bureau of Land Management
POBox 700
Vale, OR 97918

Dear Mr. Parker:

This letter is in response to your request for information on cultural resources for geothermal and oil and gas leasing on BLM lands in your district.

This office would recommend that the E.A.R. being prepared for this area contain provisions for compliance with Public Law 89-665, N.E.P.A. and Executive Order 11593.

We know the Vale District is extremely rich in cultural resources, both historic and archeologic. Adequate cultural resource surveys are needed for any areas where ground-disturbing activities are to take place. This office should then be given the opportunity to review and comment on the results of these surveys.

Sincerely,

Paul B Hartwig

Paul B. Hartwig
Historic Preservation Coordinator

EL:ko

Appendix F -Cont'd-

1 6 1977
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Oregon

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

March 11, 1977

MEMORANDUM

To : District Manager, Bureau of Land Management, Vale, Oregon

From : Field Supervisor, Fish and Wildlife Service, Portland, Oregon

Subject: Effects of Geothermal and Oil and Gas Leasing in the Vale Area (Your Reference 3210--Northern Malheur E.A.R.)

We have received your request of February 15, 1977 regarding comments on the environmental effects of proposed geothermal and oil and gas leasing in the Vale area.

The area depicted on the map enclosed with your request is quite large, making accurate analysis of possible effects difficult. In general, there are fair numbers of wildlife species inhabiting the area including antelope, chukar, sage grouse, deer, wild horses, and burros. Many reptiles and small nongame mammals and birds are also found in the area. Fish species present within the proposed lease boundaries include native redband trout, rainbow trout, smallmouth and largemouth bass, black crappie, channel catfish, and rough fish species such as carp and suckers. A list of rare and endangered plants found in the Vale area is attached for your information.

The environmental effects of geothermal and oil and gas development on the above mentioned fish and wildlife resources will vary by species and with the intensity of the development. Any development within sensitive areas such as sage grouse strutting grounds, antelope kidding grounds, or redband spawning areas will negatively affect the success of reproduction. While it is true that reduction in habitat will always affect animal populations to some degree, over the long term this elimination of small habitat areas can lead to significant reductions in carrying capacity with correspondingly severe fish and wildlife losses.

Activities which accelerate this habitat loss include improper road construction, increased recreational use, and ill-managed drilling practices which can lead to blowouts and/or erosion. Geothermal fluids as well as oil can have severe toxic effects on fish and wildlife populations if accidental spills or improper storage in sumps occurs.

CONSERVE AMERICA'S ENERGY

Appendix F -Cont'd-

Save Energy and You Serve America!

Because of the lack of specificity regarding lease sites, we can offer only general recommendations regarding protection of fish and wildlife resources. We would recommend that 1) new road construction be kept to a minimum, 2) all abandoned areas be reseeded with those vegetative species which were present prior to exploration if at all possible, 3) precautions be taken to avoid sensitive reproductive areas during exploration and/or development, and 4) special precautions be taken to avoid work in those areas which have become increasingly susceptible to erosion because of this year's low water conditions.

Please contact us if you have any additional questions regarding our recommendations.

John W. Kincheloe

Attachments

Rare and Endangered Plants

Dr. Patricia Packard's 1976 report on plant species in Malheur County, distributed by the Vale District Office of BLM contains the most recent information on many of the rarer species in Malheur County. Many of these species are known to be within the area on which this EAR is being prepared. Dr. Packard's work should be carefully consulted. It is particularly useful since, in many instances, specific locations are given for the species.

In addition to Dr. Packard's findings, we are including species which are likely to be found in the EAR area because they are known to be elsewhere in Malheur County or in neighboring counties in habitats similar to those present within the EAR area. There are also two species not in Dr. Packard's report which are known to be within the EAR area.

Likely to be in Area

1. Lomatium minus
2. Artemisia sp.
3. Luina serpentina
4. Hackelia hispida
5. H. ophiobia
6. Allium punctum
7. Ranunculus andersonii
8. Heuchera grossularifolia, var. grossularifolia
9. Penstemon seorsus

Known to be in EAR Area

1. Hackelia patens var. semiglabra
2. Thelypodium howellii, var. spectabilis

Following is an excerpt from:

TOTAL LISTING OF ALL R & E PLANTS ON SIDDALL/RNA/CHAMBERS/SMITHSONIAN LISTS

This summary is an attempt to bring together in one place the R & E plant lists presently available for Oregon for the purpose of determining concurrences and differences in the lists. It is intended as a worksheet, - a starting point, and is based on the following lists as originally typed. It does not reflect changes which have been made or are constantly being made.

Based on: Siddall list - Oct. 1974 (compiled for RNA Committee)
RNA listings by physiographic provinces - RNA Needs of the Pacific Northwest (extracted from Siddall list with additions from Smithsonian Institution list)
Kenton Chambers list - April 1974 (being compiled for R & E Plants and Animals of Oregon)
Smithsonian Institution List of Jan. 1975, publ. in July 1, 1975 Fed.Reg.

A legend is attached at the end of the worksheet.

Family/Species	Smith. status	Siddall Status	Siddall Group	RNA Prov.	Chambers Status	Comments
APIACEAE (Umbelliferae)						
Lomatium minus	E	R	IIb	CB	Poorly known	Scablands, e.OR.
ASTERACEAE						
Artemisia sp.(Three-forks)	-	R	Ia	-	Endemic	K.o.f.3-forks,OwyheeR.
Luina serpentina	T	R	Ia	CB	Endemic	Grant Co;serpentine
BORAGINACEAE						
Hackelia hispida	T+Wn,Ida	R	Ib	OBW	SnakeR.end.	Vicin.Snake River
H. ophiobia(in press)	E	R	Ia	OU	Endemic	3-Forks,OwyheeR.,Malh.
H. patens var.semiglabra	-	R	Ia	OU	-	Local,Malh.Co.nrVale
BRASSICACEAE						
Thelypodium howellii var. spectabilis	T	(R)	(Ia)	-	-	K.o.f. Ironside,Malh. Co.(added 10/75 js)
LILIACEAE						
Allium punctum	-	R	Ib	BR	Prob.end.	BlitzenR.,Harney Co
RANUNCULACEAE						
Ranunculus andersonii	-	R(O)	III	BR	-	s.Lake/Malh Cos-Ariz
SAXIFRAGACEAE						
Heuchera grossularifolia var.grossularifolia	-	R	IIb	OBW	-	Snake R/Steens,Ida. Mont
SCROPHULARIACEAE						
Penstemon seorsus	-	R	Ib	HLP	Malh.-Ida	Crook/Malh/Harn-Ida

Worksheet "Legend"

Siddall status - R = Rare
R(O) = Rare in Oregon
T or Th = Threatened
E = Endangered
?Ext = Possibly extinct

RNA Province (Research Natural) -
CR = Coast Range (incl.coast)
WV = Willamette and "interior" valleys (Rogue, Umpq.)
Si = Siskiyous
WS = West Slope and Crest Oregon Cascades
ES = East Slope, Cascades
CB = Columbia Basin
OBW = Ochocos/Blues/Wallowas
HLP = High Lava Plains
BR = Basin and Range
OU = Owyhee Uplands

Other - Disj. = Disjunct
K.o.f., KOF = Known only from
End. = Endemic
Col.G. = Columbia River Gorge
Snake RC = Snake River Canyon
Umpq = Umpqua
Ill = Illinois

Counties:
Clat = Clatsop
Till = Tillamook
Wash. = Washington
Yamh = Yamhill
Linc = Lincoln
Doug = Douglas
Jos = Josephine
Jack = Jackson
Klam = Klamath
Desch = Deschutes
Jeff = Jefferson
Clack = Clackamas
Mult = Multnomah
Hood R. = Hood River
Sher = Sherman
Gill = Gilliam
Morr = Morrow
Umat = Umatilla
Harn = Harney
Malh = Malheur

Ia = Local endemics
Ib = Regional endemics
IIa = Wide range; plants scattered
IIb = Widely disjunct populations
III = Rare in Oregon, but occurs elsewhere where status unknown
IV = Unusual population

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

ADMINISTRATIVE OFFICE

1069 STATE OFFICE BLDG. • PORTLAND, OREGON • 97201 • Ph. (503) 229-55

~~TOM McCALL~~
~~GOVERNOR~~

OBERT W. STRAUB
GOVERNOR

FEB 25 1977

ARTMENT OF THE INTER
OF LAND MANAGEM

February 23, 1977

Mr. Fearl M. Parker
District Manager
U. S. Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

Thank you very much for the opportunity to provide input for the Vale District EAR on geothermal leasing and development. Since we submitted a report in February 1976 covering the same type of program, we feel that what was said in the report is still accurate.

Enclosed is a copy of the January 1977 Ore Bin covering geothermal activity in the State since our first report was submitted. This recent article should bring data from us up to the present.

Sincerely,

Vern Newton

Vernon C. Newton, Jr.
Geologist - Petroleum Engineer

VCN:bj
Encl.

JANUARY 1977
VOLUME 39, NO. 1

THE ORE BIN

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

ECEIVED
MAR 7 1977
ARTMENT OF THE INTERI
OF LAND MANAGEMENT
Oregon

John V. Evans
XXXXXXXXXXXXXXX
GOVERNOR

OFFICE OF ENERGY
STATE OF IDAHO
STATEHOUSE
BOISE, IDAHO 83720

EARL A. ADAMS
DIRECTOR
PHONE (208) 384-3258
384-3182

March 3, 1977

Mr. Fearl M. Parker, District Manager
Bureau of Land Management
United States Department of the Interior
P.O. Box 700,
Vale, Oregon 97918

Dear Mr. Parker:

Your letter of February 15, 1977 to the Hon. John V. Evans, Governor of Idaho, requesting participation in the Northern Malheur Environmental Assessment Record has been referred to this office.

At this time we have no specific comments for the record. However, because of the proximity of the area to Idaho we are interested in the potential impact of any proposed oil, geothermal or gas leasing. We would very much appreciate receiving a copy of the record when compiled and being kept informed of any proposed development in the area.

Thank you for your letter and assistance.

Sincerely,

Christopher L. Smith

Christopher L. Smith
Project Coordinator

CLS:p

Oregon High Desert Study Group

COLLEEN GOODING
COORDINATOR

POST OFFICE BOX 25 • ST. PAUL, OREGON 97137

March 10, 1977

Mr. Fearl M. Parker
District Manager
Vale BLM District Office
PO Box 700
Vale, Oregon 97918

RE 3210
Northern Malheur EAR

Dear Mr. Parker

The Oregon High Desert Study Group encourages geothermal development on high desert lands, such as the Vale Additions. However, we strongly oppose leasing and development along wild and scenic rivers, in Wilderness Area, Primitive Areas, Research Natural Areas, or in roadless areas with Wilderness or unique qualities as defined under the 1964 Wilderness Act.

Sincerely,

Colleen Gooding

Colleen Gooding, Coordinator

RECEIVED

APR 6 1977

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Malheur National Forest
139 N. E. Dayton Street
John Day, Oregon 97845

2820
April 1, 1977

W.R. Popworth
Assistant District Manager
Bureau of Land Management
P.O. Box 700
Vale, Oregon 97918

Dear Mr. Popworth:

We have no comments to make in respect to your E.A.R. on the effects of oil and gas leasing in the Northern Malheur Resource Area.

Sincerely,

for DAN E. WILLIAMS
Forest Supervisor

Appendix F -Cont'd-

6200-11 (1/69)

ROBERT W. STRAUB
GOVERNOR

Department of Fish and Wildlife

OFFICE OF THE DIRECTOR

1634 S.W. ALDER STREET, PORTLAND, OREGON 97208

March 23, 1977

RECEIVED
MAR 28 1977
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Vale, Oregon

Mr. Fearl M. Parker
District Manager
Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

Dear Mr. Parker:

In response to your request for comments on the environmental effects of geothermal, oil and gas leasing and development in the Vale area (3210 - Northern Malheur E.A.R.) we submit the following information for your consideration.

Wildlife values in much of the northern Malheur county area depicted on your attached map are very high. Exploration activities alone could have a significant impact on deer, antelope, chukars, sagegrouse and all species of non-game wildlife in certain areas.

Since your request did not address specific areas we cannot adequately assess all potential environmental problems that might develop. However, we ask that you work with our local field biologists when information on specific sites is available. Local contacts are Wayne Bowers and Cecil Langdon, both of Ontario, (889-6975).

We appreciate the opportunity to comment on this activity. If more information is required please let us know.

Sincerely,

Jerry MacLeod

JERRY MacLEOD
Staff Biologist
Environmental Management Section
JM:mw

THE NATURE CONSERVANCY

OREGON NATURAL HERITAGE PROGRAM

1234 NW 25th AVENUE · PORTLAND OREGON 97210 · 503·228·9550

RECEIVED
MAR 31 1977
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Oregon

March 28, 1977

Vale District Manager
Bureau of Land Management
P. O. Box 700
Vale, Oregon 97918

District Manager:

The following are comments submitted toward the BLM Environmental Assessment Record on the effects of geothermal leasing and development and the effects of oil and gas leasing and development for the Vale District Area of Responsibility (map attached).

Our Oregon Natural Areas Inventory has identified 10 potential natural area sites within the area (see also attached map):

MA-25 (ONHP Code) DAGO GULCH
S½NE¼ T 26S, R 45E
Disjunct relict stand of Ponderosa pine. (Surveyed 1976.)

MA-60 RUNAWAY HILL
Sec. NE¼SW¼ 9, T 26S, R 45E
Unusual herb/grass community on ash; several narrow endemic plant species. (Surveyed 1976.)

MA-2 JUNTURA NATIVE GRASSLAND
Sec. 10, SW¼ 11, N½ 15, T 21S, R 40E
Excellent, apparently undisturbed example of native grassland-bluebunch whatgrass/big sage community and smaller Idaho fescue community. (Surveyed 1976.)

MA-10 LESLIE GLUCH
Sec. 7, 8, 17, 18, T 26S, R 45E and Sec. 2, 3, 10, 11, T 26S, R 44E
Oldest rocks in Owyhee region here; fossils; thermal spring; geologic diversity; rare plants; forb communities on ash; bighorn sheep. (Surveyed 1976.)

MA-13, MA-45 SUCCOR CREEK STATE PARK AND RECREATION AREA AND ASH BEDS
Sec. 6, 7, W½W½ 8, 17, 20, 29, N½NW¼ 33, T 24S, R 46E;
Sec. S½ 5, T 26S, R 46E
Forb communities on ash; rare plants; geologic interest--gorge and ash beds; wildlife; archeologic interest--Indian relics. (Surveyed 1976.)

Appendix F -Cont'd-

MA-20 OWYHEE BRAKES AND HONEYCOMBS
Sec. E½ 25, W½NE¼ 36, N½SW¼ 36, S½ 35, T 24 S, R 44E;
Sec. N½NW¼ 2, N½ 3, T 25S, R 44E
Rare endemic plant species; mountain mahogany; geologic interest--rugged sparsely vegetated landscapes; endemic animal species. (Surveyed 1976.)

MA-35 BENDFIRE RIDGE SITE
Sec. N½ 36, T 18S, R 38E
Low sagebrush and Ponderosa pine/bitterbrush communities. (Not surveyed.)

MA-36 GRASSY MOUNTAIN
Sec. 16, T 22S, R 44E
Big sage/bluebunch wheatgrass community. (Not surveyed.)

MA-41 RED BUTTE CANYON
Sec. 27, 28, 33, 34, T 25S, R 43E; Sec. 2, 3, T 26S, R 43E
Rare reptile species: collared lizards, western ground snakes, leopard lizards, Great Basin whiptails, desert horned lizards.

In addition, as you already are aware, Jordan Craters Research Natural Area lies within the proposed geothermal leasing district. Leasing and development in this area should be especially considered to prevent any disruption of the natural area qualities.

Evaluating the effects of geothermal, oil and gas leasing and development on these potential natural area sites will be best done on a site-by-site basis, since the significant natural features (geology, vegetation, wildlife), the extent and the effects of development will vary with each location.

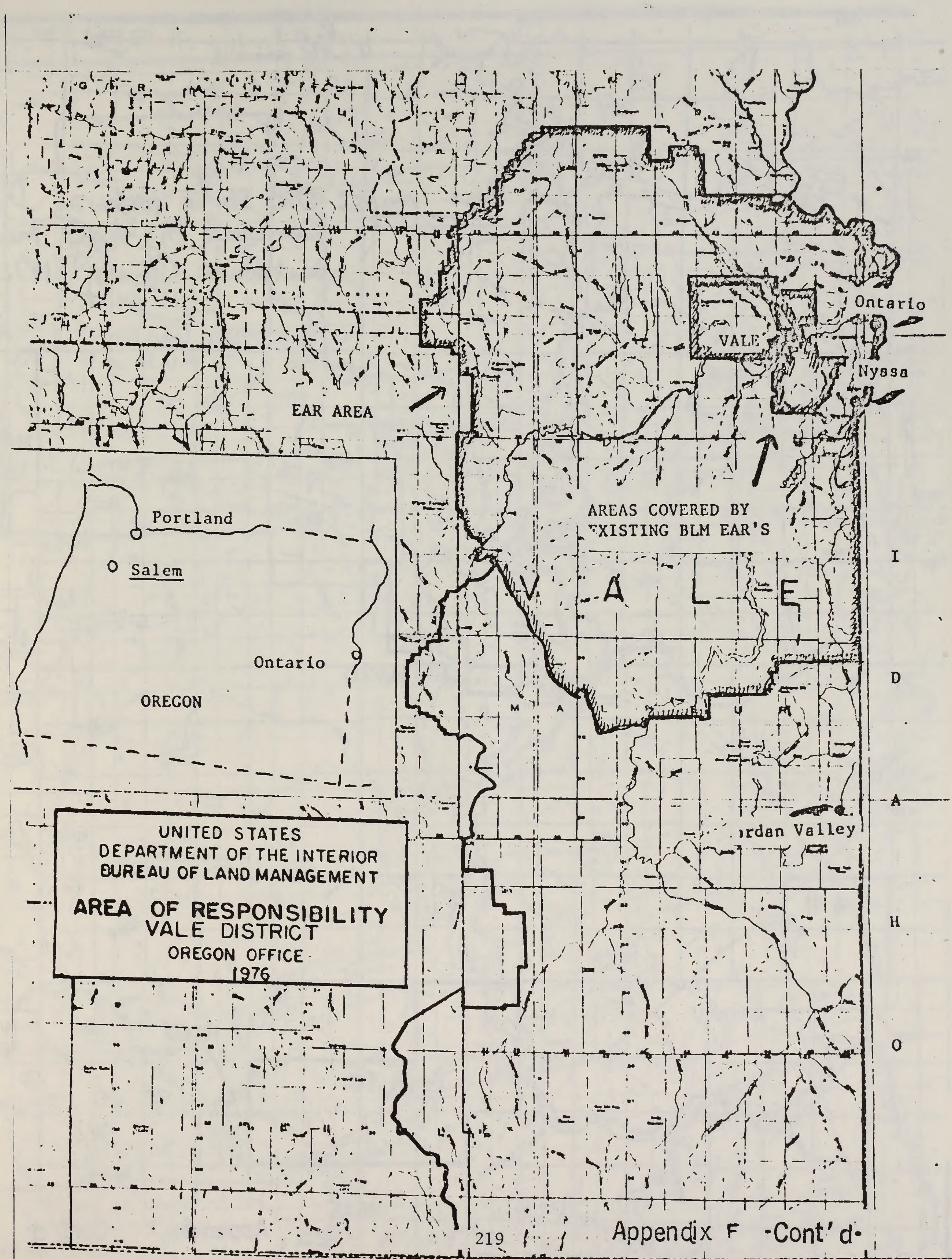
Our office would greatly appreciate the opportunity to provide further, more detailed information on these important potential natural areas, should geothermal, oil and gas developments be considered in their vicinity.

Lynn C. Cornelius
Lynn Cornelius
Staff Biologist

LCC:lfb

Encl.

Appendix F -Cont'd-



Ontario
VALE
Nyssa
EAR AREA
AREAS COVERED BY
EXISTING BLM EAR'S
Portland
Salem
V A L E
Ontario
OREGON
I
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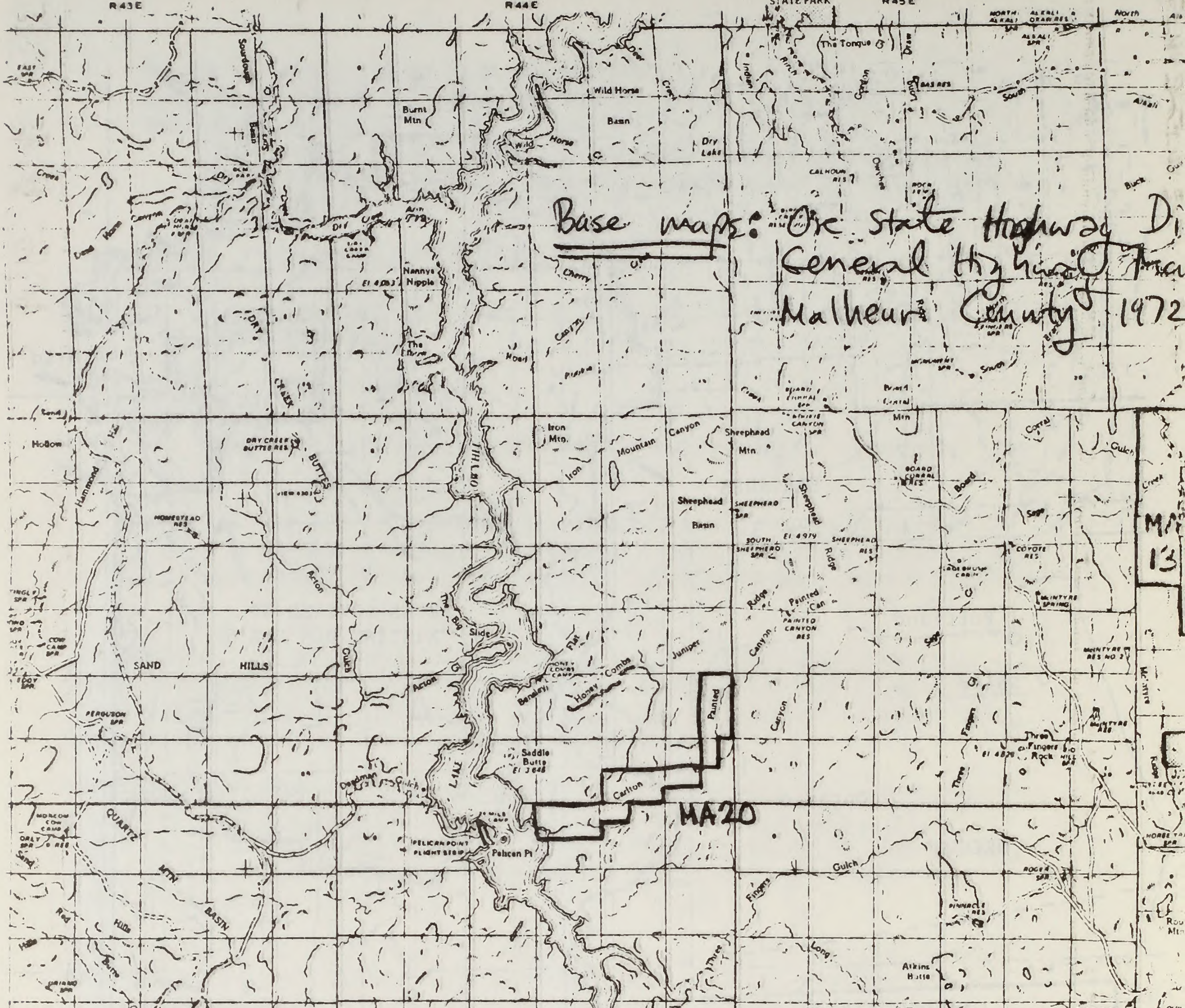
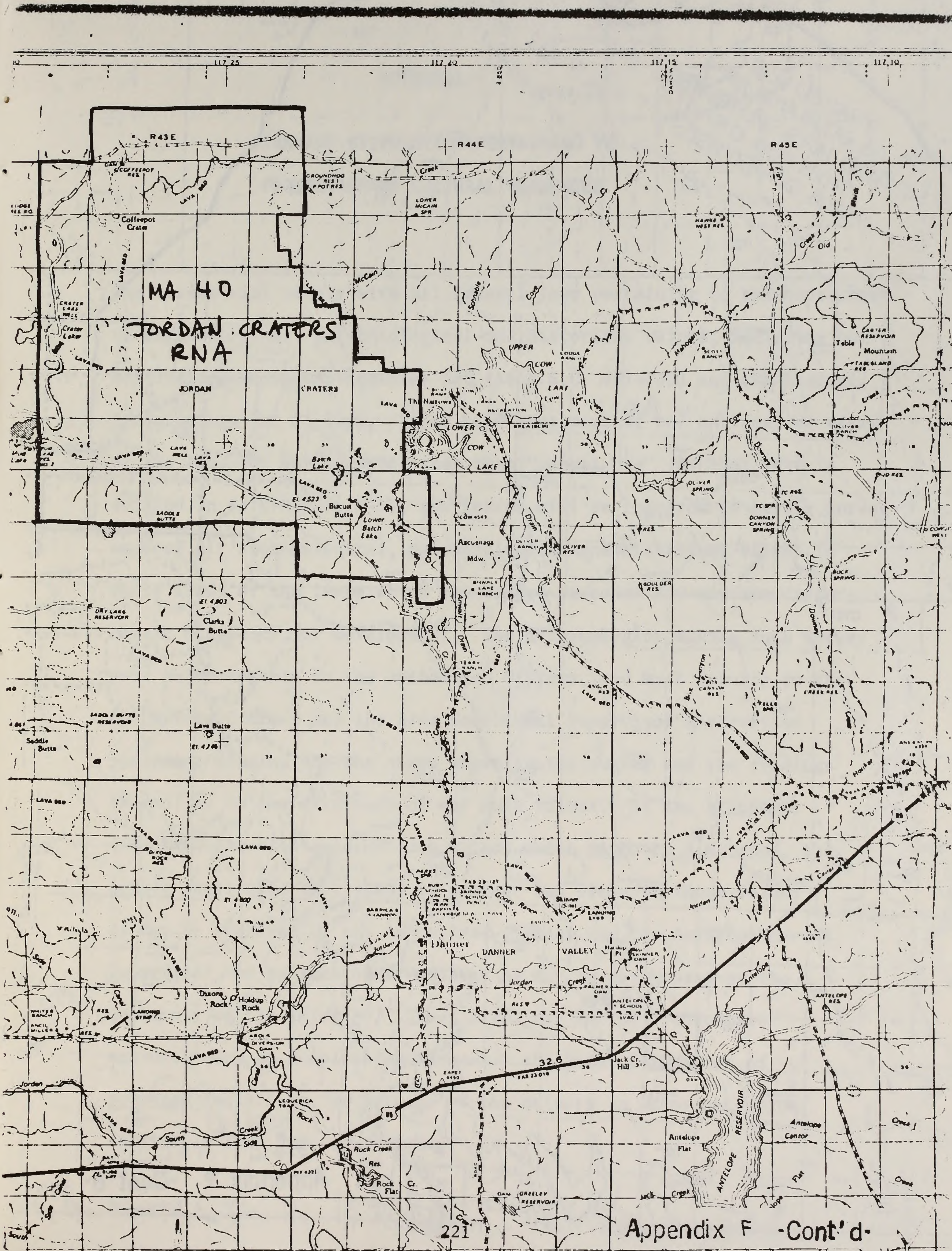
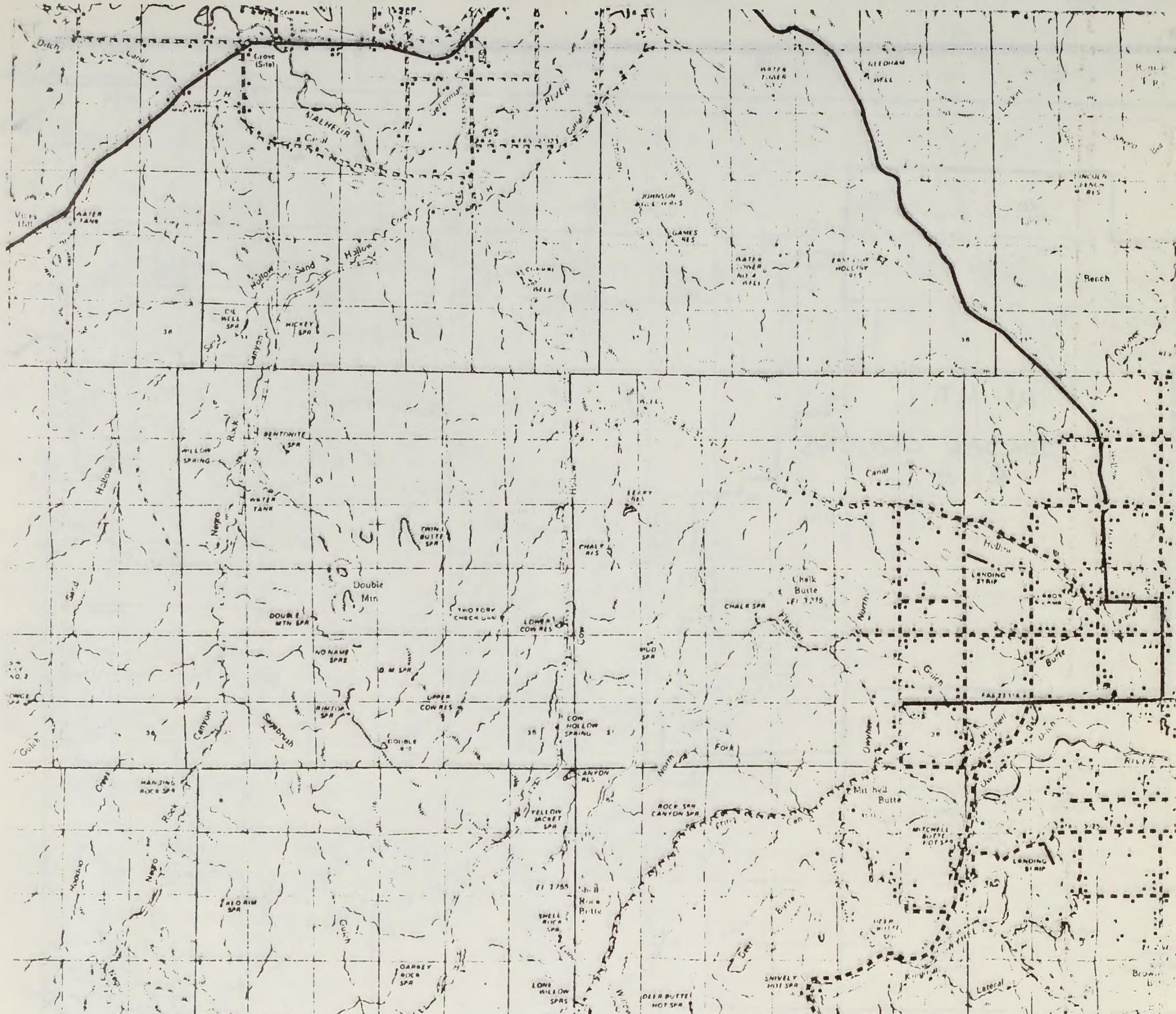
Valley
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
AREA OF RESPONSIBILITY
VALE DISTRICT
OREGON OFFICE
1976



Appendix F -Cont'd-


MA 40
JORDAN CRATERS
RNA
R43E
R44E
R45E
Coffeepot Crater
Crater Lake
JORDAN
CRATERS
The Narrows
UPPER
COW
LOWER
COW
LAKE
Batch Lake
Biscuit Butte
Lower Batch Lake
Ascuenaga Mdw.
Table Mountain
Clarks Butte
Saddle Butte
Lava Butte
Danner
DANNER
VALLEY
Jordan
Creek
Duxons Rock
Holdup Rock
ANTELOPE
RESERVOIR
Antelope Flat
Rock Creek Res.
Rock Flat
Jack Cr. Hill
95
32.6

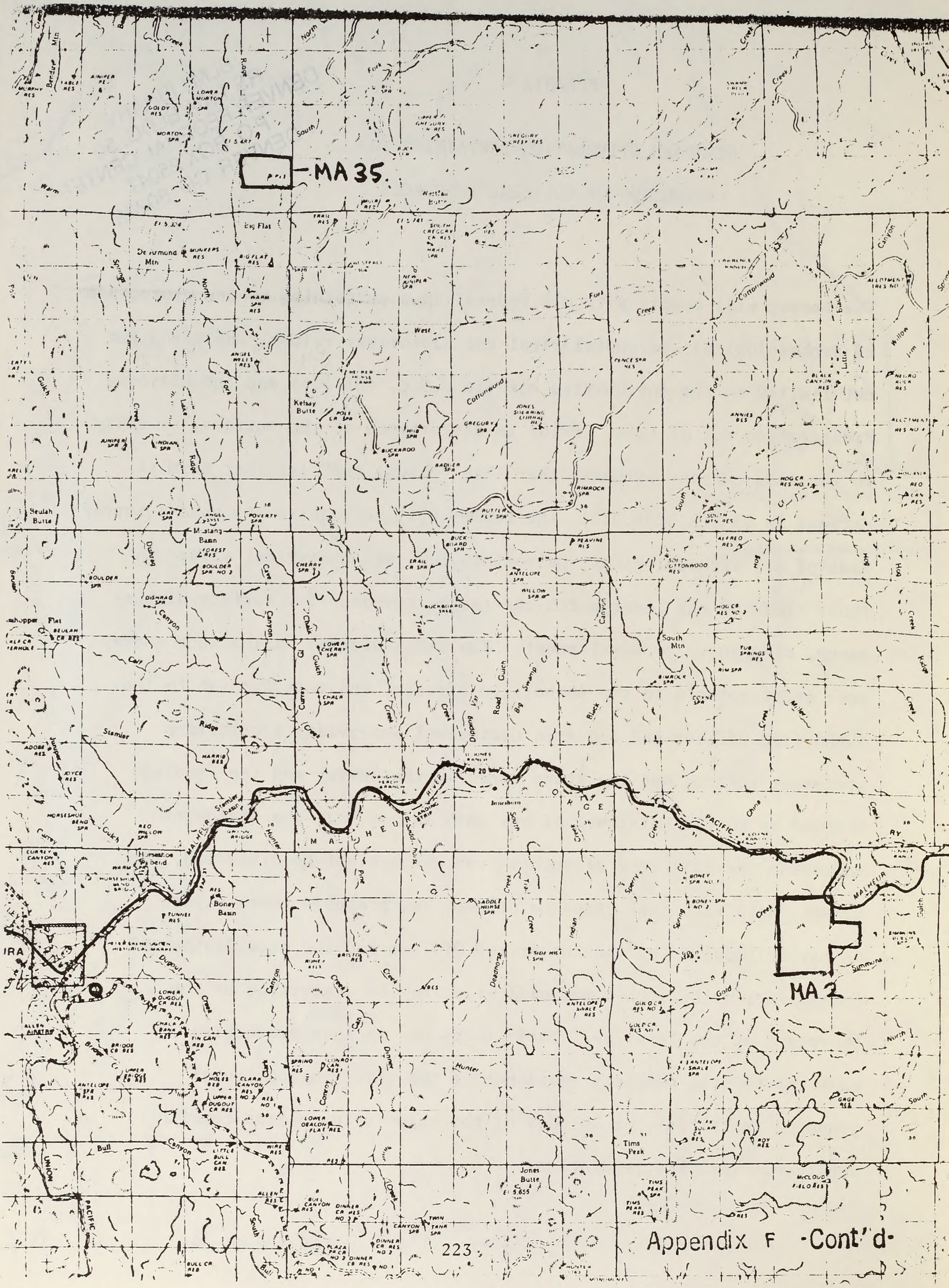


Appendix F -Cont'd-

APPENDIX G

STANDARD STIPULATION PERTAINING TO PROTECTION OF CULTURAL RESOURCES

The Lessee will comply with all Federal laws pertaining to the protection of archaeological, paleontological and historical values, including but not limited to the Antiquities Act (16 U.S.C. 431-433) and the Historic Preservation Act of 1966. Prior to disturbance of the surface, or entry on the land for any purpose other than "casual use" (as that term is defined in 43 CFR 3209.0-5), the Lessee will be required to have a survey made of all archaeological, paleontological and historical values in those areas of the lease which the Lessee proposes for surface disturbance, occupancy, or development. The archaeologist making such survey must be acceptable to the Authorized Officer, and must furnish to the Authorized Officer and the Area Geothermal Supervisor a certified statement setting out the steps taken in the survey and the findings thereof as to the existence of any such values. If the statement indicates the existence of such values which might be disturbed, the Lessee shall take such steps to protect and preserve those values as may be required by the Authorized Officer and the Area Geothermal Supervisor, or by such other officer as may be designated by the Secretary of the Interior. These steps may include protective measures such as complete avoidance of the site, relocation of proposed facilities, or salvage of the objects in accordance with applicable laws and regulations.



Appendix F -Cont'd-