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VULCAN HOT SPRINGS KNOWN GEOTHERMAL RESOURCE AREA: AN ENVIRONMENTAL ANALYSIS

Susan G. Spencer
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Editors

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DISCLAIMER

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EG&G Idaho, Inc.
Idaho Falls, Idaho 83401

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ABSTRACT

The Vulcan Hot Springs known geothermal resource area (KGRA) is one of the more remote KGRAs in Idaho. The chemistry of Vulcan Hot Springs indicates a subsurface resource temperature of 147°C, which may be high enough for power generation. An analysis of the limited data available on climate, meteorology, and air quality indicates few geothermal development concerns in these areas. The KGRA is located on the edge of the Idaho Batholith on a north-trending lineament which may be a factor in the presence of the hot springs. An occassional earthquake of magnitude 7 or greater may be expected in the region. Subsidence or elevation as a result of geothermal development in the KGRA do not appear to be of concern. Fragile granitic soils on steep slopes in the KGRA are unstable and may restrict development. The South Fork of the Salmon River, the primary stream in the region, is an important salmon spawning grounds. Stolle Meadows, on the edge of the KGRA, is used as a wintering and calving area for elk, and access to the area is limited during this period. Socioeconomic and demographic surveys indicate that facilities and services will probably not be significantly impacted by development. Known heritage resources in the KGRA include two sites and the potential for additional cultural sites is significant.

INTRODUCTION

EG&G Idaho, Inc., has completed an environmental analysis for the Vulcan Hot Springs KGRA as part of a comprehensive preplanning environmental program related to the KGRAs in the Snake River Basin. EG&G Idaho, Inc., is performing this preplanning environmental program under the auspices of the Office of Health and Environmental Research of the U.S. Department of Energy (DOE). KGRAs included under this program (see Figure 1) are Vulcan Hot Springs, Crane Creek, Castle Creek, Bruneau, Mountain Home, Raft River, Island Park, and Yellowstone. The Vulcan Hot Springs KGRA is the subject of this report.

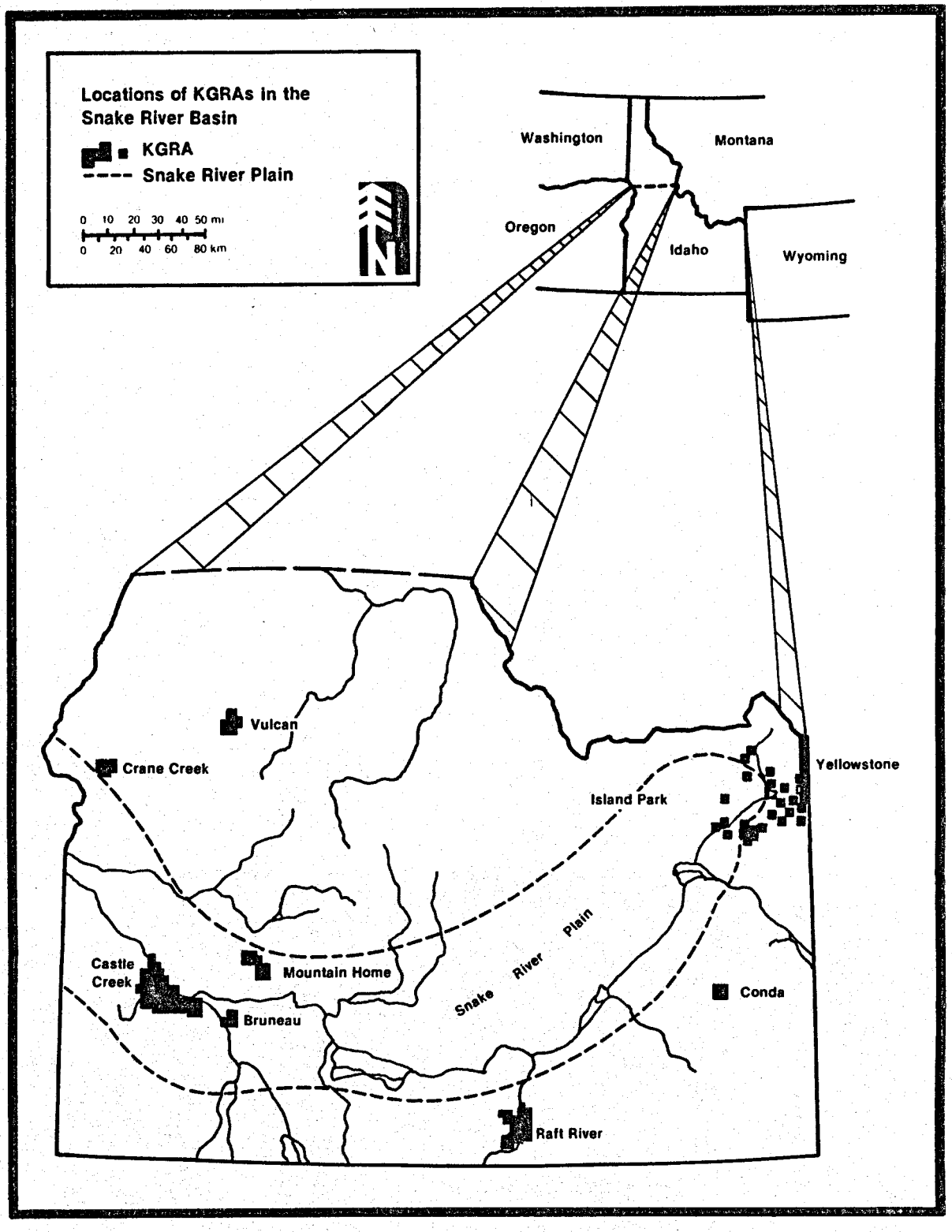

Figure 1. Map of regional setting.

The ultimate goal of the preplanning environmental program is to reduce the delays in geothermal development while minimizing environmental impacts by (a) assessing the existing environmental baseline data for the KGRAs (b) evaluating those data for adequacy and applicability, and (c) developing a plan for supplementing the existing data to achieve a sound environmental data base prior to geothermal development.

Results from the environmental program thus far include a summary of the environmental concerns related to geothermal development in each of the KGRAs,[1] an annotated bibliography of reference materials, detailed reports on the various program elements for each of the KGRAs, a program plan identifying future research needs, and a comprehensive data file. These will serve: (a) as planning tools for state and federal energy, environmental, and land management agencies, (b) as reference documents for developers to shorten and simplify project environmental evaluations, and (c) to identify the significant environmental concerns for each KGRA so that mitigation measures can be incorporated early in the development process.

This report includes available environmental information for the Vulcan Hot Springs KGRA. The information presented is a compilation of the most recent data available for analyzing the physical, biological, and human environments of this area. The sources providing the data are identified alongside the subject titles throughout the report. Current commitments and environmental concerns that might affect geothermal development in the region are discussed. Other reports in this series, as well as the technical reports which form the basis of this overview are listed in Appendix A and are available from Information Processing in the Information Division at EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83401. Landtype descriptions for the Vulcan Hot Springs KGRA are provided in Appendix B. Appendix C shows the proposed federal status of threatened plant species.

EVALUATION OF THE ENVIRONMENT

The physical, biological, and human environments of the Vulcan Hot Springs KGRA are evaluated in this section. The 1552-ha Vulcan Hot Springs KGRA is located in Valley County near the headwaters of the South Fork of the Salmon River (see Figures 2 through 6). Land within and surrounding the KGRA is part of the Boise National Forest and is under multiple-use management. The topography is rugged, with elevations ranging from 1630 to over 2190 m. Primary land uses in the region include timber production, recreation, and watershed maintenance. Significant mining occurred in the area in the late 1800s and several lead and silver mines near the KGRA remain active. Access to the area is from Cascade, Idaho, 48 km by road to the west of the KGRA.

The hot springs, which are located above the South Fork, are composed of 13 vents with a combined discharge of 32 l/s and a surface temperature of 84°C. Estimates of the subsurface temperature based on water chemistry are 135°C (quartz) and 147°C (Na-K-Ca).[2] These estimates indicate the resource may be a candidate for power generation. A chemical analysis of the effluent from the hot springs is shown in Table 1. With the exception of the fluoride content, the quality of the fluids is excellent.

Physical Environment

The evaluation of the physical environment of the Vulcan Hot Springs KGRA included analyses of climate and meteorology, air quality, geology, subsidence, seismicity, water resources, and soils. These results are discussed in the following subsections.

Climate and Meteorology (M. Delisio, GeoTechniques)

No primary meteorological data exist for the Vulcan Hot Springs KGRA. Data on climate and meteorology included in this report are extrapolated from several sources[3, 4, 5] and are provided in Table 2

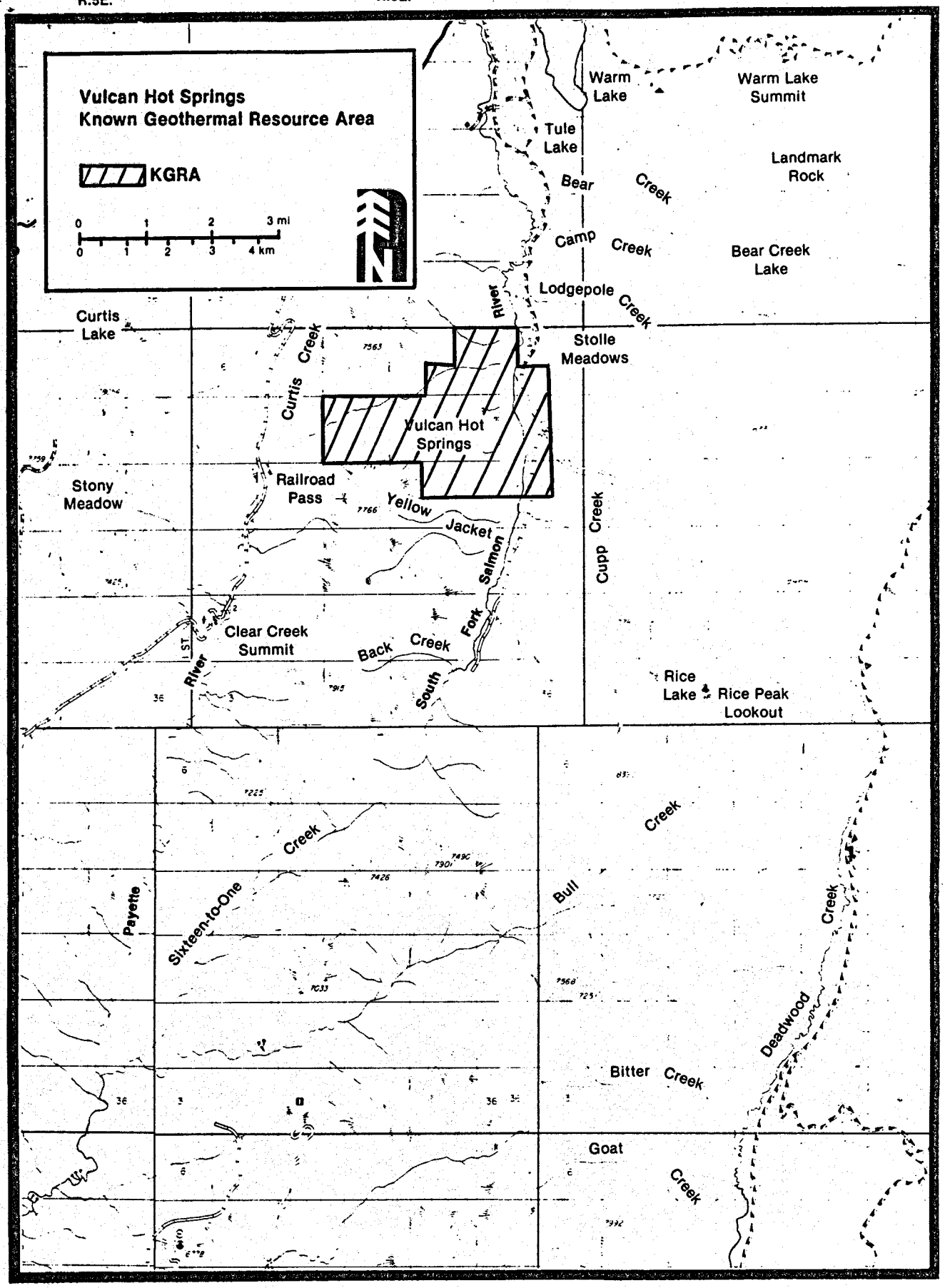

Figure 2. Map of Vulcan Hot Springs KGRA.

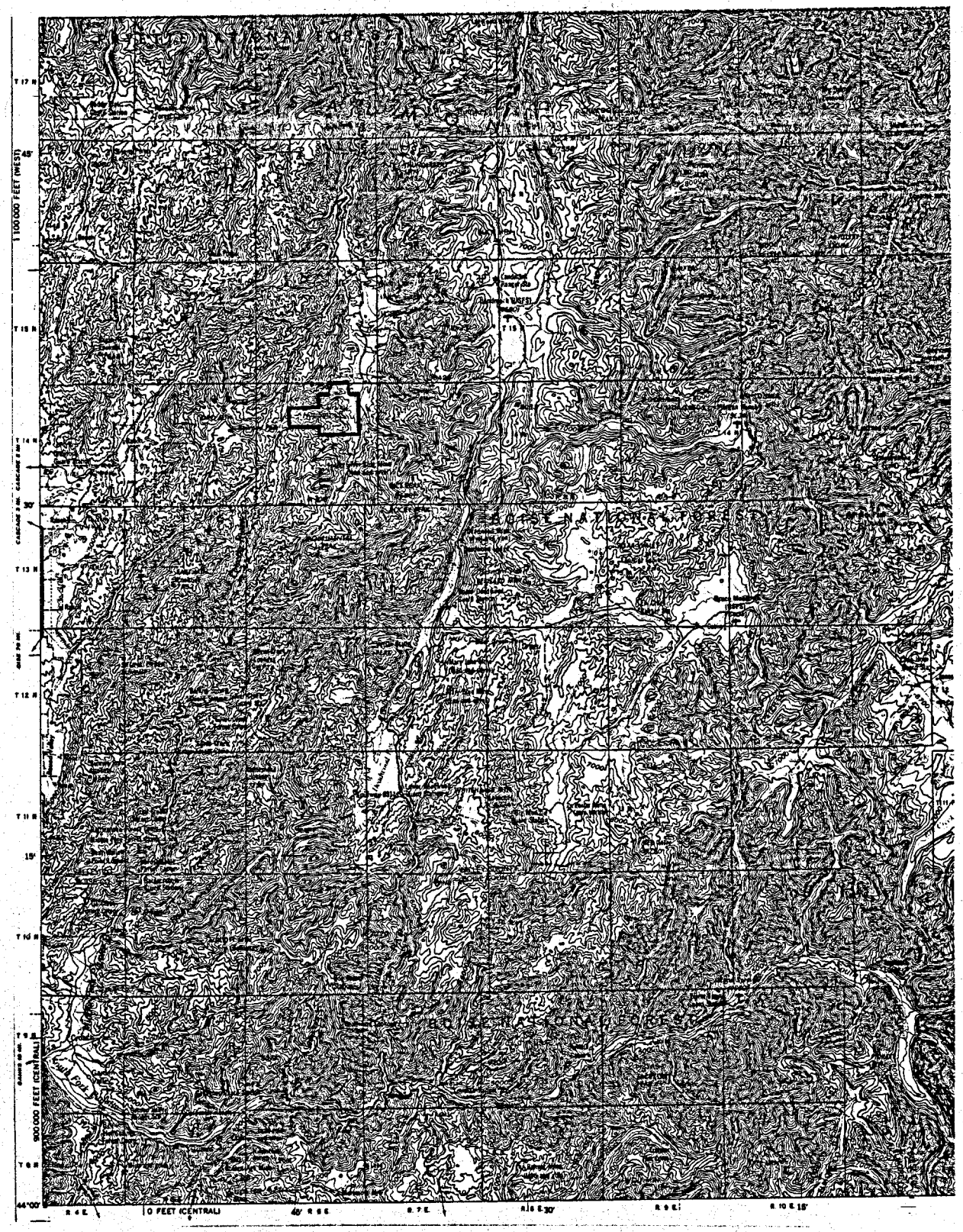

Figure 3. Topography of Vulcan Hot Springs KGRA.

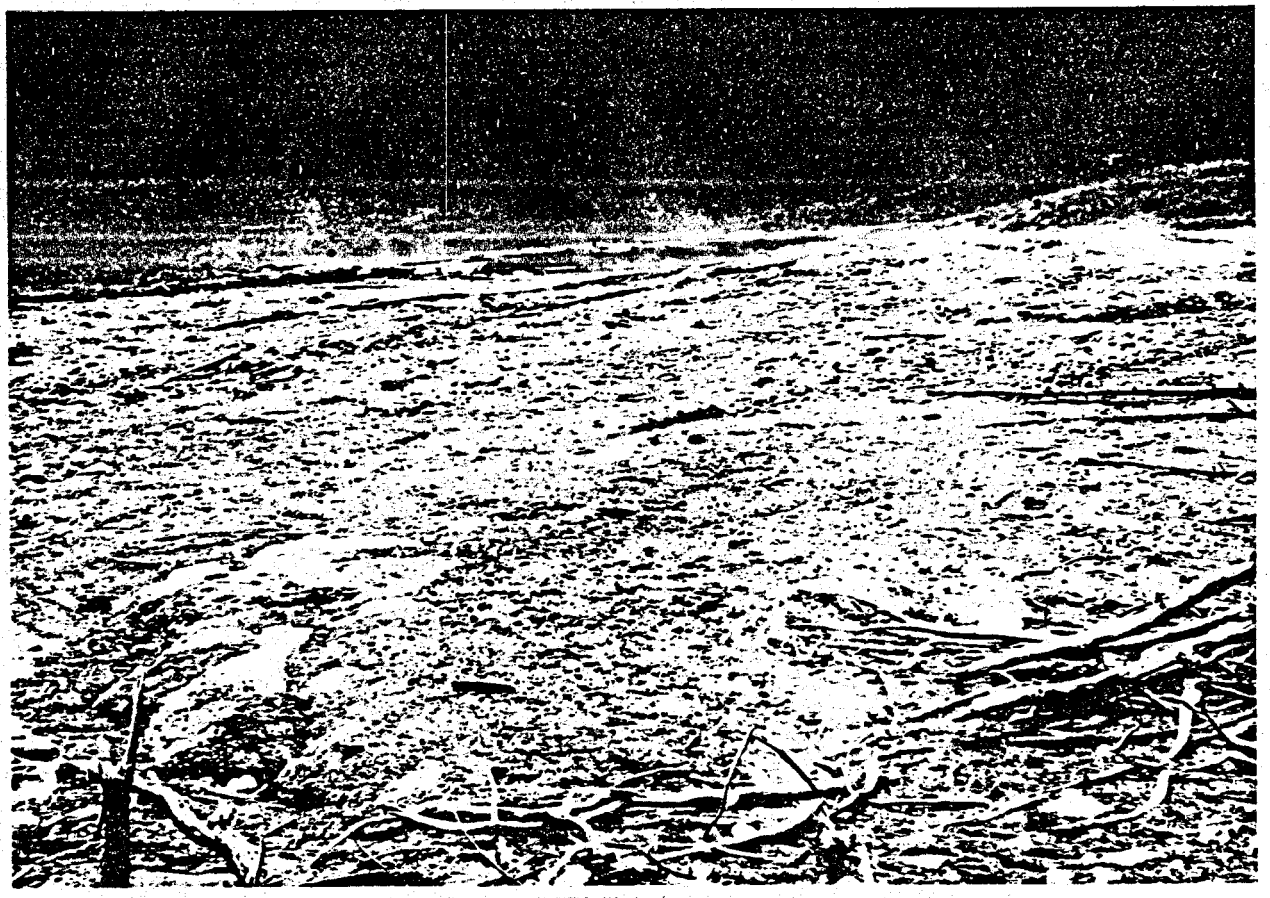

Figure 4. Photo of Vulcan Hot Springs.

Figure 5. Photo of Stolle Meadows.

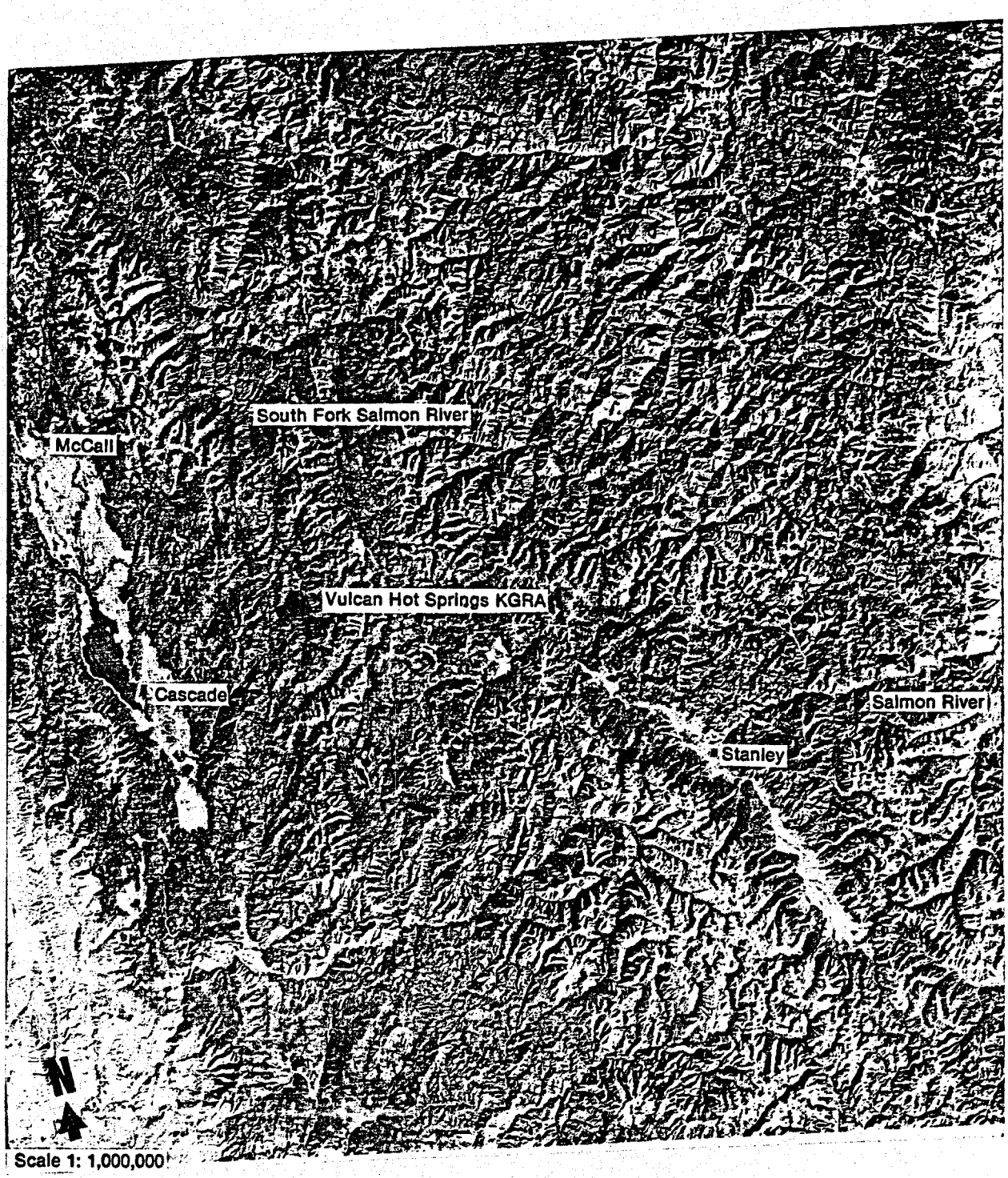

Figure 6. LANDSAT photo of Vulcan Hot Springs KGRA.

TABLE 1. CHEMICAL ANALYSIS OF VULCAN HOT SPRINGS[2,a]

Surface temperature (^{o}C)	87
Discharge (l/s)	32
B	0
Ca	1.8
K	3.0
Mg	0.1
Na	94
NH_3	0
SiO_2	120
Cl^-	17
$CO_3^=$	0
F^-	24
HCO_3^-	120
$NO_3^=$	0.05
$SO_4^=$	43
Specific conductance (µs/cm)	451
pH	8.5
Total dissolved solids	361

a. Values are in mg/l unless otherwise noted.

TABLE 2. SUMMARY OF CLIMATE CONDITIONS

Temperature (^{o}C)		
	Average	5.8
	Maximum	35
	Minimum	-27
Precipitation (mm)		
	Total Annual	540
Wind		
	Surface:	No data available
	850 mb:	Spring - W
		Summer - W
		Fall - W to NW
		Winter - SW
Stagnation (%)		
	Inversion based ≤150 m above ground:	
		Summer - 35
		Fall - 53

as an estimate of existing conditions. The KGRA is surrounded by diverse topography which is the primary influence on local climatic conditions. The average annual temperature at Cascade, the nearest weather station, is 5.8°C. Snowfall restricts access to the area in the winter. Hail up to 12 cm in diameter falls in the area during summer thunderstorms. Stong valley winds associated with these storms result in the uprooting of trees in shallow soils.

Air Quality (E. Bentley, GeoTechniques)

Air quality data are extrapolated from those collected by the Environmental Protection Agency and the Idaho Department of Health and Welfare. Vulcan Hot Springs is located in a sparsely-populated, forested region of western Idaho. The main sources of pollutants in the county have been several wood processing plants. Point source information from the Cascade Mill indicates annual releases of 38 000-kg particulates, 16 000-kg sulfur dioxide, 11 000-kg nitrous oxides, 21 000-kg hydrocarbons, and 21 000-kg carbon monoxide. This mill is located over 48 km west of the KGRA, and these data are not necessarily representative of pollutants found in the KGRA.

The hot springs are located in a north-south trending valley, which experiences long periods of air stagnation in the fall and winter. Any plans for geothermal development should take into consideration this stagnation problem. Fog advecting from the South Fork of the Salmon River and Warm Lake is not uncommon. Dust contributed by construction activity associated with geothermal development would be a short-term problem and could be mitigated.

Geology (R. Hardyman, GeoTechniques)

Geologically, the Vulcan Hot Springs KGRA is located within the Idaho Batholith, a few kilometers east of the gneiss and schist terrain that marks the western margin of the batholith at this latitude. The Idaho Batholith was emplaced in late Cretaceous time

into an assemblage of island-arc volcanic rocks, trench-back arc and shelf sediments that were swept against the continent during Triassic and Jurassic time. Eocene and perhaps younger Tertiary intrusions were emplaced into the batholith and older rocks, and erosion, accompanied by some vertical faulting in Tertiary time, has exposed the batholith to the present erosion level.

Published geologic mapping of the KGRA and vicinity exists only as very general reconnaissance maps[6] or compilations[7]. The rocks exposed in the KGRA consist of plutonic igneous rocks of quartz monzonite affinity.[6] This rock, designated the quartz monzonite of Warm Lake by Schmidt,[6] displays a porphyritic, hypidiomorphic to xenomorphic granular texture. Recrystallized, granoblastic textures are locally present in the KGRA. This rock apparently represents the core of the Idaho Batholith. No metasedimentary rock inclusions occur associated with this unit. A typical sample of this rock contains 30 to 37% quartz, 19 to 27% potassium feldspar, 30 to 40% plagioclase, 2 to 4% biotite, and 1 to 4% muscovite. Quaternary alluvium floors the narrow valley extending north from the KGRA to Warm Lake.

The Vulcan Hot Springs KGRA lies approximately 6 km east of a major north-south trending inferred fault that passes west of Warm Lake.[7] Other north-south trending lineaments (possible faults) passing through the area are visible on LANDSAT imagery of the region. The narrow valley extending north from the KGRA to Warm Lake may be located along a major bedrock fault in the granitic rocks. Northeast trending lineaments in the area are less well defined on the LANDSAT imagery.

Subsidence (J. Applegate, GeoTechniques)

Subsidence of the ground surface associated with the production of fluids (petroleum and water) has been documented in many areas of the world. A significant number of these areas are in the American West and include Houston, Texas; portions of southern Arizona; Las

Vegas, Nevada; the Wilmington and Inglewood oil fields of southern California; the San Joaquin Valley of California; the South Bay area near San Jose, California; and the Raft River Valley of Idaho. Generalized criteria can be established from assessing these areas where subsidence has occurred. The areas of subsidence generally occur where there are youthful, relatively unconsolidated sedimentary rocks of Cenozoic age.[8] These rocks are generally of lacustrine and/or alluvial origin and include interbedded coarse-grained and fine-grained rocks. The permeable sands and/or gravel aquifers have low compressibility and are interbedded with clayey aquitards of low permeability, high compressibility, and variable thickness. The withdrawal of fluids causes a decrease in the hydrostatic head of the aquifers and, in turn, causes a transfer of additional load of the matrix (grain-to-grain load). The effect results in small amounts of generally elastic compaction in the coarse-grained aquifer and much larger amounts of inelastic compaction in the fine-grained aquitard. In the aquitard, the increase in effective stress results in a dewatering of the clays.[9] Montmorillonite is the common clay mineral in many of the aforementioned cases of subsidence[8] and has the ability to lose large volumes of water.

Withdrawal of fluids appears to be the most likely subsidence mechanism in the geothermal areas under study. However, hydrocompaction and tectonic-related subsidence are potential mechanisms that should be assessed:

1. Hydrocompaction is subsidence due to the collapse of the soil structure of certain moisture deficient deposits when these deposits lose their dry strenth due to wetting.[10] Hydrocompaction is a one-time process in which excess moisture penetrates below the root-zone into moisture deficient material. The process may continue to intensify as the water percolates downward and deeper deposits become wetted.

2. Tectonic subsidence is subsidence, or uplift, that is related to active tectonic processes within the earth such as movement along faults, aseismic movement, emplacement of igneous bodies, etc. As with subsidence related to fluid withdrawal, tectonic subsidence is best observed with repeated leveling. Again, these data are extremely limited. There is some documentation of tectonic movement of 67 mm in the Raft River Valley, Idaho.[11]

The Vulcan Hot Springs KGRA occurs within the Idaho Batholith and, consequently, is unique. The structure of the area is dominated by a major north-northeast trending lineament. Within the area, the valley fill is Pleistocene upland deposits derived from alpine glaciation.[7] The fill does not appear to be deep; there is no indication of the valley fill on the gravity map.

The area does not appear to be highly susceptible to subsidence. Any subsidence that might occur would be tied to water level drawdowns in an area of highly fractured and/or altered granodiorite or in an area of valley fill. It is not anticipated that such a zone would be very large.

Seismicity (J. Applegate, GeoTechniques)

Seismicity studies to determine levels of microearthquake activity have been one of the principal exploration tools to define areas of geothermal activity. It has been observed that many geothermal areas have large numbers of small earthquakes. It is postulated that the microseismic events are a function of the youthful geologic activities (volcanism, faulting, etc.) that are associated with geothermal areas. Thus, it is more common than not to find significant seismic activity in close proximity to geothermal systems.

All of the KGRAs in southwest Idaho are in Seismic Risk Zone II. Zone 0 is the least risk, and Zone III has the highest risk. However, the data base upon which this recommendation was made was somewhat limited. The problem is that the instrumental seismic data set represents only a limited time period. This is a major problem in the evaluation of seismic risk. In the last few years several additional seismic networks have been installed in the state. However, the only two that provide much useable data for this study are the networks surrounding the Idaho National Engineering Laboratory (INEL) and a three-station array in the vicinity of Boise, Idaho, which is operated by Boise State University (BSU).

With the limited seismic instrumental data base, it is necessary to assess other forms of data. The importance of assessing the geological criteria for evaluating seismicity has been emphasized very strongly by Allen.[12] These data include indicated active faults (in areas where adequate investigations have been undertaken), evaluation of maps of lineaments, LANDSAT imagery, U-2 photos, and geophysical data including seismic reflection, gravity, and aero-magnetics. These data sets are, of course, not directly indicative of active seismic zones, but do allow much clearer assessment of potential hazards.

In the portion of southwestern Idaho where the geothermal areas are located, there has been an operating seismograph network since 1975. This network recorded over 800 earthquakes during 1976 and 1977.[13] Other available instrumental data come from the INEL network (operating since 1971), and from the National Oceanic and Atmospheric Administration (NOAA) computer files on earthquake activity for 1880 through 1975. Numerous workers have published geological reports on areas in southwestern Idaho. The most applicable report and map for this project was a map of active faults in Idaho compiled by Witkind.[14]

These data sets may be sufficient to evaluate the general seismicity of the area, but the limited time span for instrumental data and the small number of observation points do not make the data set applicable for detailed analysis of site specific areas. Geologic studies are generally limited in detail and spatial extent to the point that it is quite possible that all of the active faults have not been mapped.

The Vulcan Hot Springs KGRA occurs in the central portion of the Idaho Batholith. It occurs on a major north-northeast trending lineament, which can be observed on LANDSAT imagery. This feature trends along the Middle Fork of the Payette River and appears to be a structural control on hot springs near Garden Valley, Silver Creek Hot Springs, Boiling Springs, and Vulcan Hot Springs.

Witkind's map[14] shows a fault approximately 10 km to the east which affects a late Pleistocene moraine. This fault appears to be the west boundary fault to Bear Valley, which is the site of a number of small earthquakes (see Figures 7 and 8). The historical seismicity map, Figure 7, shows a significant amount of seismic activity in the vicinity of Vulcan Hot Springs. The majority of these events are represented by a swarm of activity that occurred in November and December of 1970, with two events of magnitude 4.3.[15] These events occurred slightly to the east in Bear Valley; the closest event was probably within 15 km of the Vulcan Hot Springs KGRA. The map of 1976 and 1977 seismicity, Figure 8, also shows seismic activity in the immediate vicinity. Several events are shown within 10 km of the Vulcan Hot Springs area.

There are no published microseismic data from within the immediate area. The closest areas studied over a number of years are the Cascade and Stanley areas.[16,17] Both areas clearly have earthquake swarms. This is also illustrated by the previously mentioned swarm activity in Bear Valley.

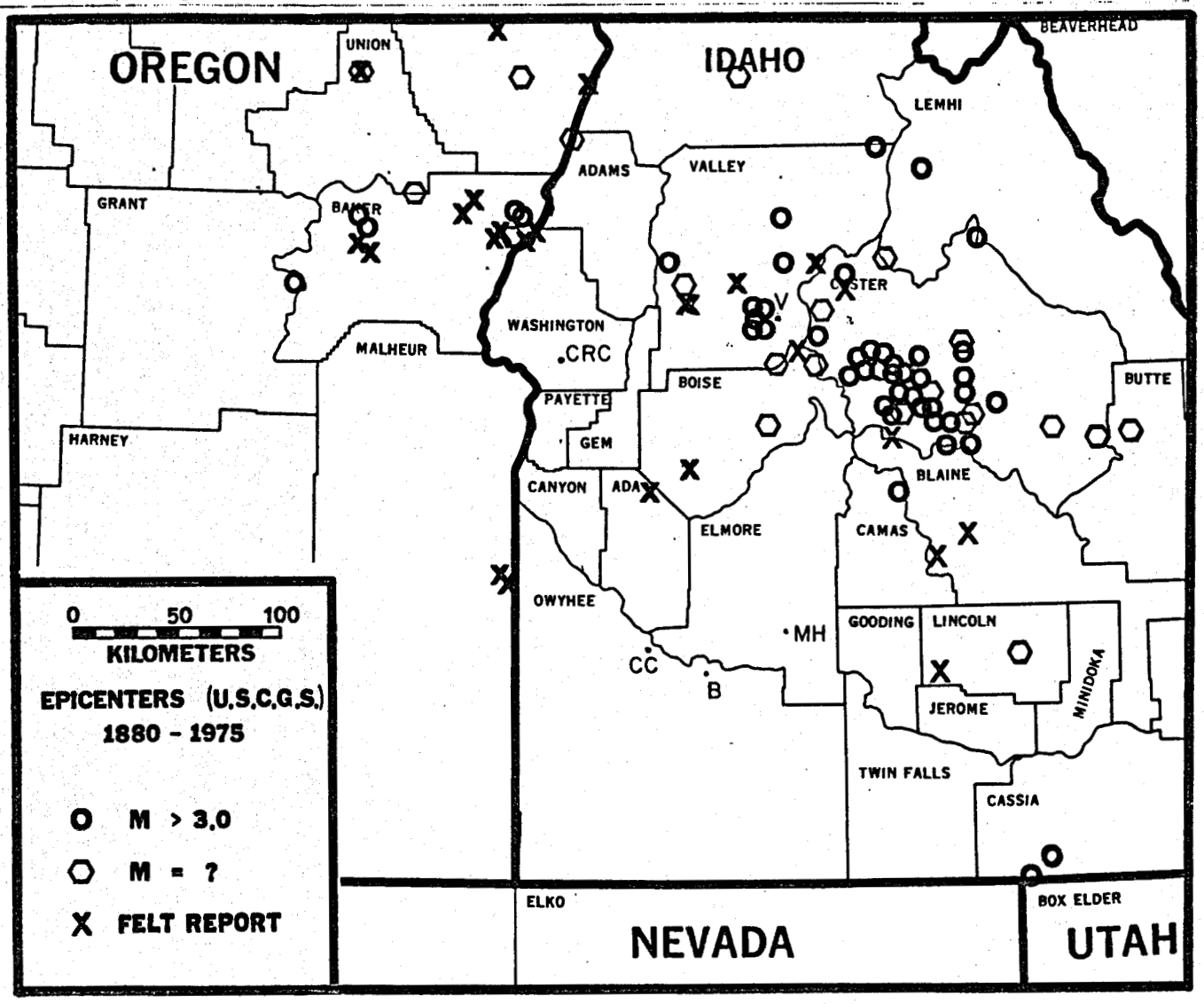

Figure 7. Historical seismicity for 1880 through 1975 from U.S. Coast and Geodetic Survey (NOAA) (KGRAs are identified as MH - Mountain Home, B - Bruneau, CC - Castle Creek, CRC - Crane Creek, and V - Vulcan).

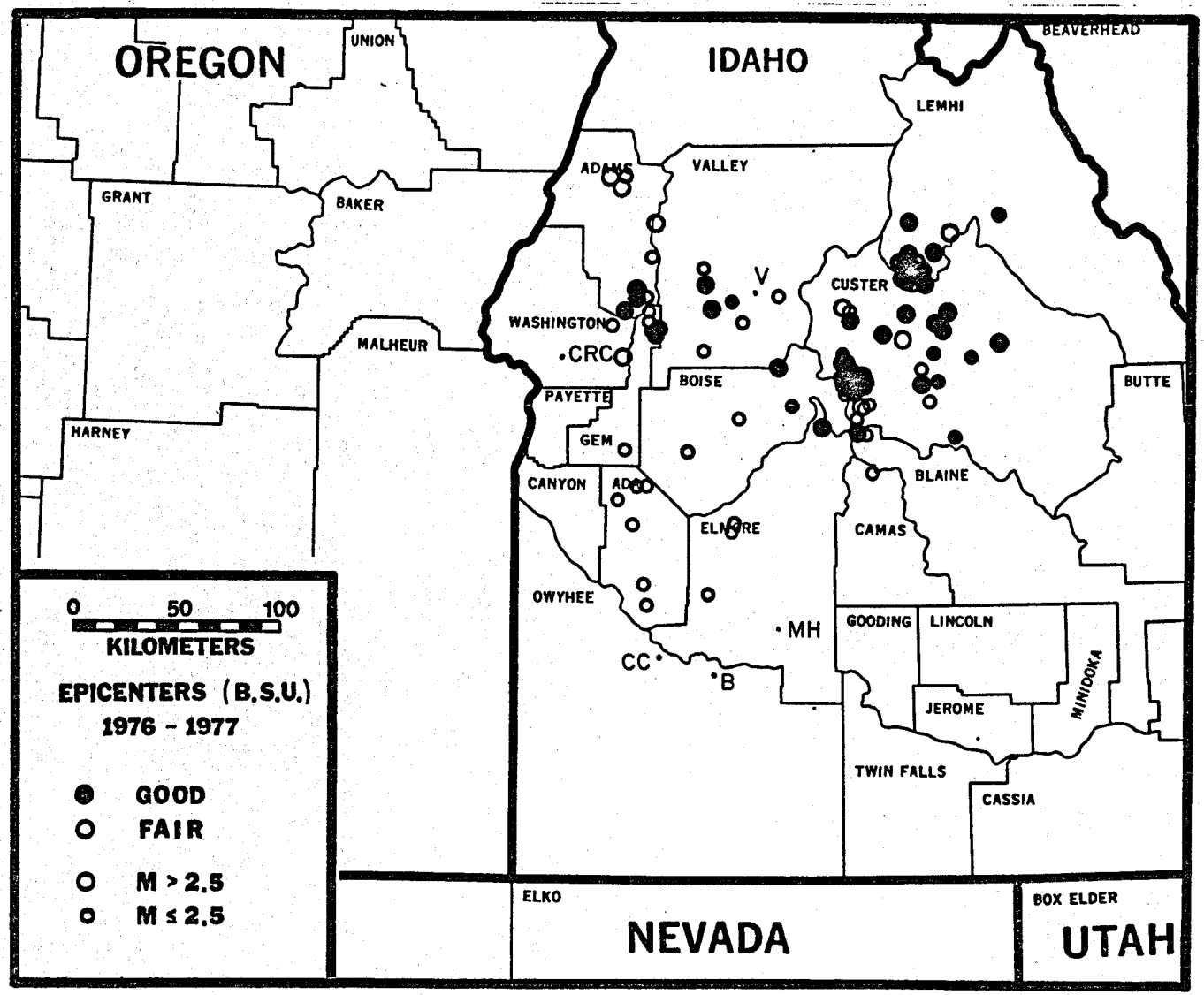

Figure 8. Seismicity for 1976 and 1977 from Boise State University network (KGRAs are identified as MH - Mountain Home, B - Bruneau, CC - Castle Creek, CRC - Crane Creek, and V - Vulcan).

The data available appear to indicate a relatively high likelihood of there being occasional earthquakes of magnitude 7 or greater within 25 km of the Vulcan Hot Springs. However, the data are not sufficient to indicate any recurrence interval, and additional data are needed to establish frequencies of earthquakes.

All of the geothermal areas are either within or in close proximity to the Idaho Seismic Belt.[18] The Idaho Seismic Belt is a northwest trending zone cutting across the Idaho Batholith. Additional work[13] indicates that at least at the western margin of the batholith the seismicity is somewhat more diffused. The close relationship between the KGRAs and the Idaho Seismic Belt adds additional weight to the question of induced seismcity.

Induced seismicity is a question that is undergoing extensive research to establish the cause and under what conditions it is a problem. Several areas have provided extensive case histories on the relationship of seismicity to injection and/or withdrawal of fluids. These include Derby, Colorado;[19,20] Rangeley, Colorado; and, more recently, near Snyder, Texas. Studies are underway to verify or negate the hypothesis that there is induced seismic activity associated with the geothermal system at the Geysers geothermal field in California.

Special problems may result from geothermal development in an area where large quantities of hot water or steam are produced and then cooler water is reinjected. This could possibly result in thermal stresses in the subsurface. This is an interesting hypothesis, especially in areas (the Snake River Plain) where plastic creep may be occurring. Perhaps the cooling effect could, over a significant period of time, create areas where the stress might be relieved with brittle deformation instead of plastic deformation, and hence result in seismic activity.

The problem of induced seismicity is a real one and must be addressed with the acquisition of the necessary data. Fortunately, however, none of the KGRAs are in highly populous areas where even relatively low levels of induced seismicity could be disruptive and destructive to urban structures and facilities. Induced seismicity in these areas could, however, be highly disruptive to development of facilities necessary to produce and utilize the geothermal energy. With proper control of the reinjection program, including pressure, volume, and location of reinjection, induced seismicity may be minimized or eliminated.

Water Resources (C. L. Miller and C. C. Warnick, Idaho Water Resource Research Institute)

The primary stream in the Vulcan Hot Springs KGRA is the South Fork of the Salmon River, which flows through the eastern portion. Results from a study of hydrology, water quality, and water rights for the South Fork are presented in the following subsections.

Hydrology. The South Fork of the Salmon River drains an area of 243 km^2 at the river gaging station near Knox, Idaho (see Figure 9). The principal tributaries to the South Fork downstream of this point are Curtis Creek, Lodgepole Creek, Rice Creek, and Mormon Creek, all of which flow in a northerly direction.

The topography of the drainage basin is characterized by V-shaped valleys that are drained by tributaries to the South Fork and the flat bottom lands of the valley through which the South Fork flows. Elevations in the drainage basin vary from 2650 m at Rice Peak to 1600 m near the river gaging station.

The hydrologic data base of the drainage basin surrounding the Vulcan Hot Springs KGRA consists of rainfall and snowfall gage records for sites that surround the drainage basin and a stream flow gage record for a site on the South Fork at the lower end of the drainage basin.

The rainfall and snowfall gage records are available for sites at Cascade, Deadwood Dam, Yellow Pine, McCall, and Lowman. Figure 10 shows the monthly distribution of runoff at the gaging site on the South Fork near Knox. Table 3 gives information on the records that form the hydrologic data base for the area surrounding the KGRA. Histories of the movements of the rainfall and snowfall gages are available from the Weather Service Office in Boise. Figure 9 shows an isohyetal map of the drainage basin.

There are no groundwater hydrology data available for the area around the Vulcan Hot Springs KGRA.

Water Quality. The water quality data base for the South Fork of the Salmon River consists of the data from Water Information Bulletin No. 30[21] and data found in an entomology thesis by R. J. Schott[22]. Table 1 presents the geothermal water quality data for Vulcan Hot Springs. Schott's thesis contains tables of water quality data for Vulcan Hot Springs and the South Fork (see Table 4). Schott established a sampling site above the confluence of Vulcan Hot Springs and the South Fork, one sampling site below the confluence, and five sampling sites on Vulcan Hot Springs.

Water Rights. There are no water rights filed within the Vulcan Hot Springs KGRA. However, one water right downstream of the KGRA involves a series of seven hot springs. Also, a 570-l/s water right downstream on the South Fork is held by the Idaho Department of Fish and Game for operating a salmon and steelhead egg gathering facility. The water right filings are identified as to location and nature of the filing in Figure 11.

Soils (N. Savage, Idaho Water Resources Research Institue)

The only existing data on soils are those contained in the U.S. Forest Service Soil Hydrological Reconnaissance (1969) which is based on a soil and hydrology survey.[23] All landtypes within the KGRA

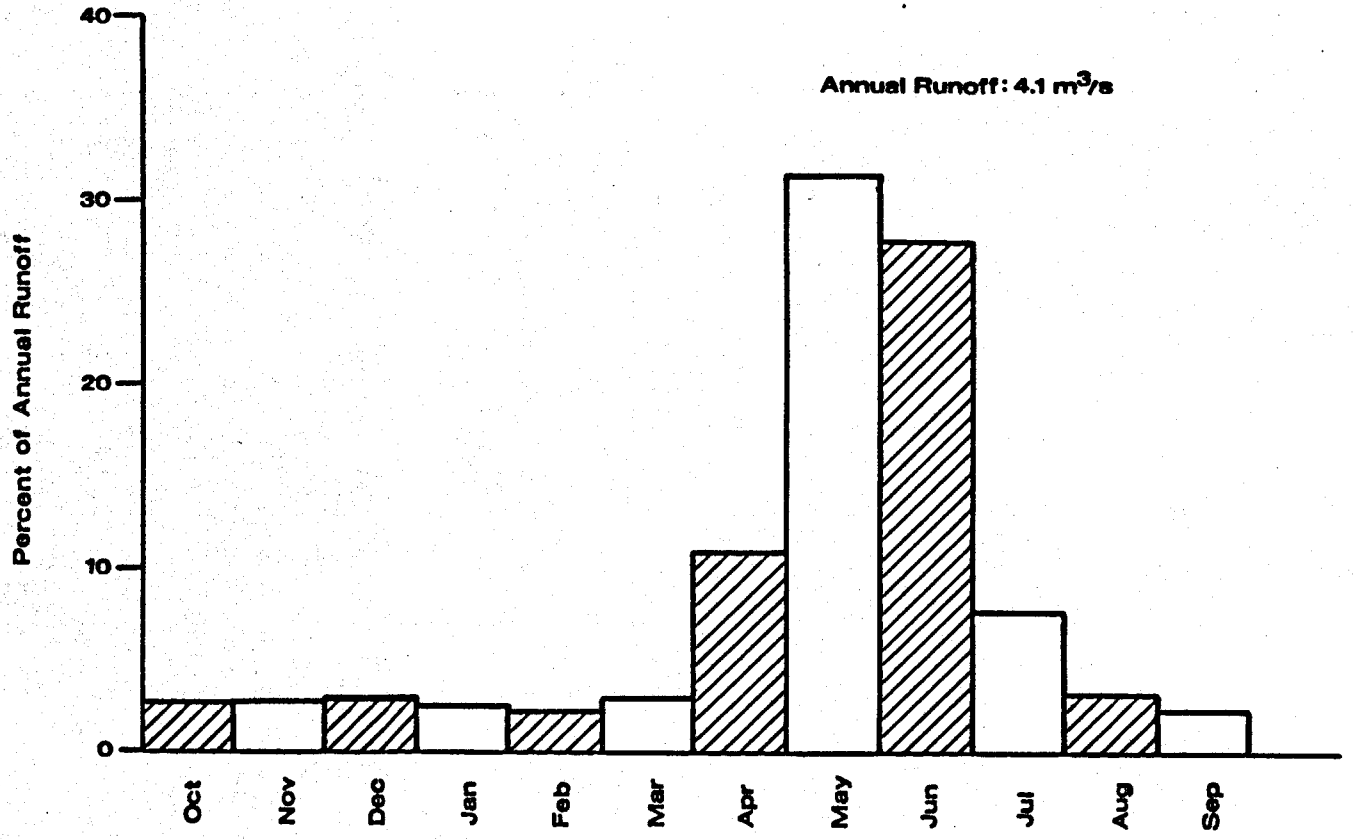

Figure 10. Characteristic monthly runoff of the South Fork of the Salmon River near Knox, Idaho.

TABLE 3. INFORMATION ON HYDROLOGIC RECORDS SURROUNDING THE VULCAN HOT SPRINGS KGRA[a]

Station	Type of Record	Latitude	Longitude	Period of Records (month/year)	Length (months)	Annual Average
Cascade 1 NW	Rainfall	42°, 32'	116°, 03'	01/1944 - 12/1976	396	548.64 mm
	Snowfall			11/1948 - 12/1976	196	2758.44 mm
Deadwood Dam	Rainfall	44°, 19'	115°, 38'	12/1929 - 08/1975	549	823.21 mm
	Snowfall			12/1929 - 08/1975	397	4546.60 mm
Yellow Pine 7 S	Rainfall	44°, 47'	115°, 30'	08/1970 - 12/1976	77	690.37 mm
	Snowfall			10/1970 - 12/1976	51	2994.66 mm
McCall	Rainfall	44°, 54'	116°, 07'	01/1930 - 12/1976	564	719.84 mm
	Snowfall			01/1930 - 12/1976	381	4056.38 mm
Lowman	Rainfall	44°, 05'	115°, 38'	08/1948 - 04/1953 07/1953 - 05/1954 04/1955 - 08/1961 05/1965 - 12/1977	57 11 77 32	655.81 mm
	Snowfall			11/1948 - 12/1976	88	
South Fork Salmon River near Knox	Streamflow	44°, 39'	115°, 42'	10/1928 - 09/1960	384	1.29×10^8 m^3

a. Source: NOAA, U.S. Department of Commerce.

TABLE 4. WATER QUALITY OF SOUTH FORK OF SALMON RIVER

	South Fork[a]	South Fork[b]	Vulcan I[c]	Vulcan II[c]	Vulcan III[c]	Vulcan IV[c]	Vulcan V[c]
Temperature (°C)	7.5	10	21	25	29	35	39
Dissolved Oxygen (mg/l)	9.5	9.0	7.4	6.6	6.2	5.6	5.5
Total Alkalinity (mg/l)	16	24	94	96	99	98	92
Conductivity (µmhos)	10	20	380	400	440	420	450
pH	7.2	8.2	8.4	9.2	9.2	9.2	9.2

[a]South Fork sampled just above confluence with Vulcan Hot Springs discharge

[b]South Fork sampled below confluence with Vulcan Hot Springs discharge

[c]Samples of Vulcan Hot Springs discharge taken progressively closer to the hot springs

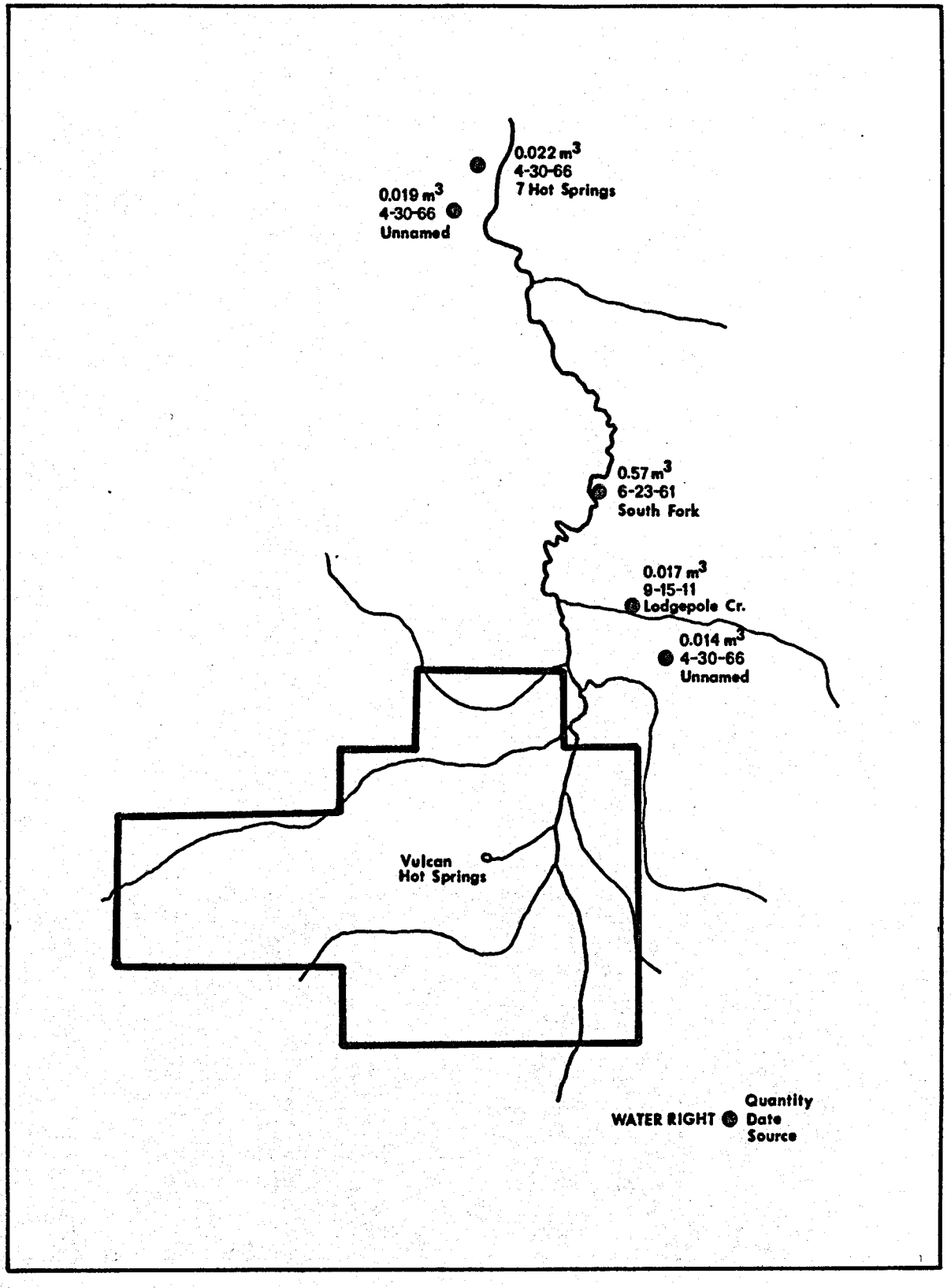

Figure 11. Map of water rights in Vulcan Hot Springs KGRA.

have been identified (see Figure 12) and are described in Appendix B. The landtype descriptions contain useful information on topography, geomorphic features, bedrock characteristics, vegetation, and management qualities as well as limited soil descriptions. Soil data include texture, color, acidity of surface and subsurface layers, and depth of soil profile. Topography in the KGRA ranges from 0 to 60% slope gradient, with most of the area on landtypes having 20% slopes and being heavily forested. The soils, developed over granitic rocks of the Idaho Batholith, are highly erodable. Both of these factors would impose limitations on geothermal development.

Biological Environment

Terrestrial and aquatic ecologies of the Vulcan Hot Springs KGRA are discussed in this section. The potential impact that possible geothermal development would impose on these ecologies is evaluated.

Terrestrial Ecology (C. D. Jorgensen and T. L. Johnson, Brigham Young University)

The assessment of the terrestrial ecology of the Vulcan Hot Springs KGRA examined the habitats associated with the region. The potential impact of possible geothermal development was assessed with regard to habitats found in the KGRA and their relative abundance in the region.

Flora. The principal vegetation habitat in the KGRA is the Douglas fir (see Figure 13). The KGRA does not occupy a significant portion of this habitat in the region. However, the KGRA includes an important wet meadow and wintering grounds for elk. Winter access to the area has been restricted to avoid disturbing wintering animals and cows with their calves. Geothermal development may be hampered as a result of the extreme difficulty posed in resolving the problem of disturbing calving cows.

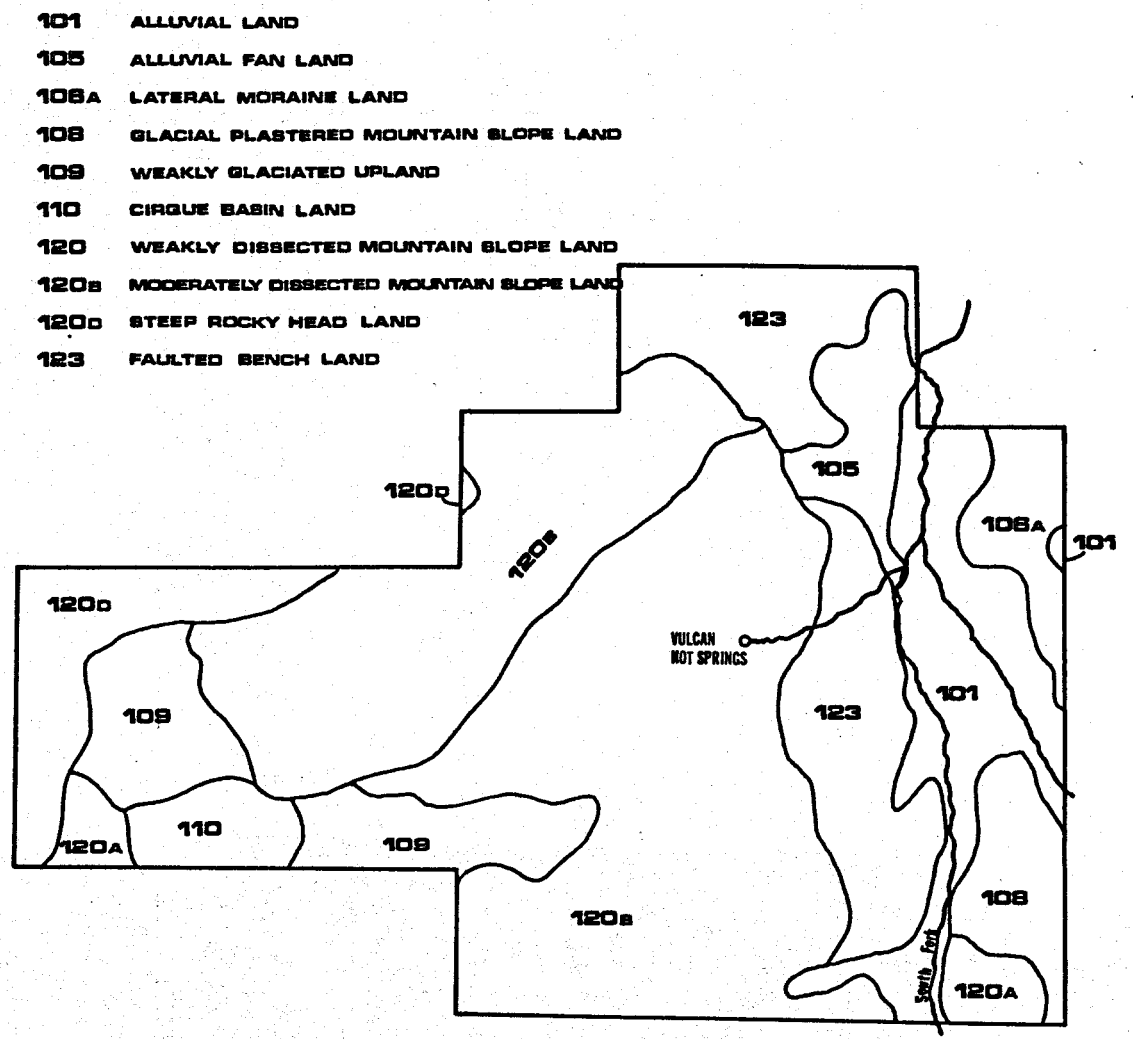

Figure 12. Map showing landtypes in Vulcan Hot Springs KGRA.

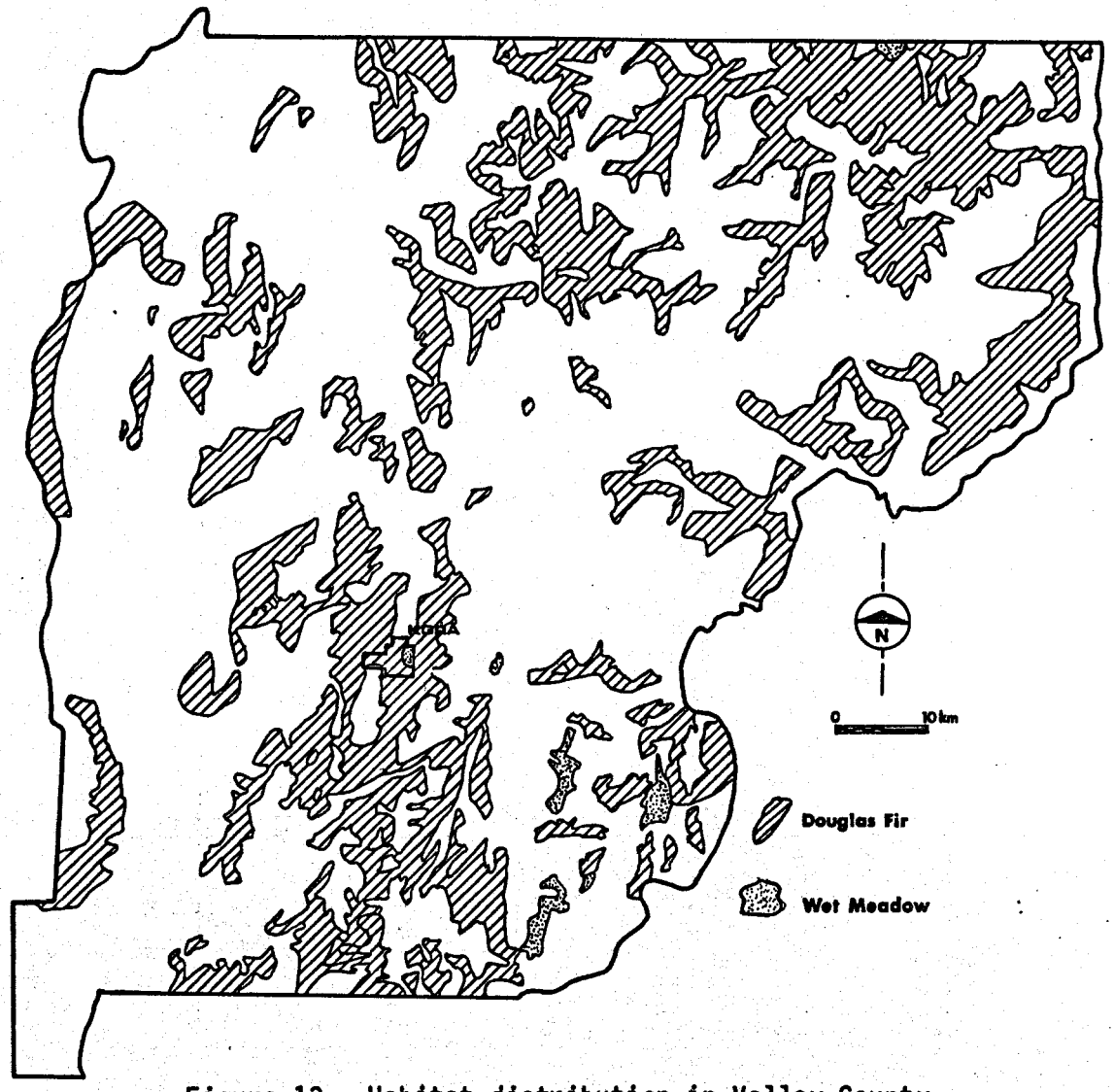

Figure 13. Habitat distribution in Valley County.

Threatened and endangered plant species are illustrated with respect to their proximity to the KGRA in Figure 14. Specific species information is included in Appendix C. Records of these plant species were usually made from museum collections only, not from extensive studies. Data for the proposed threatened and endangered plant species was taken directly from Henderson et al.[24] Their study not only recommends a status based on the existing state of knowledge, but makes some recommendations of change in status. Only those species whose status appears critical because of a lack of information or extremely limited distributions are discussed beyond mere illustration of their status. Most of these data are limited. Because specific efforts have not been made to establish their status, the data are almost incidental and need much more validation to be conclusive.

Fauna. Species of vertebrates were compiled for the Vulcan Hot Springs KGRA, based largely on their reported association with habitats included in the area. These data were collected from numerous sources, and since none were specifically concerned with geothermal development, they represent the best estimate of what might be expected. Specific on-site research would be required to validate species present and relative numbers, but in the absence of such data, the listings provided in Tables 5 through 8 represent the best summary of what is included in the resources available. These listings are as comprehensive as possible, with reported species being deleted only if there is reason for doing so.

The information included in Tables 5 through 8 was available from a limited number of resources. These data sources are summarized as follows for:

1. Amphibians and reptiles, References 25, 26, and 27
2. Birds, References 25, 28, 29, 30, and 31
3. Mammals, References 25, 31, 32, and 33.

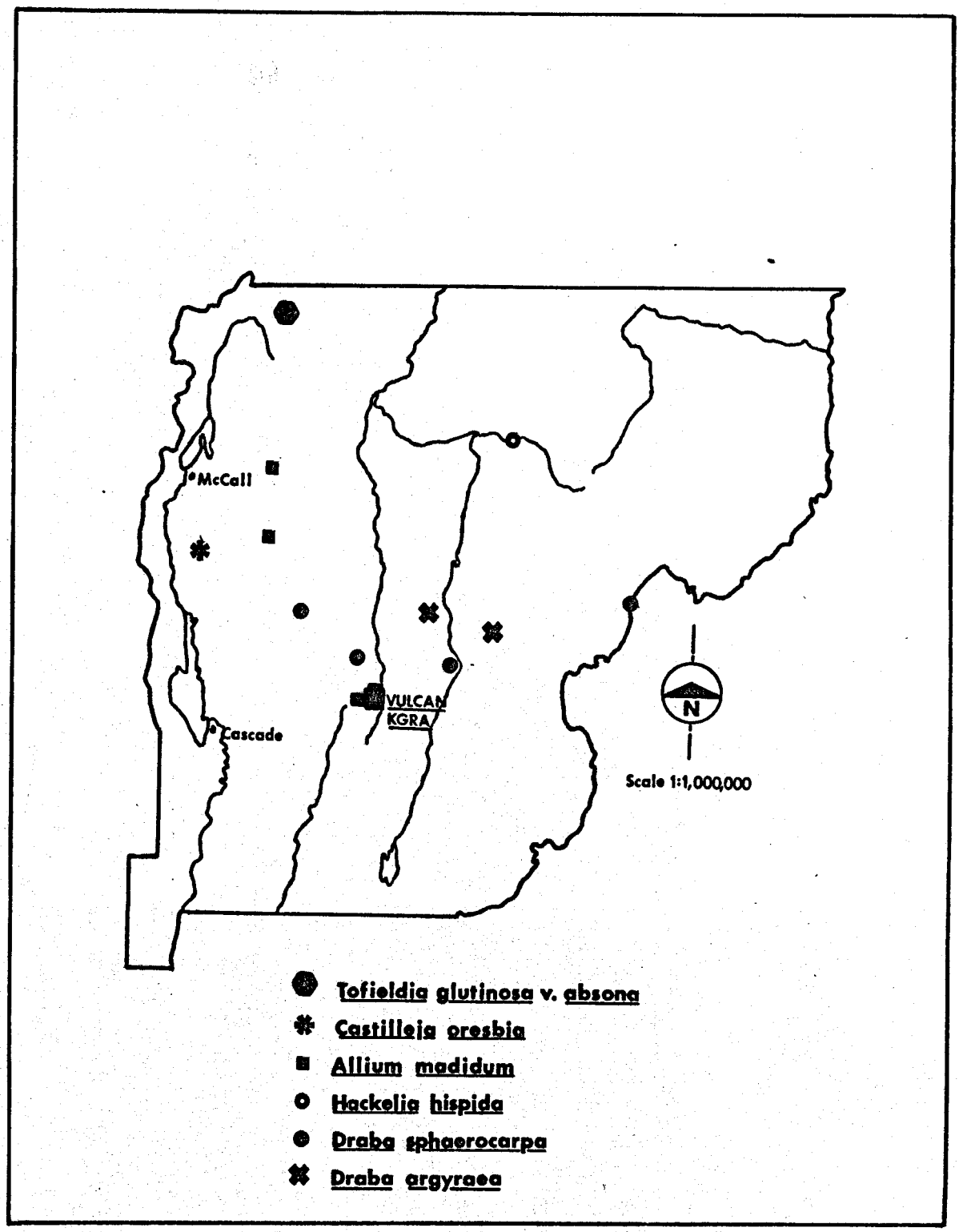

Figure 14. Distribution of threatened and endangered plants in Valley County.

TABLE 5. RELATIVE ABUNDANCE AND HABITAT LISTINGS FOR AMPHIBIANS IN VULCAN HOT SPRINGS KGRA

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Long-toed Salamander	Ambystoma macrodactylum	L	L	L	L	X	X	X	X
Pacific Giant Salamander	Dicamptodon ensatus	L	L	L	L	X	X	X	X
Tailed Frog	Ascaphus truei	L	L	L	L	X	X	X	X
Western Toad	Bufo boreas	L	L	L	L	X	X	X	X
Spotted Frog	Rana pretiosa	M	M	M	M	X	X	X	X
Leopard Frog	Rana pipiens	L	L	L	L	X	X	X	X

[a]Key to Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

[b]Key to Habitat Types: 1=Wet Meadows, 2=Lodgepole Pine, 3=Douglas Fir, 4=Subalpine.

TABLE 6. RELATIVE ABUNDANCE AND HABITAT LISTINGS FOR REPTILES IN VULCAN HOT SPRINGS KGRA

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Western Fence Lizard	Sceloporus occidentalis	L	L	L	L			X	
Sagebrush Lizard	Sceloporus graciosus	L	L	L	L			X	
Western Skink	Eumeces skiltonianus	L	L	L	L				X
Rubber Boa	Charina bottae	L	H	L	L			X	X
Racer	Coluber constrictor	L	L	L	L			X	
Gopher Snake	Pituophis melanoleucus							X	
Common Garter Snake	Thamnophis sirtalis	L	L	L	L	X	X	X	X
Western Garter Snake	Thamnophis elegans	L	L	L	L	X	X	X	X
Western Rattlesnake	Crotalus viridis	H	H	H	H		X	X	

[a] Key to Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

[b] Key to Habitat Types: 1=Wet Meadows, 2=Lodgepole Pine, 3=Douglas Fir, 4=Subalpine.

TABLE 7. RELATIVE ABUNDANCE AND HABITAT LISTINGS FOR BIRDS IN VULCAN HOT SPRINGS KGRA

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Whistling Swan	Olor columbianus	U	U	U	U				
Canada Goose	Branta canadensis	M	L	M	L	X			
Mallard	Anas platyrhynchos	M	L	M	P	X	X		
Pintail	Anas acuta	U	U	U	U				
Gadwall	Anas strepera	U	U	U	U				
Wigeon	Anas americana	U	U	U	U				
Northern Shoveler	Anas clypeata	U	U	U	U				
Blue-winged Teal	Anas discors	U	U	U	U				
Cinnamon Teal	Anas cyanoptera	U	U	U	U				
Green-winged Teal	Anas crecca	M	L	M	P		X		
Wood Duck	Aix sponsa	U	U	U	U				
Canvasback	Aythya valisineria	U	U	U	U				
Ring-necked Duck	Aythya Collaris	U	U	U	U				
Greater Scaup	Aythya marila	U	U	U	U				
Lesser Scaup	Aythya affinis	U	U	U	U				
Common Goldeneye	Bucephala clangula	U	U	U	U				
Barrow's Goldeneye	Bucephala islandica	U	U	U	U				
Bufflehead	Bucephala albeola	U	U	U	U				
Ruddy Duck	Oxyura jamaicensis	U	U	U	U				
Common Merganser	Mergus merganser	M	M	M	M		X	X	
Hooded Merganser	Lophodytes cucullatus	U	U	U	U				
Turkey vulture	Cathartes aura	U	U	U	U				
Goshawk	Accipiter gentilis	M	M	M	M	X	X	X	X
Cooper's Hawk	Accipiter cooperii	L	L	L	P			X	
Sharp-shinned Hawk	Accipiter striatus	L	L	L	P			X	

TABLE 7. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Marsh Hawk	Circus cyaneus	L	L	L	P	X			
Rough-legged Hawk	Buteo lagopus	L	L	L	M	X	X	X	X
Red-tailed Hawk	Buteo jamaicensis	H	H	H	M	X	X	X	X
Ferruginous Hawk	Buteo regalis	L	L	L	L	X	X	X	X
Swainson's Hawk	Buteo swainsoni	L	L	L	P			X	
Golden Eagle	Aquila chrysaetos	H	H	H	H	X	X	X	X
Bald Eagle	Haliaeetus leucocephalus	M	L	H	M	X	X	X	X
Osprey	Pandion haliaetus	L	L	L	P	X			
Peregrine Falcon	Falco peregrinus	A	A	A	P				X
American Kestrel	Falco sparverius	H	H	L	L	X	X	X	X
Blue Grouse	Dendragapus obscurus	M	M	H	H	X	X	X	X
Spruce Grouse	Canachites canadensis	M	M	M	M	X	X	X	X
Ruffed Grouse	Bonasa umbellus	H	H	H	H	X	X	X	X
Chukar	Alectoris chukar	U	U	U	U				
Sandhill Crane	Grus canadensis	L	L	L	P	X			
Killdeer	Charadrius vociferus	L	L	L	L	X	X	X	X
Spotted Sandpiper	Actitis macularia	P	P	P	P				
Least Sandpiper	Erolia minutilla	U	U	U	U				
Western Sandpiper	Ereunetes mauri	U	U	U	U				
Wilson's Phalarope	Steganopus tricolor	U	U	U	U				
Common Snipe	Capella gallinago	U	U	U	U				
California Gull	Larus californicus	M	M	M	P	X			
Ring-billed Gull	Larus delawarensis	U	U	U	U				
Franklin's Gull	Larus pipixcan	U	U	U	U				
Mourning Dove	Zenaidura macroura	M	M	L	L		X	X	

TABLE 7. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Screech Owl	Otus asio	L	L	L	L			X	
Great Horned Owl	Bubo virginianus	L	L	L	L	X	X	X	X
Long-eared Owl	Asio otus	U	U	U	U				
Great Gray Owl	Strix nebulosa	U	U	U	U				
Flammulated Owl	Otus flammeolus	U	U	U	U				
Saw-whet Owl	Aegolius acadicus	L	L	L	L	X	X	X	X
Poor Will	Phalaenoptilus nuttallii	L	M	L	P			X	
Common Nighthawk	Chordeiles minor	M	M	L	L		X	X	
Broad-tailed Hummingbird	Selasphorus platycercus	L	L	L	P			X	X
Calliope Hummingbird	Stellula calliope	U	U	U	U				
Rufous Hummingbird	Selasphorus rufus	L	L	L	L	X	X	X	X
Belted Kingfisher	Megaceryle alcyon	M	M	M	M	X	X	X	X
Common Flicker	Colaptes auratus	M	M	M	M			X	
Pileated Woodpecker	Dryocopus pileatus	M	H	L	L	X	X	X	X
Lewis's Woodpecker	Asyndesmus lewis	M	M	L	P			X	
White-headed Woodpecker	Dendrocopos albolarvatus	U	U	U	U				
Yellowbellied Sapsucker	Sphyrapicus varius	U	U	U	U				
Williamson's Sapsucker	Sphyrapicus thyroideus	U	U	U	U				
Hairy Woodpecker	Dendrocopos villosus	L	L	L	L	X	X	X	X
Downy Woodpecker	Dendrodopos pubescens	L	L	L	L			X	
Northern Three-toed Woodpecker	Picoides tridactylus	U	U	U	U				
Say's Phoebe	Sayornis saya	L	L	L	P			X	
Traill's Flycatcher	Empidonax traillii	L	L	L	P		X	X	X
Hammond's Flycatcher	Empidonax hammondii	U	U	U	U				
Dusky Flycatcher	Empidonax oberholseri	U	U	U	U				

TABLE 7. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Western Wood Pewee	Contopus sordidulus	L	L	L	P			X	X
Olive-sided Flycatcher	Nuttallornis borealis	L	L	L	P		X	X	X
Cliff Swallow	Petrochelidon pyrrhonota	H	H	M	P	X	X	X	
Violet-green Swallow	Tachycineta thalassina	L	L	L	P	X			
Tree Swallow	Iridoprocne bicolor	L	L	L	P			X	
Bank Swallow	Riparia riparia	U	U	U	U				
Rough-winged Swallow	Stelgidopteryx ruficollis	U	U	U	U				
Steller's Jay	Cyanocitta stelleri	M	M	M	L	X	X	X	X
Gray Jay	Perisoreus canadensis	M	M	M	M	X	X	X	X
Black-billed Magpie	Pica pica	H	H	H	H	X	X	X	X
Clark's Nutcracker	Nucifraga columbiana	H	H	H	H	X	X	X	X
Common Raven	Corvus corax	H	H	H	H	X	X	X	X
Common Crow	Corvus brachyrhynchos	L	M	M	L		X	X	X
Black-capped Chickadee	Parus atricapillus	L	M	L	L	X	X	X	X
Mountain Chickadee	Parus gambeli	H	H	L	L	X	X	X	X
Plain Titmouse	Parus inornatus	L	L	L	L			X	
Dipper	Cinclus mexicanus	M	M	M	M	X	X	X	X
White-breasted Nuthatch	Sitta carolinensis	H	H	H	H	X	X	X	X
Red-breasted Nuthatch	Sitta canadensis	H	H	H	H	X	X	X	X
Pigmy Nuthatch	Sitta pygmaea	L	L	L	L	X	X	X	X
Brown Creeper	Certhia familiaris	L	L	L	L	X	X	X	X
House Wren	Troglodytes aedon	M	M	M	L	X	X	X	X
Winter Wren	Troglodytes troglodytes	L	L	L	P	X	X	X	
Rock Wren	Salpinctes obsoletus	M	M	P	P			X	
Gray Catbird	Dumetella carolinensis	U	U	U	U				

TABLE 7. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Robin	Turdus migratorius	H	H	H	M	X	X	X	X
Hermit Thrush	Hylocichla guttata	L	L	L	P	X	X	X	X
Swainson's Thrush	Hylocichla ustulata	L	L	L	P		X	X	X
Veery	Hylocichla fuscescens	L	L	L	P		X	X	X
Mountain Bluebird	Sialia currucoides	H	H	M	P		X	X	X
Townsend's Solitare	Myadestes townsendi	L	L	H	L	X	X	X	X
Golden-crowned Kinglet	Regulus satrapa	M	M	M	M	X	X	X	X
Ruby-crowned Kinglet	Regulus calendula	L	L	L	L	X	X	X	X
Water Pipit	Anthus spinoletta	U	U	U	U				
Bohemian Waxwing	Bombycilla garrula	L	L	L	L	X	X	X	X
Cedar Waxwing	Bombycilla cedrorum	U	U	U	U				
Northern Shrike	Lanius excubitor	L	L	L	L	X	X	X	
Loggerhead Shrike	Lanius ludovicianus	L	L	L	L	X	X	X	
Starling	Sturnus vulgaris	M	M	M	M	X	X	X	X
Warbling Vireo	Vireo gilvus	L	L	L	P			X	
Orange-crowned Warbler	Vermivora celata	U	U	U	U				
Yellow Warbler	Dendroica petechia	L	L	L	P			X	
Yellow-rumped Warbler	Dendroica coronata	H	H	L	P	X	X	X	X
Townsend's Warbler	Dendroica townsendi	L	L	L	P	X	X	X	X
MacGillivray's Warbler	Oporornis tolmiei	L	L	L	P	X	X	X	X
Wilson's Warbler	Wilsonia pusilla	H	L	L	A	X	X	X	
House Sparrow	Passer domesticus	M	M	M	M	X	X	X	
Bobolink	Dolichonyx oryzivorus	U	U	U	U				
Western Meadowlark	Sturnella neglecta	M	M	M	P	X	X		
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	L	L	L	P	X			

TABLE 7. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Red-winged Blackbird	Agelaius phoeniceus	L	L	L	P	X			
Northern Oriole	Icterus galbula	L	L	L	P			X	
Brewer's Blackbird	Euphagus cyanocephalus	L	L	L	P	X			
Western Tanager	Piranga ludoviciana	M	M	L	P	X	X	X	X
Black-headed Grosbeak	Pheucticus melanocephalus	L	L	L	L	X	X	X	X
Lazuli Bunting	Passerina amoena	M	M	L	P			X	X
Evening Grosbeak	Hesperiphona vespertina	L	L	L	L	X	X	X	X
Cassin's Finch	Carpodacus cassinii	M	M	M	M		X	X	X
House Finch	Carpodacus mexicanus	L	L	L	L		X	X	X
Pine Grosbeak	Pinicola enucleator	U	U	U	U				
Gray-crowned Rosy Finch	Leucosticte tephrocotis	U	U	U	U				
Black Rosy Finch	Leucosticte atrata	U	U	U	U				
Common Redpoll	Acanthis flammea	U	U	U	U				
Pine Siskin	Spinus pinus	H	H	H	H	X	X	X	X
American Goldfinch	Spinus tristis	L	L	L	P	X	X	X	X
Red Crossbill	Loxia curvirostra	M	M	H	H	X	X	X	X
White-winged Crossbill	Loxia lecoptera	M	M	H	H			X	X
Green-tailed Towhee	Chlorura chlorura	L	L	L	P	X	X	X	X
Rufous-sided Towhee	Pipilo erythrophthalmus	M	M	L	P	X	X	X	X
Vesper Sparrow	Pooecetes gramineus	P	P	P	P				
Dark-eyed Junco	Junco hyemalis	M	M	M	H	X	X	X	X
Chipping Sparrow	Spizella passerina	H	H	L	L			X	X
White-crowned Sparrow	Zonotrichia leucophrys	L	L	L	L	X	X	X	X
Fox Sparrow	Passerella iliaca	L	L	L	L	X	X	X	X
Lincoln's Sparrow	Melospiza lincolnii	P	P	P	P				
Song Sparrow	Melospiza melodia	L	L	L	L	X	X	X	X

[a]Key to Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

[b]Key to Habitat Types: 1=Wet Meadows, 2=Lodgepole Pine, 3=Douglas Fir, 4=Subalpine.

TABLE 8. RELATIVE ABUNDANCE AND HABITAT LISTINGS FOR MAMMALS IN VULCAN HOT SPRINGS KGRA

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Shrews		H	H	H	H	X	X	X	X
Vagrant Shrew	Sorex vagrans								
Dusky Shrew	Sorex obscurus								
Masked Shrew	Sorex cinereus								
Water Shrew	Sorex palustris								
Bats		M	M	M	M	X	X	X	X
Little Brown Myotis	Myotis lucifugus								
Fringed Myotis	Myotis thysanodes								
Long-legged Myotis	Myotis volans								
California Myotis	Myotis californicus								
Silver-haired Bat	Lasionycteris noctivagans								
Big Brown Bat	Eptesicus fuscus								
Hoary Bat	Lasiurus cinereus								
Western Big-eared Bat	Plecotus townsendi								
Black Bear	Ursus americanus	H	H	H	H	X	X	X	X
Raccoon	Procyon lotor	M	M	M	M	X	X	X	X
Marten	Martes americana	H	H	H	H	X	X	X	X
Weasel		L	L	L	L	X	X	X	X
Shorttail Weasel	Mustela erminea								
Longtail Weasel	Mustela frenata								
Mink	Mustela vison	L	L	L	L	X	X	X	X
River Otter	Lutra canadensis	M	M	M	M	X	X	X	X
Badger	Taxidea taxus	M	M	M	L	X	X	X	X
Striped Skunk	Mephitis mephitis	L	L	L	L	X	X	X	
Coyote	Canis latrans	H	H	H	H	X	X	X	X
Red Fox	Vulpes fulva	L	L	L	L	X	X	X	X
Mountain Lion	Felis concolor	H	H	H	H	X	X	X	X
Canada Lynx	Lynx canadensis	H	H	H	H	X	X	X	X
Bobcat	Lynx rufus	L	L	L	L	X	X	X	X

TABLE 8. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Yellowbelly Marmot	Marmota flaviventris	M	M	M	M			X	X
Columbian Ground Squirrel	Spermophilus columbianus	M	M	M	M	X	X	X	X
Golden-mantled Squirrel	Spermophilus lateralis	H	H	H	H	X	X	X	X
Chipmunk		M	M	M	M	X	X	X	X
Least Chipmunk	Eutamias minimus								
Yellow Pine Chipmunk	Eutamias amoenus								
Red Squirrel	Tamiasciurus hudsonicus	H	H	H	H	X	X	X	X
Northern Flying Squirrel	Glaucomys sabrinus	H	H	H	H	X	X	X	X
Northern Pocket Gopher	Thomomys talpoides	M	M	M	M	X	X	X	X
Beaver	Castor canadensis	M	M	M	M	X	X	X	X
Western Harvest Mouse	Reithrodontomys megalotis	M	M	M	M		X		
Deer Mouse	Peromyscus maniculatus	H	H	H	H	X	X	X	X
Bushytail Woodrat	Neotoma cinerea	H	H	H	H	X	X	X	X
Mountain Phenacomys	Phenacomys intermedius	P	P	P	P	X	X	X	X
Boreal Redback Vole	Clethrionomys gapperi	H	H	H	H	X	X	X	X
Meadow Vole	Microtus pennsylvanicus	H	H	H	H	X	X	X	X
Mountain Vole	Microtus montanus	H	H	H	H	X	X	X	X
Longtail Vole	Microtus longicaudus	P	P	P	P	X			
Richardson Vole	Microtus richardsoni	P	P	P	P	X			
Muskrat	Ondatra zibethica	M	M	M	M	X	X		
House Mouse	Mus musculus	U	U	U	U				
Western Jumping Mouse	Zapus princeps	M	M	M	M			X	
Porcupine	Erethizon dorsatum	H	H	H	H	X	X	X	X
Pika	Ochotona princeps	H	H	H	H		X	X	X
Snowshoe Hare	Lepus americanus	H	H	H	H		X	X	X

TABLE 8. (continued)

Species		Relative Abundance[a]				Habitat Types[b]			
Common Name	Scientific Name	Sp	Su	Fa	Wi	1	2	3	4
Mountain Cottontail	Sylvilagus nuttalli	L	L	L	L	X			
Elk	Cervus canadensis	H	H	H	H	X	X	X	X
Mule Deer	Odocoileus hemionus	H	H	H	H	X	X	X	X
Moose	Alces alces	U	U	U	U				
Mountain Goat	Oreamnos americanus	U	U	U	U				

[a]Key to Relative Abundance: H=High, M=Medium, L=Low, A=Absent, P=Population level unknown, U=Presence unknown.

[b]Key to Habitat Types: 1=Wet Meadows, 2=Lodgepole Pine, 3=Douglas Fir, 4=Subalpine.

Tables 5 through 8 represent a convenient compilation of the information obtained. Since numerous techniques were used to gather these data (sometimes little more than guessing about distributions), it seemed better to simply assign their numbers to some "relative abundance" category. This was the best way to avoid encouraging conclusions by the reader that could not be supported with data. Where blanks occur in the tables, data were either unavailable and the species are believed to be present, or data were too questionable to base an opinion on.

Species of special concern (key species), listed in Table 9, have been classified according to whether they are considered game species, furbearer, or of extended concern because of restricted range, specific habitat requirements, population numbers so low that they may be easily eliminated from Idaho, and/or whether they are threatened or endangered. Because these species have received more consideration in past work, more data are available and Table 9 should be considered rather accurate.

Distributions of some species of concern listed in Table 9 are plotted in Figures 15 through 20, which show their proximities to the KGRA. Species not included in these figures were either ubiquitous or their distributions were unknown, such as would be expected for many of the nongame and migratory species. Included data were taken from the Idaho Environmental Overview and adopted from the county maps. These data must be accepted cautiously. Local habitat variation not included in the overall diagrams will create many exceptions to what is illustrated, providing sufficient research is done.

The Vulcan Hot Springs KGRA apparently has more migrating waterfowl flying over than other geothermal areas (see Table 10). Even so, the area does not serve as a resting area for migrating birds; therefore, it probably should not receive special attention as far as migrating waterfowl are concerned.

TABLE 9. SPECIES OF SPECIAL CONCERN IN OR ON PROXIMITY OF KGRAs AND RESPECTIVE NONCOMPETITIVE APPLICATION AREAS (Classified According to Reason for Concern)

Species		KGRA Areas[a]				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern[b]
Mammals:								
Black Bear	Ursus americanus		/[c]		X	X		
Raccoon	Procyon lotor	X	X	X	X		X	
Marten	Martes americana				X		X	
Fisher	Martes pennanti				/[c]			X
Mink	Mustela vison	X	X	X	X		X	
Wolverine	Gulo luscus				/[c]			X
Gray Wolf	Canis lupus				/[c]			XE
Red Fox	Vulpes fulva	X	X	X	X		X	
Kit Fox	Vulpes macrotis	/[c]						X
Mountain Lion	Felis concolor		X		X	X		
Canada Lynx	Lynx canadensis				X		X	X
Bobcat	Lynx rufus	X	X	X	X		X	X
Idaho Ground Squirrel	Spermophilus brunneus			X				X
Beaver	Castor canadensis	X	X	X	X		X	
Muskrat	Ondatra zibethica	X	X	X	X		X	
Mountain Cottontail	Sylvilagus nuttalli	X	X	X	X	X		
Pygmy Rabbit	Sylvilagus idahoensis	X	X	X		X		
Elk	Cervus canadensis	/[c]	X		X	X		
Mule Deer	Odocoileus hemionus	X	X	X	X	X		
Whitetail Deer	Odocoileus virginianus				/[c]	X		
Moose	Alces alces				/[c]	X		
Pronghorn Antelope	Antilocapra americana	X	X	X		X		
Mountain Goat	Oreamnos americanus				/[c]	X		
Bighorn Sheep	Ovis canadensis	X				X		

TABLE 9. (continued)

Species		KGRA Areas[a]				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern[b]
Birds:								
Canada Goose	Branta canadensis	X	X	X	X	X		
Snow Goose	Chen hyperborea	/[c]	/[c]	/[c]		X		
Ross' Goose	Chen rossii		/[c]			X		
Mallard	Anas platyrhynchos	X	X	X	X	X		
Pintail	Anas acuta	X	X	X	/[c]	X		
Gadwall	Anas strepera	X	X	X	/[c]	X		
Wigeon	Anas americana	X	X	X	/[c]	X		
Northern Shoveler	Anas clypeata	X	X	X	/[c]	X		
Blue-winged Teal	Anas discors	X	X	X	/[c]	X		
Cinnamon Teal	Anas cyanoptera	X	X	X	/[c]	X		
Green-winged Teal	Anas crecca	X	X	X	X	X		
Wood Duck	Aix sponsa	X	X	X	/[c]	X		
Redhead	Aythya americana	X	X	X	/[c]	X		
Canvasback	Aythya valisineria	X	X	X	/[c]	X		
Ring-necked Duck	Aythya collaris	X	X	X	/[c]	X		
Greater Scaup	Aythya marila	X	X	X	/[c]	X		
Lesser Scaup	Aythya affinis	X	X	X	/[c]	X		
Common Goldeneye	Bucephala clangula	X	X	X	/[c]	X		
Barrow's Goldeneye	Bucephala islandica		X	X	/[c]	X		
Bufflehead	Bucephala albeola	X	X	X	/[c]	X		
Ruddy Duck	Oxyura jamaicensis	X	X	X	/[c]	X		
Common Merganser	Mergus merganser	X	X	X	/[c]	X		
Red-breasted Merganser	Mergus serrator		X	X		X		
Hooded Merganser	Lophodytes cucullatus	X	X	X	/[c]	X		
Ferruginous Hawk	Buteo regalis	X	X	X	X			X

TABLE 9. (continued)

Species		KGRA Areas[a]				Special Concern Category		
Common Name	Scientific Name	B	M	C	V	Game	Furbearer	Extended Concern[b]
Bald Eagle	Haliaeetus leucocephalus	X	X	X	X			E
Prairie Falcon	Falco mexicanus	X	X	X				X
Peregrine Falcon	Falco peregrinus	X	X		X			XE
Wild Turkey	Meleagris gallopavo		/[c]			X		
Blue Grouse	Dendragapus obscurus	X	X	X	X	X		
Spruce Grouse	Canachites canadensis	X	X		X	X		
Ruffed Grouse	Bonasa umbellus		X	X	X	X		
Sharp-tailed Grouse	Pedioecetes phasianellus			X		X		X
Sage Grouse	Centrocercus urophasianus	X	X	X		X		
Bobwhite	Colinus virginianus	X				X		X
California Quail	Lophortyx californicus	X	X	X		X		X
Mountain Quail	Oreortyx pictus		X			X		
Ring-necked Pheasant	Phasianus colchicus	X	X	X		X		
Chukar	Alectoris chukar	X	X	X	X	X		
Gray Partridge	Perdix perdix	X	X	X		X		
American Coot	Fulica americana	/[c]	/[c]	X		X		
Common Snipe	Capella gallinago	/[c]	/[c]	X	/[c]	X		
Mourning Dove	Zenaidura macroura	X	X	X	X	X		
Reptiles:								
Ringneck Snake	Diadophis punctatus	X						X
Long-nosed Snake	Rhinocheilus lecontei	X	X					X
Western Ground Snake	Sonora semiannulata	X	X	X				X
Night Snake	Hypsiglena torquata	X	X					X

[a] KGRA Areas: B=Castle Creek-Bruneau, M=Mountain Home, C=Crane Creek, V=Vulcan.
[b] Special Concern: "X"=Classified by the Idaho State Fish and Game as species whose restricted range, specific habitat requirements and/or population numbers make them vulnerable to elimination from the state.
"E"=Indicates species that are federally protected as "Endangered Species", according to the Endangered Species Act (Revised List; August, 1978).
[c] Reported range of species is within close proximity of the non-competitive application areas.

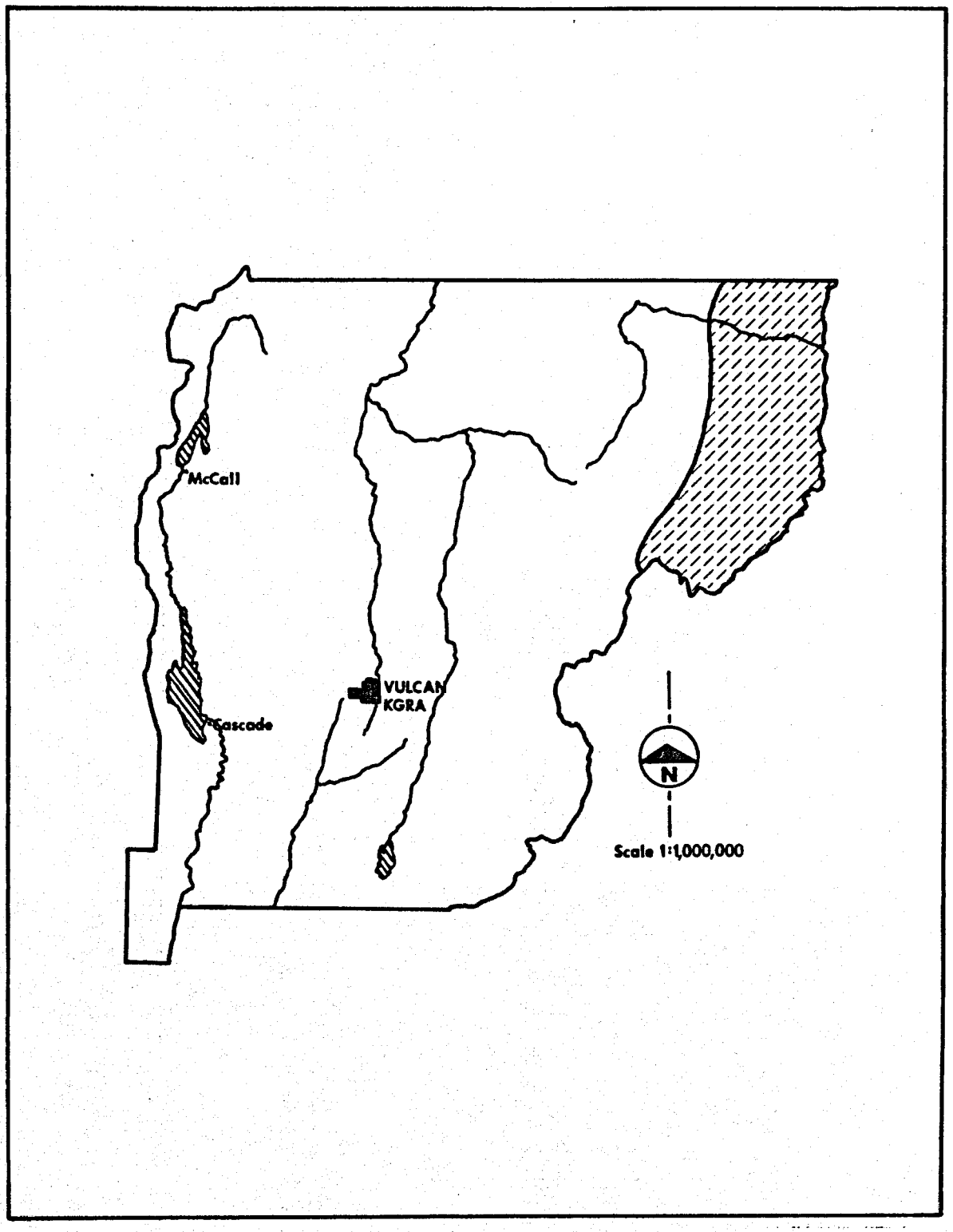

Figure 15. Distribution of elk, Cervis canadensis, habitat within Valley County.

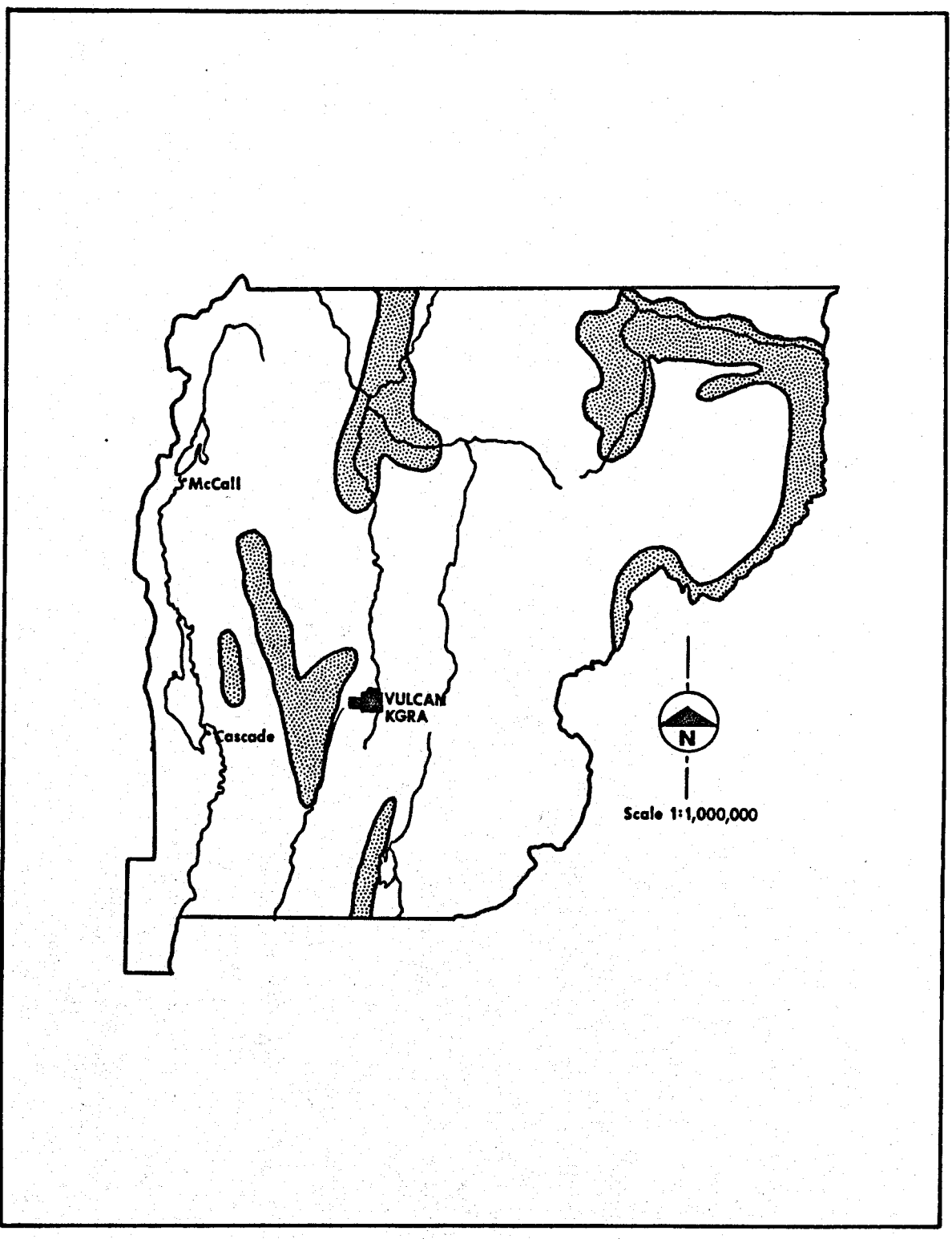

Figure 16. Distribution of mule deer, Odocoileus hemionus, wintering habitat within Valley County.

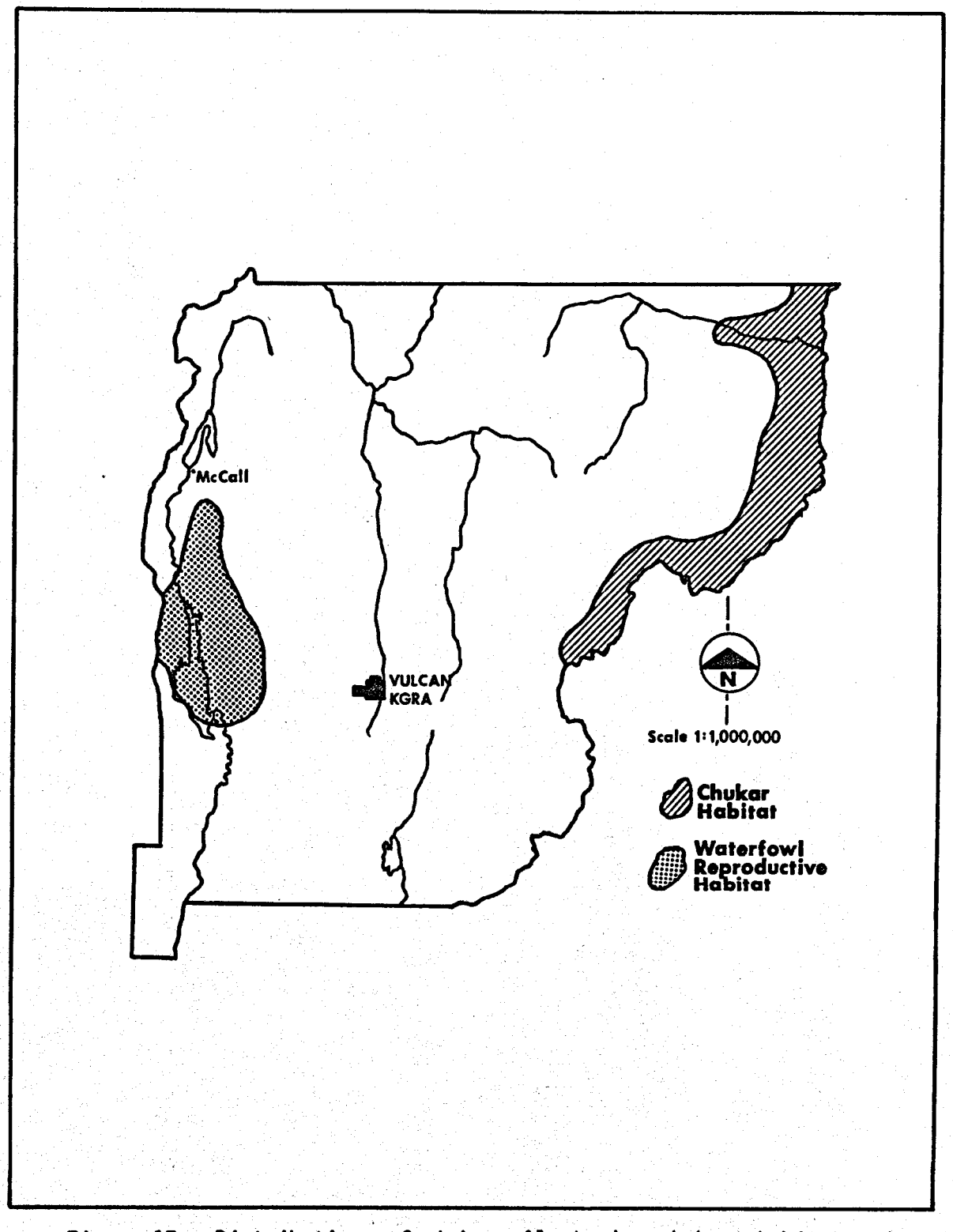

Figure 17. Distributions of chukar, Alectorius chukar, habitat and waterfowl reproduction habitats within Valley County.

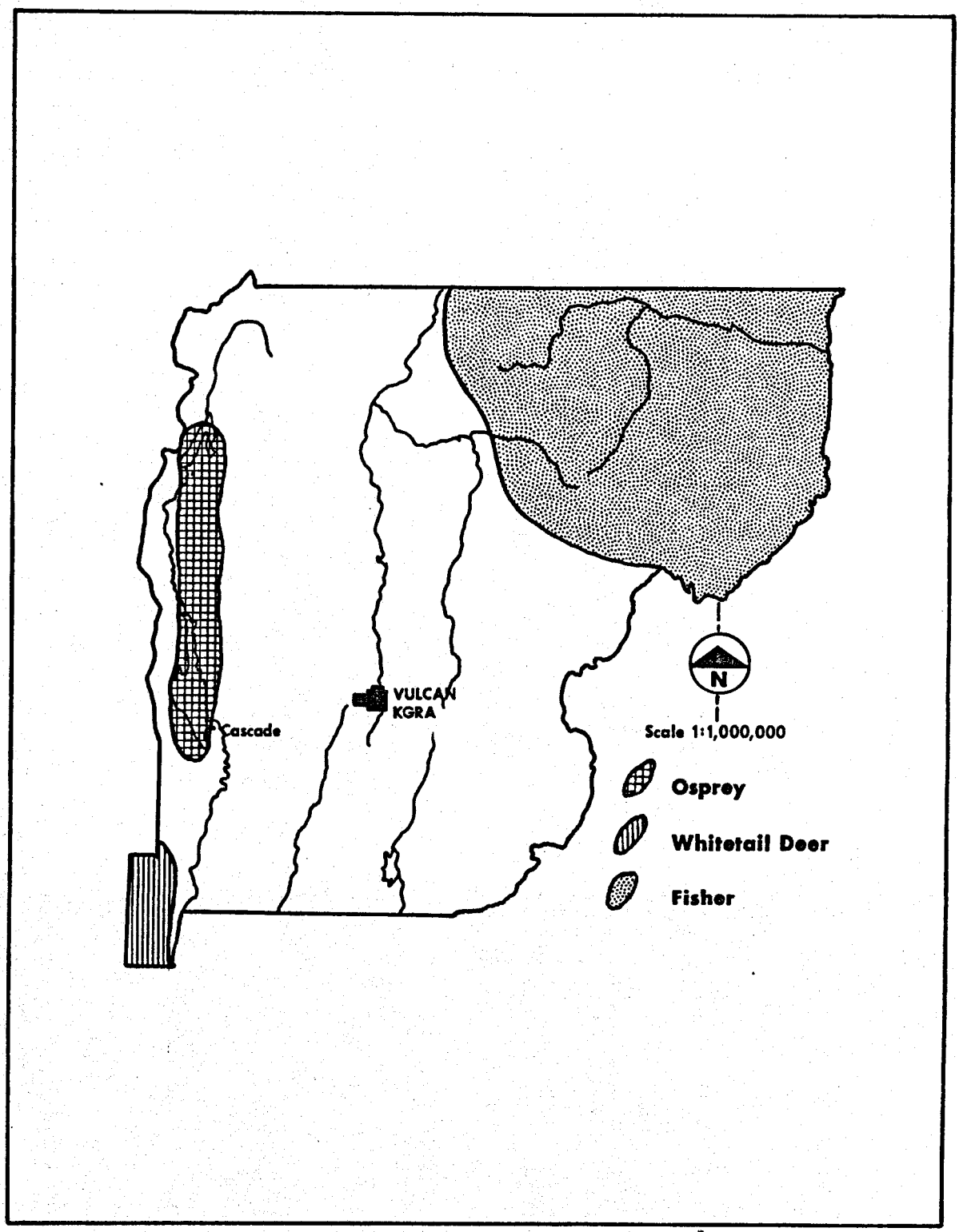

Figure 18. Distributions of fisher, Martes pennanti, osprey, Pandion haliaetus, and whitetail deer, Odocoileus virginianus, habitats within Valley County.

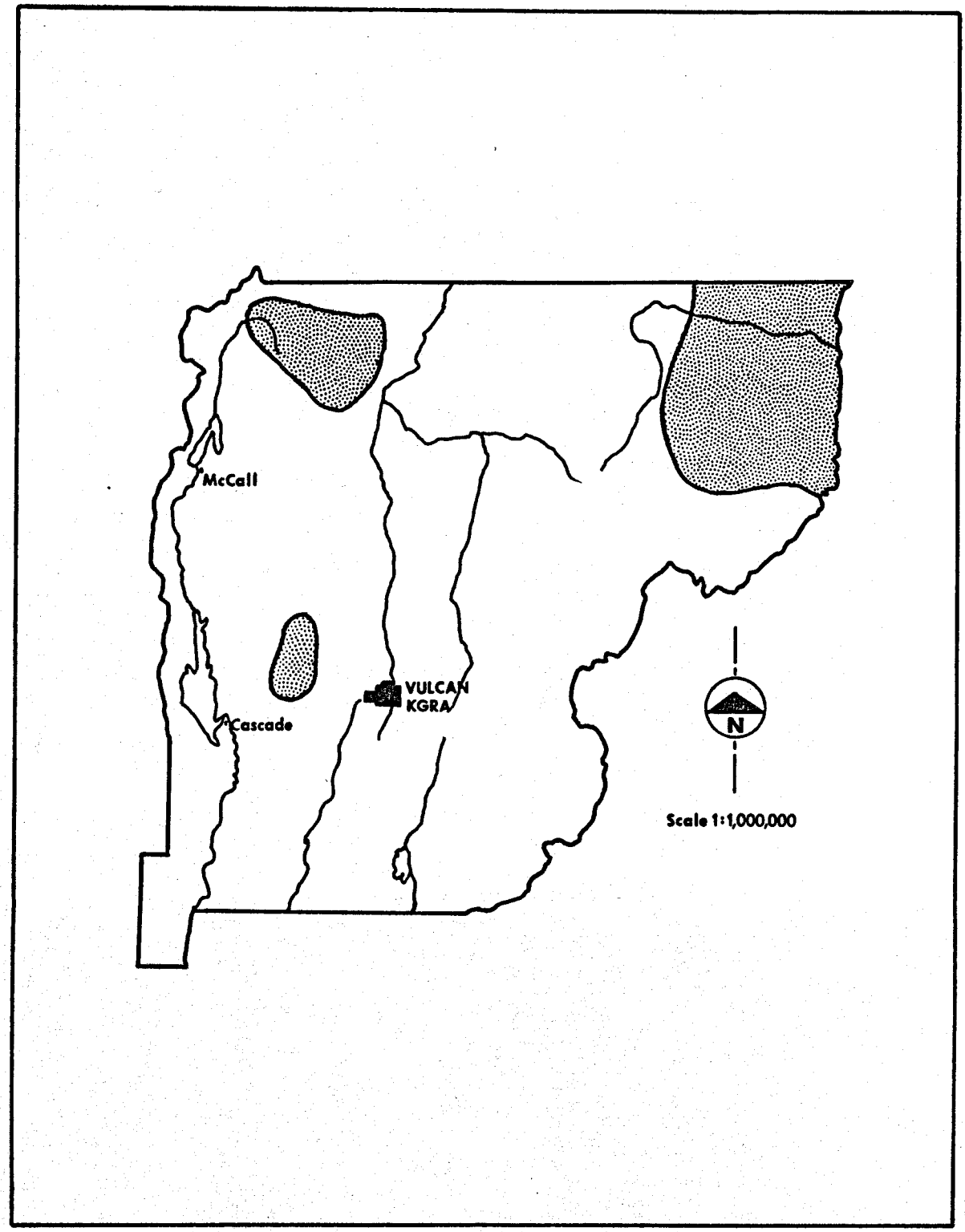

Figure 19. Distribution of mountain goat, Oreamnos americanus, habitat within Valley County.

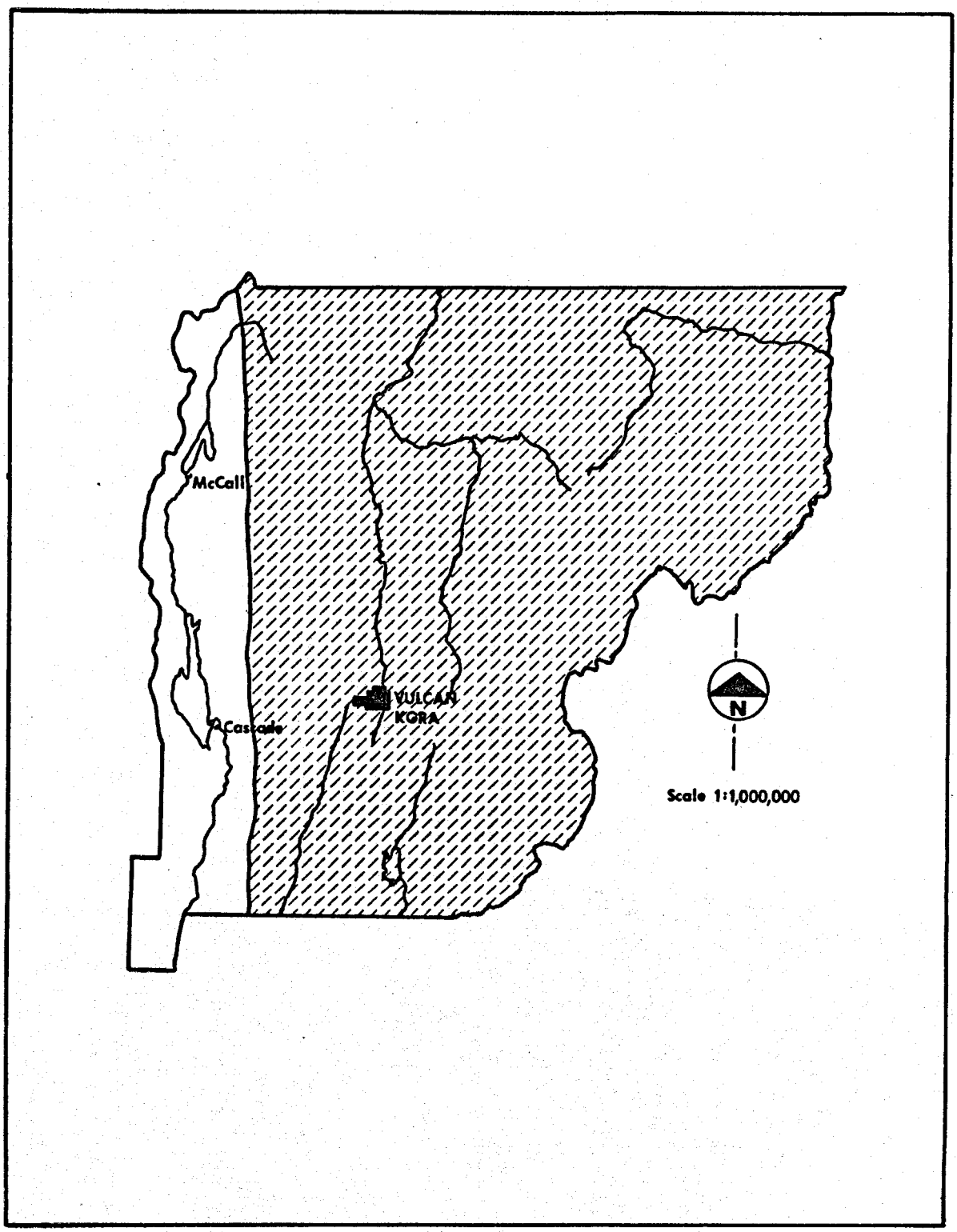

Figure 20. Distributions of marten, Martes americana, and Canada lynx, Lynx canadensis, habitats within Valley County.

TABLE 10. ESTIMATED PERCENTAGE OF MIGRATING DUCKS, GEESE, AND SWANS THAT FLY OVER KGRAs ANNUALLY

Species	Percent Over KGRA's[a]					Total Migrating Birds (thousands)
	Castle Creek	Bruneau	Mountain Home	Crane Creek	Vulcan	
Whistling Swan	—	—	—	—	—	102 - 233
Lesser Snow Goose (Fall)	1 - 2	1 - 2	1 - 2	14 - 11	14 - 11	735 - 2,240
Lesser Snow Goose (Spring)	2 - 2	2 - 2	2 - 2	39 - 41	39 - 41	651 - 2,210
Canada Goose (Small races)	—	—	—	—	—	646 - 1,200
Canada Goose (Large races)	3 - 2	3 - 2	3 - 2	3 - 2	3 - 2	1,558 - 1,718
American Wigeon	17 - 16	17 - 16	17 - 16	17 - 16	17 - 16	2,419 - 4,950
Gadwall	3 - 2	3 - 2	3 - 2	3 - 2	3 - 2	778 - 3,010
Green-Winged Teal	—	—	—	4 - 2	4 - 2	3,176 - 12,870
Blue-Winged Teal	—	—	—	1 - 1	1 - 1	4,442 - 8,330
Mallard	12 - 11	12 - 11	12 - 11	12 - 11	12 - 11	12,078 - 26,850
Pintail	—	—	—	23 - 20	23 - 20	8,520 - 17,500
Shoveler	3 - 4	3 - 4	3 - 4	9 - 9	9 - 9	1,116 - 2,560
Canvasback	—	—	—	—	—	468 - 1,002
Redhead	5 - 6	5 - 6	5 - 6	—	5 - 6	548 - 1,290
Lesser Scaup	—	—	—	—	—	1,724 - 3,960
Bufflehead	—	—	—	—	—	240 - 574
Ruddy Duck	13 - 13	13 - 13	—	—	—	230 - 474

[a]Where a dash is entered in the table implies that major flights over the KGRA are not expected, although the species is likely to be present in small, perhaps incidental numbers.

Another game animal this KGRA could seriously impact is mule deer that migrate through the area to-and-from their winter range. The impact of partial or complete disruption of this route could not be assessed with the data available.

Small birds breeding in and around the Vulcan Hot Springs KGRA will be more numerous than in other KGRAs because of the montane environment. Plots to study these species need to be established, and reproductive success assessed before and after geothermal development begins, since they are likely to be more sensitive to man's presence than other species groups in the KGRA.

Aquatic Ecology (K. P. McCarthy and J. F. Sullivan, EG&G Idaho, Inc.)

Most of the aquatic literature concerning the region near the Vulcan Hot Springs KGRA is on fisheries of the South Fork of the Salmon River. These data should be representative of aquatic habitat potentially impacted by geothermal development.

The channel of the South Fork is about 167 km long and averages 23 m wide and 0.67 m deep. About two-thirds of the river is riffles, with pools comprising the remainder. The drainage supports Idaho's largest population of summer-run chinook salmon, as well as steelhead and other species of salmonids. The most favorable salmon spawning grounds in the river are at Stolle Meadows in the KGRA.

Species diversity and distribution of benthic insects in and near Vulcan Hot Springs was found to be a function of proximity to the thermal discharge. An increase in pH and subsequent reduction in dissolved carbon dioxide downstream of the Hot Springs eliminates the moss, Fontinalis, which supports a diversity of insect species above the confluence. Two key aquatic insects, the damselfly (A. vivida) and the elmid beetle (Microcylloepus pusillus), were studied in the thermal flow, and populations were found to vary along the thermal gradient.[22] An ecological-electrophoretic study of the damselfly

indicated adaptability to a wide range of temperatures. Genetic features in the species developed peculiar to the acclimation temperature.

Habitat surveys of the South Fork conducted in 1975 and 1977 were part of an ongoing effort to monitor fragile fisheries habitat that had been damaged in the mid-1960s. The chinook salmon has decreased to less than 8% of historical runs. The most serious hazard to aquatic habitat in the area is increased siltation due to logging and recreational use. Core samples from the seven major spawning areas on the South Fork revealed 19.1 and 22.2% fines in the spawning gravels at Stolle Meadows in 1975 and 1977, respectively. These values are at least one-third less than the values at the other areas. Interestingly, all percent fine values decreased between 1975 and 1977 except at Stolle Meadows, the highest spawning area. About half as much sand was found on the stream bottom at the upper portion of the river.[35,36] Consequently, spawning conditions for chinook salmon are more favorable at Stolle Meadows. These conclusions substantiate the work of Platts.[37]

Land use plans for the South Fork are cognizant of the degradation of fisheries habitat in the river but assume a small increase in sediment load will not be reflected in the spawning gravels. Planned activities are designed to limit sediment increase in the downstream spawning areas to 5%. Sediment increase will be limited to 12.4% at Stolle Meadows. Activity will be modified should these increases prove degradational to habitat.[38]

W. S. Platts, of the U.S. Forest Service, has pioneered techniques and data assimilation dealing with fisheries of the South Fork. In 1974, an attempt was made to provide data correlating fish response to geomorphic and aquatic settings for the purpose of interdisciplinary ecologic classifications. Conclusions relevant to this study are:

1. Highest fish population densities were found in channels having 30 to 50% pool areas.

2. Streams in depositional valley terrain and dissected mountain areas contained the majority of fish populations.

3. Areas of channels with high populations of rainbow trout had low Dolly Varden populations. Sculpin were found only with rainbow trout.

4. Fish population densities were highest in channels having grass-brush streamside cover. The salmon favored grass cover, while the trout favored brush cover.

5. Although sediment increase is detrimental to spawning, no population density decreases were seen in more sediment-laden channels.

Plant cover in the area varied from herbaceous to shrubby plants. A study of aquatic macrophytes in the Columbia and Snake River drainages indicated a heavy or "nuisance" occurrence of macrophytes in 33% of the areas sampled.

From four samples taken along the South Fork, the following species of macrophytes were present:[39]

1. Ranunculus aquitalis L., Potamogeton praelongus Wolf, taken on the South Fork at 1.6 km below Cabin Creek

2. Ranunculus aquitalis L., taken on the South Fork at 1.6 km above Buckhorn Creek

3. Ranunculus aquitalis L., taken on the South Fork at 4.8 km below Krassel Ranger Station[a]

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a. The Krassel Ranger Station is located approximately 45 km north of the resource area.

4. Fontinalis sp., Ranunculus aquitalis L., taken on Camp Creek at 9.6 km above Krassel Ranger Station.

Of these macrophytes found, Aquitalis was among the taxa most often found in nuisance densities.

Human Environment

The largest part of the demographic and socioeconomic impacts of any significant geothermal resource development at the Vulcan Hot Springs KGRA will be largely confined to the western part of Valley County in Idaho. Most of the population impact will be on the city of McCall. The majority of demographic and socioeconomic data for low-population areas are reported on the county basis. It is expected that the county data will suffice for environmental study purposes.

The data reported in the following sections summarize the larger set of demographic and socioeconomic data for Valley County reported in a regional study of the ten-county southwest Idaho area.[40] Heritage resources in the Vulcan Hot Springs KGRA are also evaluated and discussed.

Demography (W. C. Lewis, Lewis and Associates)

Table 11 summarizes population data for Valley County and the three principal population centers of McCall, Donnelly,and Cascade. These cities are all located on Highway 55, the main artery through the western part of Valley County, and are located west and south of the Vulcan Hot Springs KGRA. Population increased almost 21% in the county between 1970 and 1976. Similar percentage increases were reported in all three of the principal centers. The components of that population change are also reported in Table 11 and show positive

TABLE 11. POPULATION CHANGE IN VALLEY COUNTY FROM 1970 THROUGH 1976

County (Cities)	Population 1970	Population 1976 (1975)[a]	% Change 1970-1976 (1975)[a]
Valley County	3,609	4,400	20.8
(Cascade)	833	1,004	20.5
(Donnelly)	114	143	25.4
(McCall)	1,758	2,147	22.1

Components of Population Change, 1970-1976

Area	Population Change	Births	Deaths	Net Migration
Valley County	800	500	200	500

[a]City data is for 1975.

Source: U. S. Bureau of the Census, 1977. Idaho Department of Health and Welfare, 1977. Idaho Division of Budget, Policy Planning, and Coordination, 1978.

net immigration during the 6-year period. The strong population gain and the associated positive immigration are indicators of a healthy socioeconomic climate. Although it is a low-population area, only 4400 population in 1976, the area is one characterized by growth.

Summary characteristics of the population from the 1970 population census are reported in Table 12. The population of the county is homogeneous, indicated by Caucasians accounting for almost 99% of the total population and only 2.5% of the population being foreign-born. The statistics on educational attainment and percentage of 16- and 17-year-olds in school is about average for this area and relatively good compared to most parts of the country.

Detailed forecasts of population, employment by industry, labor force, and school enrollment through 2000 are reported in Table 13. These data are current, having been developed in July 1978, and provide a more than adequate level of detail for environmental assessment. Such data are essential in an environmental assessment to meet two objectives: (a) to describe the future socioeconomic environment in the absence of any significant resource development and (b) to provide a baseline or standard against which the impacts of development can be compared. The projections show steady population increase for the next 20 years, with end-of-century population estimated at 6490, an increase of 48% over the current level. Similar increases are projected for both employment and labor force.

Summary data on school enrollment and number of teachers in the two school districts in Valley County are reported in Table 14. It is expected that the largest part of any population impact would accrue to McCall, and secondarily to Donnelly. These two cities share a common school district (Idaho School District 421); the names, grades, and enrollment in the elementary, junior high, and senior high schools are reported in Table 15.

TABLE 12. SUMMARY CHARACTERISTICS OF POPULATION FOR VALLEY COUNTY DURING 1970

Characteristics		Number	Percent
Population:	White	3,571	98.9
	Black	--	--
	Other	38	1.1

	Male %	Female %
Median school years completed	12.0	12.4
Percent high school graduates	50.0	64.8
16-17 year-olds in school	87.4	
Percent of population foreign born	2.5	

Source: U. S. Bureau of the Census, 1972a.

TABLE 13. POPULATION AND EMPLOYMENT FORECAST FOR VALLEY COUNTY DURING 1978

EMPLOYMENT SUMMARY

	1972	1975	1980	1985	1990	1995	2000
AGRICULTURE	116	124	111	99	87	79	72
MINING	2	2	2	2	2	2	2
CONSTRUCTION	109	60	87	104	123	145	170
WOOD PRODUCTS	204	187	207	226	248	267	287
OTHER MANUFACTURING	14	18	27	34	41	51	63
TRANS. COMM. AND UTILS	108	128	148	162	178	194	213
WHSLE AND RETAIL TRADE	432	410	495	543	597	654	717
FINANCE, INS, REAL EST	64	98	145	160	223	272	333
SERVICES AND MISC.	350	324	392	436	486	541	603
STATE AND LOCAL GOVT.	303	367	418	463	511	560	616
FEDERAL GOVERNMENT	258	253	254	256	258	260	261
TOTAL	1963	1971	2291	2511	2759	3029	3342

FORECAST SUMMARY

	1970	1975	1980	1985	1990	1995	2000
TOTAL POPULATION	3600	3780	4420	4860	5460	5960	6490
TOTAL EMPLOYMENT *	1960	1970	2290	2510	2750	3020	3340
LABOR FORCE **	2050	2100	2470	2690	2970	3250	3580
TOTAL SCHOOL ENROLLMENT	950	890	990	1120	1360	1500	1580
NURSERY	0	0	0	0	0	0	0
KINDERGARTEN	50	40	70	80	100	100	100
ELEMENTARY	610	500	580	730	870	930	960
HIGH SCHOOL	260	310	300	260	350	420	460
COLLEGE	10	20	30	30	30	30	40
HOUSEHOLD HEADS	1150	1160	1330	1450	1610	1730	1870

* EMPLOYMENT BASE YEAR = 1972
** LABOR FORCE BASE YEAR = 1970
** LABOR FORCE IS DEPENDENT UPON UNEMPLOYMENT RATE AND THE AVERAGE NUMBER OF JOBS HELD BY EACH WORKER

COMPONENTS OF POPULATION GROWTH SUMMARY

	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000
TOTAL CHANGE	182	637	442	593	508	525
NATURAL INCREASE	198	259	311	301	326	387
BIRTHS	382	456	532	544	595	682
DEATHS	184	197	221	243	269	295
MIGRATION	-15	383	133	295	184	139
EMPLOYMENT	-15	383	133	295	184	139
RETIREMENT	0	0	0	0	0	0

Source: Idaho Dept. of Water Resources and Center for Research, Grants and Contracts, Boise State Univ., July, 1978.

TABLE 14. SUMMARY OF EDUCATION DATA FOR VALLEY COUNTY

District	Enrollment				Teachers	Student/ Teacher Ratio
	Elementary[a]	Secondary[b]	Total	Change From 1976-1977		
421 - McCall/Donnelly	419	389	808	-7	43	18.8
422 - Cascade	254	159	313	-11	19	16.5
Total	573	548	1,121	-18	62	17.2

[a]Grades K-6.

[b]Grades 7-12.

Source: Idaho Department of Education, 1977 and 1978.

TABLE 15. NAME, ENROLLMENT, AND LOCATION OF SCHOOLS NEAR VULCAN HOT SPRINGS KGRA IN VALLEY COUNTY DURING 1977 and 1978

City	School	Grades	Enrollment
McCall	McCall-Donnelly Senior High School	9-12	259
Donnelly	McCall-Donnelly Junior High School	7-8	129
McCall	McCall-Donnelly Elementary School	K-6	404

Source: Fennell, 1977.

Crime frequencies and rates per 100 000 population for the period 1971 through 1976 are reported in Table 16. The data suggest relatively low crime rates, although the 1976 rate is more than double that for 1971. The largest number of crimes are in the burglary and larceny categories. Crimes of violence, including murder, rape, and robbery, are very infrequent in this region. Valley County is typical of the low population area in the Intermountain West where crime does not appear to be a significant problem. In the southwest Idaho region, only Ada County, and especially Boise City, appear to have a significant crime problem.

Many analysts suggest that rapid economic growth in low-population areas is almost always associated with a significant increase in the rate of crime. A review of the experiences of several impacted communities suggests this need not be the case. Some places have experienced very rapid increase in the rates of all types of crime, whereas other places have seen no measurable change. Given the magnitude and type of development expected at the Vulcan Hot Springs KGRA, it is not anticipated that crime should be an item of particular concern.

In some areas, rapid population and economic growth has strained the ability of local health care facilities to service an increased number of residents. Many low-population areas provide only limited medical facilities and personnel. In relative terms, Valley County has an adequate number of doctors (six), with a population-per-medical-doctor ratio of 733. Ambulance services are available, and there are two hospitals with 31 acute care beds. Unless geothermal development in this county occurs much more rapidly and at a larger scale than is anticipated, health care facilities should prove adequate.

TABLE 16. CRIME FREQUENCIES AND RATES PER 100 000 POPULATION IN VALLEY COUNTY FROM 1971 THROUGH 1976

	1971	1972	1973	1974	1975	1976
Part I Crimes (Rate)	90 (2,365.9)	39 (1,026.3)	182 (4,671.5)	347 (8,434.6)	190 (4,202.6)	240 (5,282.9)
Murder	0 (-)	0 (-)	0 (-)	2 (48.6)	0 (-)	0 (-)
Rape	0 (-)	0 (-)	0 (-)	1 (24.3)	0 (-)	1 (22.0)
Robbery	0 (-)	0 (-)	0 (-)	0 (-)	0 (-)	1 (22.0)
Aggravated assault	7 (184.0)	3 (78.9)	1 (25.7)	18 (437.5)	8 (177.0)	15 (330.2)
Burglary	50 (1,314.4)	12 (315.8)	97 (2,489.7)	151 (3,670.4)	80 (1,769.5)	82 (1,805.0)
Larceny	30 (788.6)	24 (631.6)	73 (1,873.7)	158 (3,840.5)	89 (1,968.6)	124 (2,729.5)
Motor vehicle theft	3 (78.9)	0 (-)	11 (282.3)	17 (413.2)	13 (287.5)	17 (374.2)

Source: Idaho Law Enforcement Planning Commission, 1978.

Socioeconomics (W. C. Lewis, Lewis and Associates)

Summary data on labor force, unemployment, and employment in Valley County for the period 1974 through 1977 are reported in Table 17. Although employment has grown 14% during this period, the unemployment rate has consistently remained above 12%, suggesting a significant unemployment problem. The average level of unemployment for 1977 was 327 workers. This suggests that not only could the Valley County labor market absorb additional demand for labor from geothermal resource development, such development would contribute toward resolving what appears to be a chronic unemployment problem. New industry employing as many as 250 workers could be absorbed without difficulty.

Detailed employment data for 1971 through 1976 are reported in Table 18, and a detailed analysis of these data is included in Table 19. Between 1971 and 1976, the largest percentage gains in employment were recorded in nondurable goods manufacturing, wholesale trade, and finance, insurance, and real estate. Of particular interest are the location quotients, which indicate the relative specialization of industry in the county when compared to both the nation and the state. A location quotient in excess of unity implies that Valley County has more than a proportionate share of employment in that sector. Relative to the nation, agriculture, construction, and federal civilian government are the relatively important sectors.

Selected housing characteristics from the 1970 U.S. Census of Housing are reported for Valley County in Table 20. While these data are interesting, they are seriously outdated and of only limited value.

Summary data on retail trade and selected services activity for 1972 are reported in Tables 21 and 22. These data provide some indication of the ability of the local private sector to supply goods and services to the existing population and potential increases therein. Both the retail and services activity are concentrated in the urban centers, especially in McCall and Donnelly, and the number

TABLE 17. LABOR FORCE, UNEMPLOYMENT, UNEMPLOYMENT RATE, AND EMPLOYMENT IN VALLEY COUNTY FROM 1974 THROUGH 1977

Year	Labor Force	Unemployment	Unemployment Rate	Employment
			%	
1974	2,018	259	12.8	1,759
1975	2,047	295	14.4	1,752
1976	2,100	265	12.6	1,835
1977	2,325	327	14.1	1,998

Source: Idaho Department of Employment Security, 1977, 1978a, and 1978b.

TABLE 18. EMPLOYMENT BY TYPE AND BROAD INDUSTRIAL SOURCES IN VALLEY COUNTY FROM 1971 THROUGH 1976
(Full and Part Time)

ITEM	1971 1/	1972 1/	1973 1/	1974 1/	1975 2/	1976 2/
EMPLOYMENT BY PLACE OF WORK						
TOTAL EMPLOYMENT 3/	1,843	1,886	1,992	1,963	2,240	2,209
NUMBER OF PROPRIETORS	309	308	316	331	328	329
FARM PROPRIETORS	127	124	122	120	119	119
NONFARM PROPRIETORS	182	184	194	211	209	210
TOTAL WAGE AND SALARY EMPLOYMENT	1,534	1,578	1,676	1,632	1,912	1,880
FARM	39	38	37	40	40	53
NON-FARM	1,495	1,540	1,639	1,592	1,872	1,827
PRIVATE	976	1,005	1,071	997	1,136	1,116
AG.SERV.,FOR.,FISH.,AND OTHER 4/	(D)	17	21	22	25	28
MINING	(D)	2	2	3	3	4
CONSTRUCTION	61	112	126	94	73	80
MANUFACTURING	299	228	242	245	232	244
NON-DURABLE GOODS	2	(D)	(D)	11	28	13
DURABLE GOODS	297	(D)	(D)	234	204	231
TRANSPORTATION AND PUBLIC UTILITIES	92	107	111	113	153	124
WHOLESALE TRADE	3	3	6	8	4	15
RETAIL TRADE	232	265	284	250	318	292
FINANCE,INSURANCE,AND REAL ESTATE	35	40	47	50	65	79
SERVICES	234	231	232	212	263	250
GOVERNMENT AND GOVERNMENT ENTERPRISES	519	535	568	595	736	711
FEDERAL, CIVILIAN	174	184	196	202	321	285
FEDERAL, MILITARY	37	35	35	38	36	34
STATE AND LOCAL	308	316	337	355	379	392

1/ ESTIMATES BASED ON 67 SIC.
2/ ESTIMATES BASED ON 72 SIC.
3/ CONSISTS OF WAGE AND SALARY JOBS PLUS NUMBER OF PROPRIETORS.
4/ INCLUDES NUMBER OF JOBS HELD BY U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.
PRIMARY SOURCE FOR PRIVATE NON-FARM EMPLOYMENT: ES-202 COVERED WAGES - IDAHO DEPT. OF EMPLOYMENT
(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL DATA. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, August, 1978.

TABLE 19. EMPLOYMENT BY TYPE AND BROAD INDUSTRIAL SOURCES IN VALLEY COUNTY FROM 1971 THROUGH 1976
(Full and Part Time - Summary Analytics)

ITEM	PERCENT OF U.S. 1976	PERCENT OF STATE 1976	% TOTAL W+S EMPL 1976	PERCENT CHANGE 76/71	PERCENT CHANGE 76/75	LOCATION QUOTIENT U.S. 1976	LOCATION QUOTIENT STATE 1976
EMPLOYMENT BY PLACE OF WORK							
TOTAL EMPLOYMENT 1/	.0023	.57		20	-1		
NUMBER OF PROPRIETORS	.0038	.58		6	0		
FARM PROPRIETORS	.0042	.43		-6	0		
NONFARM PROPRIETORS	.0035	.72		15	0		
TOTAL WAGE AND SALARY EMPLOYMENT	.0022	.57		23	-2		
FARM	.0038	.22	2.82	36	33	1.7357	.3853
NON-FARM	.0022	.60	97.18	22	-2	.9879	1.0485
PRIVATE	.0017	.49	59.36	14	-2	.7632	.8581
AG.SERV.,FOR.,FISH.,AND OTHER 2/	.0074	1.16	1.49	(D)	12	3.4020	2.0297
MINING	.0005	.12	.21	(D)	33	.2346	.2086
CONSTRUCTION	.0022	.47	4.26	31	10	1.0104	.8144
MANUFACTURING	.0013	.47	12.98	-18	5	.5854	.8182
NON-DURABLE GOODS	.0002	.05	.69	550	-54	.0748	.0945
DURABLE GOODS	.0021	.82	12.29	-22	13	.9506	1.4377
TRANSPORTATION AND PUBLIC UTILITIES	.0027	.75	6.60	35	-19	1.2398	1.3022
WHOLESALE TRADE	.0003	.08	.80	400	275	.1500	.1312
RETAIL TRADE	.0022	.56	15.53	26	-8	1.0037	.9704
FINANCE,INSURANCE,AND REAL ESTATE	.0018	.63	4.20	126	22	.8285	1.1035
SERVICES	.0015	.50	13.30	7	-5	.7049	.8648
GOVERNMENT AND GOVERNMENT ENTERPRISES	.0040	.92	37.82	37	-3	1.8361	1.6090
FEDERAL, CIVILIAN	.0099	2.56	15.16	64	-11	4.5270	4.4605
FEDERAL, MILITARY	.0014	.28	1.81	-8	-6	.6225	.4900
STATE AND LOCAL	.0032	.73	20.85	27	3	1.4537	1.2703

1/ CONSISTS OF WAGE AND SALARY JOBS PLUS NUMBER OF PROPRIETORS.
2/ INCLUDES NUMBER OF JOBS HELD BY U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.
PRIMARY SOURCE FOR PRIVATE NON-FARM WAGE AND SALARY EMPLOYMENT: IDAHO DEPT. OF EMPLOYMENT
(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, August, 1978.

TABLE 20. SELECTED HOUSING CHARACTERISTICS IN VALLEY COUNTY DURING 1970

Characteristics		Total	Rural
Number of year-round units		1,557	1,557
Onwer occupied:	Number	829	829
	Percent	53.2%	53.2%
Vacant units		407	407
Vacancy rate		26.1%	26.1%
With all plumbing facilities:	Number	1,496	1,496
	Percent	96.1%	96.1%
On public sewer:	Number	1,088	1,088
	Percent	69.9%	69.9%
Median value--owner occupied		$12,300	$12,300
Contract rent--renter occupied		70	70

Source: U. S. Bureau of the Census, 1972c.

TABLE 21. SUMMARY OF RETAIL TRADE DATA FOR VALLEY COUNTY DURING 1972

		Valley County
All establishments:	Number	87
	Sales (000)	$8,151
Establishments with payroll:	Number	56
	Sales (000)	$7,379
	Payroll (000)	$811
	Employees	192
Number of establishments:		
Building materials, hardware, etc.		2
General merchandise		3
Food stores		8
Automotive dealers		6
Service stations		11
Apparel and accessory stores		--
Furniture and home furnishings		3
Eating and drinking places		31
Drug stores		2
Miscellaneous		21

Source: U. S. Department of Commerce, 1976c.

TABLE 22. SUMMARY OF SELECTED SERVICES DATA FOR VALLEY COUNTY DURING 1972

		Valley County
All establishments:	Number	50
	Receipts (000)	$1,469
Establishments with payroll:	Number	20
	Receipts (000)	$1,107
	Payroll (000)	338
	Employees	122

	Valley County	
	Number	Receipts
Hotels, motels, etc.	15	$996
Automotive repair	3	(D)
Miscellaneous repair	4	(D)
Amusement and recreation	7	90
Legal services	5	78

(D) -- not reported to avoid disclosure of individual firm data.

Source: U. S. Department of Commerce, 1976f.

of establishments in each category is relatively small. Detailed data on personal income by major source and a set of summary analytics are reported in Tables 23 and 24. These data are provided by the Regional Economics Information System developed and managed by the Bureau of Economic Analysis, U.S. Department of Commerce. The 1976 level of per capita income, $6482, is right at the national average and about 13% above the average for Idaho. Excluding Ada County, per capita income in Valley County is higher than any other county in southwest Idaho.

Data on agriculture are especially important because that sector may be significantly impacted by geothermal development. Summary data from the 1974 Census of Agriculture are reported in Table 25. This sector accounts for only 8% of total county earnings, and agriculture is far less important in Valley County than in many other surrounding counties. The average farm size (447 hectares) is relatively large, but only 4.5% of county land area is in farms. In fact, only 1.1% of all land is in cropland. The value of land and buildings per farm is almost $300 000. In the aggregate, irrigated agriculture is relatively unimportant in terms of land area, as it accounts for only 0.8% of all land and 17% of farmland. However, because geothermal development may impact the quantity and quality of water available from wells, the area of irrigated agriculture may be especially important. Related to agriculture is the entire question of land use. Summary data on that subject are reported in Table 26. Only 0.1% of total land area is in urban use. Another 13.4% is in agriculture and rangeland. The dominant landowner is the federal government, accounting for 88% of total landownership. This is not atypical in the intermountain region, which suggests a special set of problems when evaluating any potential development in Valley County.

Land-use control mechanisms are also inventoried in Table 26. The county has a subdivision ordinance and a planning and zoning commission. The secondary source reported no county comprehensive plan or zoning ordinance. Lack of a zoning ordinance is sometimes

TABLE 23. PERSONAL INCOME BY MAJOR SOURCES FOR VALLEY COUNTY FROM 1971 THROUGH 1976
(Thousands of Dollars)

ITEM	1971 1/	1972 1/	1973 1/	1974 1/	1975 2/	1976 2/
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK 3/						
BY TYPE						
WAGE AND SALARY DISBURSEMENTS	9,680	10,419	11,302	12,189	14,506	15,162
OTHER LABOR INCOME	511	646	743	854	1,265	1,345
PROPRIETORS INCOME 4/	2,128	2,757	3,569	3,418	3,217	3,378
FARM	765	1,238	1,799	1,545	1,238	1,177
NON-FARM 4/	1,363	1,519	1,770	1,873	1,979	2,201
BY INDUSTRY						
FARM	977	1,467	2,051	1,838	1,550	1,579
NON-FARM	11,342	12,355	13,563	14,623	17,398	18,306
PRIVATE	7,507	8,206	9,014	9,707	11,539	12,353
AG.SERV.,FOR.,FISH.,AND OTHER 5/	(D)	119	120	112	151	173
MINING	(D)	-71	-53	-100	-101	-112
CONSTRUCTION	587	1,095	1,452	1,335	1,187	1,394
MANUFACTURING	2,999	2,631	2,594	3,060	3,243	3,636
NON-DURABLE GOODS	(L)	(D)	(D)	83	212	95
DURABLE GOODS	2,985	(D)	(D)	2,977	3,031	3,543
TRANSPORTATION AND PUBLIC UTILITIES	842	1,134	1,265	1,412	2,076	1,881
WHOLESALE TRADE	118	122	140	197	197	203
RETAIL TRADE	1,295	1,495	1,655	1,671	2,157	2,253
FINANCE,INSURANCE, AND REAL ESTATE	359	412	439	513	667	852
SERVICES	1,200	1,269	1,402	1,507	1,942	1,991
GOVERNMENT AND GOVERNMENT ENTERPRISES	3,835	4,149	4,549	4,916	5,859	5,953
FEDERAL, CIVILIAN	2,546	2,735	2,933	3,069	3,706	3,525
FEDERAL, MILITARY	45	51	53	60	65	67
STATE AND LOCAL	1,244	1,363	1,563	1,787	2,088	2,361
DERIVATION OF PERSONAL INCOME BY PLACE OF RESIDENCE						
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	12,319	13,822	15,614	16,461	18,948	19,885
LESS: PERSONAL CONTRIBUTIONS FOR SOCIAL INSURANCE BY PLACE OF WORK	623	697	771	926	1,079	1,117
NET LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	11,696	13,125	14,843	15,535	17,869	18,768
PLUS: RESIDENCE ADJUSTMENT	-52	-16	-13	23	-29	112
NET LABOR AND PROPRIETORS INCOME BY PLACE OF RESIDENCE	11,644	13,109	14,830	15,558	17,840	18,880
PLUS: DIVIDENDS, INTEREST, AND RENT 7/	2,513	2,916	3,528	4,307	4,766	5,307
PLUS: TRANSFER PAYMENT	1,852	2,049	2,365	3,099	3,778	4,073
PERSONAL INCOME BY PLACE OF RESIDENCE	16,009	18,074	20,723	22,964	26,384	28,260
PER CAPITA PERSONAL INCOME (DOLLARS)	4,335	4,753	5,052	5,273	6,032	6,482
TOTAL POPULATION (THOUSANDS)	3.7	3.8	4.1	4.4	4.4	4.4

1/ ESTIMATES BASED ON 1967 SIC. 2/ ESTIMATES BASED ON 1972 SIC.
3/ CONSISTS OF WAGE AND SALARY DISBURSEMENTS, OTHER LABOR INCOME, AND PROPRIETORS' INCOME.
PRIMARY SOURCE FOR PRIVATE NON-FARM WAGES: ES-202 COVERED WAGES -IDAHO DEPARTMENT OF EMPLOYMENT
4/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR NON-FARM PROPRIETORS.
5/ INCLUDES WAGE AND SALARIES OF U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.
7/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR RENTAL INCOME OF PERSONS.
(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION; DATA ARE INCLUDED IN TOTALS.
(L) LESS THAN $50,000. DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, July, 1978.

TABLE 24. PERSONAL INCOME BY MAJOR SOURCES FOR VALLEY COUNTY FROM 1971 THROUGH 1976
(Summary Analytics)

ITEM	PERCENT OF U.S.	PERCENT OF STATE	% TOTAL EARNINGS	PERCENT CHANGE 76/71	PERCENT CHANGE 76/75	LOCATION QUOTIENT U.S.	LOCATION QUOTIENT STATE
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK 3/							
BY TYPE							
WAGE AND SALARY DISBURSEMENTS	.0017	.52		57	5		
OTHER LABOR INCOME	.0018	.57		163	10		
PROPRIETORS INCOME 4/	.0039	.67		59	5		
FARM	.0065	.63		54	-5		
NON-FARM 4/	.0032	.69		61	11		
BY INDUSTRY							
FARM	.0063	.46	7.94	62	2	3.3250	.8466
NON-FARM	.0018	.55	92.06	61	5	.9431	1.0159
PRIVATE	.0015	.47	62.12	65	7	.7780	.8599
AG.SERV.,FOR.,FISH.,AND OTHER 5/	.0046	.89	.87	(D)	15	2.4281	1.6406
MINING	-.0007	-.22	-.56	(D)	11	-.3854	-.3975
CONSTRUCTION	.0023	.45	7.01	137	17	1.2214	.8367
MANUFACTURING	.0013	.54	18.30	21	12	.7061	.9975
NON-DURABLE GOODS	.0001	.03	.48	(D)	-55	.0500	.0637
DURABLE GOODS	.0021	.89	17.82	19	17	1.0890	1.6438
TRANSPORTATION AND PUBLIC UTILITIES	.0024	.72	9.46	123	-9	1.2661	1.3198
WHOLESALE TRADE	.0004	.12	1.42	140	44	.2121	.2133
RETAIL TRADE	.0021	.53	11.33	74	4	1.0803	.9751
FINANCE,INSURANCE, AND REAL ESTATE	.0015	.59	4.28	137	24	.8132	1.0929
SERVICES	.0012	.38	10.01	66	3	.6092	.7051
GOVERNMENT AND GOVERNMENT ENTERPRISES	.0032	.89	29.94	55	2	1.6850	1.6292
FEDERAL, CIVILIAN	.0078	1.97	17.73	38	-5	4.1226	3.6188
FEDERAL, MILITARY	.0004	.09	.34	49	3	.1913	.1703
STATE AND LOCAL	.0019	.56	11.87	90	13	1.0144	1.0326
DERIVATION OF PERSONAL INCOME BY PLACE OF RESIDENCE							
TOTAL LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	.0019	.54		61	5		
LESS: PERSONAL CONTRIBUTIONS FOR SOCIAL INSURANCE BY PLACE OF WORK	.0020	.57		79	4		
NET LABOR AND PROPRIETORS INCOME BY PLACE OF WORK	.0019	.54		60	5		
NET LABOR AND PROPRIETORS INCOME BY PLACE OF RESIDENCE	.0019	.54		62	6		
PLUS: DIVIDENDS, INTEREST, AND RENT 7/	.0028	.91		111	11		
PLUS: TRANSFER PAYMENTS	.0021	.67		120	8		
PERSONAL INCOME BY PLACE OF RESIDENCE	.0021	.60		77	7		

3/ CONSISTS OF WAGE AND SALARY DISBURSEMENTS, OTHER LABOR INCOME, AND PROPRIETORS' INCOME.
PRIMARY SOURCE FOR PRIVATE NON-FARM WAGES: ES-202 COVERED WAGES -IDAHO DEPARTMENT OF EMPLOYMENT
4/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR NON-FARM PROPRIETORS.
5/ INCLUDES WAGE AND SALARIES OF U.S. RESIDENTS WORKING FOR INTERNATIONAL ORGANIZATIONS.
7/ INCLUDES THE CAPITAL CONSUMPTION ADJUSTMENT FOR RENTAL INCOME OF PERSONS.
(D) NOT SHOWN TO AVOID DISCLOSURE OF CONFIDENTIAL INFORMATION, DATA ARE INCLUDED IN TOTALS.

Source: Regional Economics Information System, Bureau of Economic Analysis, July, 1978.

TABLE 25. GENERAL AGRICULTURAL DATA FOR VALLEY COUNTY DURING 1974

Number of farms	97
Land in farms (acres)	106,993
Average farm size (acres)	1,103
County land area (acres	2,352,640
Percent in farms	4.5%
Value of land and buildings	
Total (000)	$28,807
Per farm	$296,977
Per acre	$269
Cropland (acres)	25,484
Percent of all land	1.1%
Percent of all farmland	23.8%
Irrigated land (acres)	18,339
Percent of all land	0.8%
Percent of all farmland	17.1%
Quantity of irrigation water applied (ac ft)	43,114
Per acre (ac ft)	2.4
Value of agricultural products sold--total (000)	$3,444
Average per farm	$35,504

Source: U. S. Bureau of the Census, 1977.

TABLE 26. SUMMARY DATA ON LAND USE, LAND OWNERSHIP, AND LAND-USE CONTROL MECHANISMS IN VALLEY COUNTY DURING 1976 AND 1977

	Acres	% of Total
Land Use--1976:		
Urban	2,100	0.1
Agricultural	76,100	3.2
Rangeland	244,100	10.2
Other	2,070,700	86.5
Land Ownership--1977:		
Federal government	2,070,583	88.0
State government	67,436	2.8
Private	213,441	9.1
Local government	2,180	0.1
Land-Use Control Mechanisms:		
Planning and Zoning Commission	Yes	
County Comprehensive Plan	No	
Subdivision Ordinance	Yes	
Zoning Ordinance	No	

Source: Idaho Division of Budget, Policy Planning, and Coordination, 1978

seen as a problem in the sense of the public sector not being able to direct land development. Solid economic analyses suggest that the absence of a zoning ordinance may in fact be optimal.

Summary data on assessed value and property tax charges for 1977 are reported in Table 27. Assessed value per capita for all property and real and personal property are $4592 and $350, respectively. The per capita property tax charge in 1977 was $314.

Heritage Resources (R. Knudson and M. Pfaff, Idaho Water Resources Research Institute)

Potential and known heritage resources for the Vulcan Hot Springs KGRA are evaluated in the following discussion. The topics covered in the evaluation are paleontological, prehistoric, and historic resources.

Paleontological Resources. No formal paleontological survey has been conducted for the Vulcan Hot Springs KGRA and no paleontological materials have been reported from the locality. The bedrock under the KGRA is the Idaho Batholith, a felsic Cretaceous pluton covered with Quaternary valley alluvium, which has a low potential for producing significant paleontological remains.

Prehistoric Resources. In August 1977, Boise National Forest archaeologists conducted a brief reconnaissance of some segments of the Vulcan Hot Springs KGRA, particularly Tyndall Creek bottoms, the western segment of Stolle Meadows, the Rice Creek terraces where that creek breaks out into the South Fork Salmon valley, and the trail from the South Fork up to Vulcan Hot Springs.[41] The survey covered 6% of the total KGRA and approximately 22% of the alluvial bottomland. Two small prehistoric lithic scatters were identified along Rice and Tyndall Creeks, respectively. In the survey report the staff archaeologists commented that the dense vegetative cover in the KGRA made ground inspection virtually impossible except on trails and roads

TABLE 27. SUMMARY DATA ON ASSESSED VALUE AND PROPERTY TAX IN VALLEY COUNTY DURING 1977

Assessed value of all property--total (000)	$20,205
Per capita	$4,592
All property tax charges--total (000)	$1,539
Per capita	$350
Property tax charges-real and personal property--total (000)	$1,381
Per capita	$314
Measures of uniformity in assessment ratios:	
Weighted assessment ratio	13.16
Regression index	1.03
Coefficient of variation	44.12

Source: Idaho State Tax Commission, 1977a.

and that not enough time was available for intensive investigation of the entire area. Prince, in her comments on the survey, stated that:[42]

> The discovery of only two limited-activity sites...is suggested to result from their fortuitous presence in areas of high visibility, rather than to be an accurate reflection of the number of sites actually present. Therefore, it is recommended that a 100% survey of this area be carried out before the proposed (geothermal) development takes place.

H. G. Wylie, the Forest Service Southern Idaho Zone Archaeologist, concurred with this opinion and stated that, "The sites appear to be significant for the scientific data they contain."[43]

Ethnographically, both Nez Perce and Shoshoni Indians appear to have exploited the Vulcan Hot Springs area. Years ago, V. Ray recorded ethnographic Nez Perce fishing and hunting camps at Warm Lake and on the Middle Fork of the Payette at the mouth of Bull Creek (north and south of the Vulcan Hot Springs KGRA respectively). This is cited by Schwede,[44,45] used as a basis for defining Nez Perce territory by Chalfant,[46] (see Figure 21) and acknowledged by the Indian Claims Commission[47]. Marshall[48] includes the Vulcan Hot Springs area within his general map of Nez Perce territory. However, it was the recommendation of the expert ethnographers appearing for the Nez Perce in that tribe's claim against the United States Government that those camps did not represent exclusive use and continuous occupancy by the Nez Perce, hence they were not territory meriting seizure compensation. One should expect, then, that the Vulcan Hot Springs and Stolle Meadows within the KGRA were occasionally visited and used by the Nez Perce on their travels between Warm Lake and the Payette, but that they maintained no major residence there.

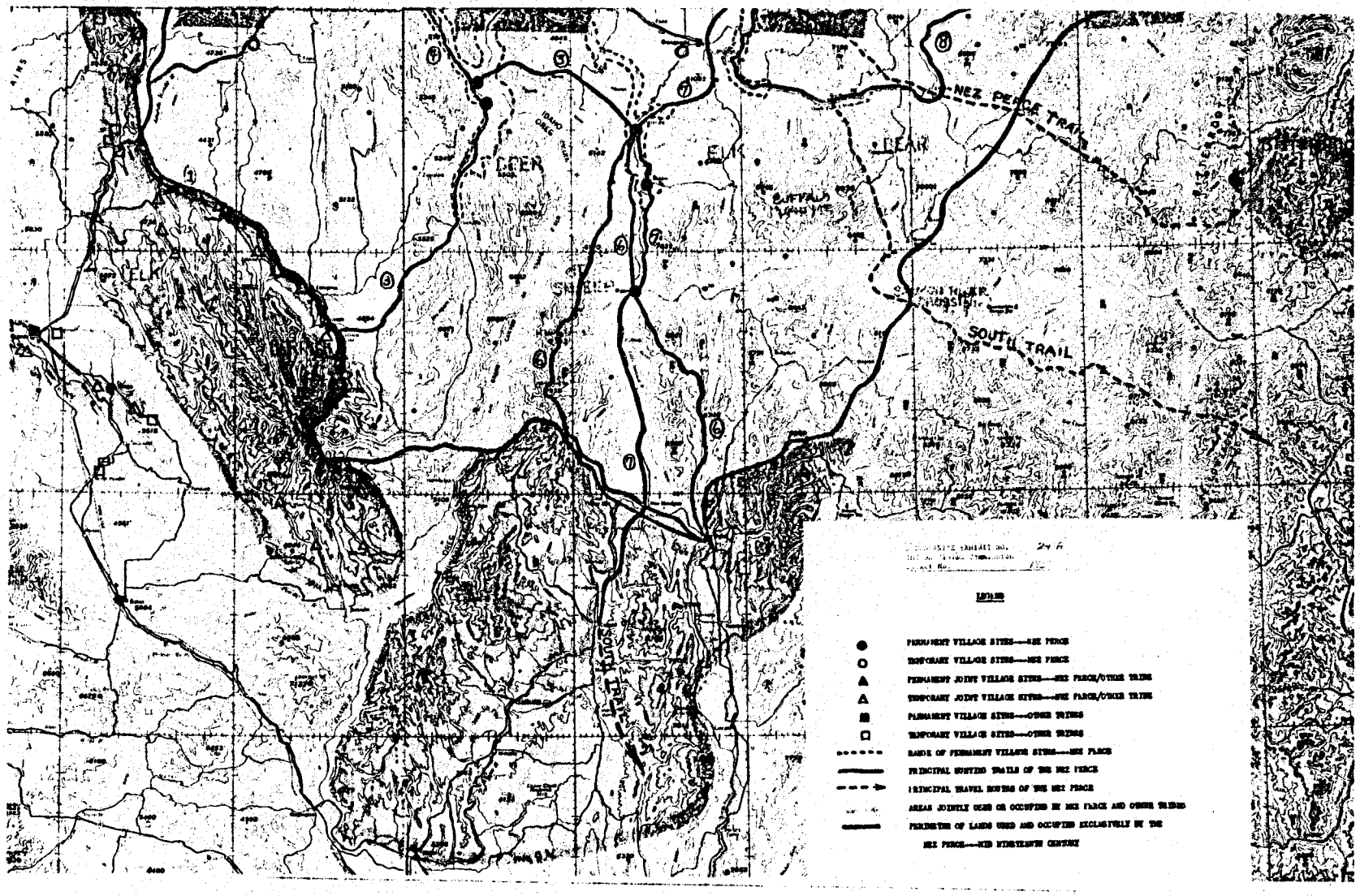

Figure 21. Map of southern portions of pre-AD 1800 Nez Perce territory.

Much the same situation seems to apply to Shoshoni use of the Vulcan Hot Springs area. In most ethnographic accounts of the Lemhi or Western Shoshoni, the mountainous area to the north of Boise is not ascribed to any particular group, certainly to no group as a major settlement area. The Indian Claims Commission[49] ruled that the Lemhi Shoshoni territory had its western border approximately in the Warm Lake-Vulcan Hot Springs area; the inhabitants of the Vulcan area were most likely Sheepeater or Mountain Shoshoni[50]. The Vulcan Hot Springs area, and that valley protion of the South Fork in general, has varied plant and animal resources including camas, anadromous fish (spawning area), deer, and moose. On the basis of the ethnographic information, and in consideration of the locality's topographic position near the divide between the Salmon and Payette drainages, one can hypothesize that the area has been marginal to permanent human settlements for most of prehistory. However, it could be expected to include remnants of a complicated pattern of cultural variation and mixing, with people from both north and south moving in and out of the valley either separately or in concert. Evidence from similar high elevation Salmon River headwaters areas indicates that central montane Idaho has been exploited by human populations for 10 000 years,[51] with fairly continuous use of spawning and hunting grounds over that time period[52]. Recent reconnaissance of the Middle Fork Salmon drainage basin[53] indicates that a culturally complicated archaeological record should be expected to occur throughout this Salmon-Snake River headwaters area, and that this record has the potential of providing data for significant scientific research into human adaptability over time. Thus, while the Vulcan Hot Springs KGRA has received some brief archaeological survey, it needs more thorough reconnaissance and testing to evaluate the presence or absence of significant prehistoric cultural resources.

Historic Resources. No historic resources were recovered during the archaeological survey discussed above, and no specific records of historic exploitation of the area could be found. The KGRA was probably used as at least an occasional camp during the 1820s and

1830s when fur traders were working in the area,[54] since they frequently camped at Warm Lake and Vulcan Hot Springs, a nearby and attractive site. The earliest specific indication of Euroamerican use of the Vulcan Hot Springs KGRA is a map (see Figure 22) of the military route followed by Captain Bernard and his troops during the Sheepeater Campaign of 1879.[55] In Figure 22, the location of the 21 July camp seems to coincide with Vulcan Hot Springs. However, Bernard's diary does not describe this camp in enough detail to determine whether or not it is indeed that site. In any event, the military camp was transient, but is an indication of use of the Vulcan Hot Springs area as a travel route, perhaps for some time. A Forest Service road now follows a similar track, coming south from Warm Lake and running past the Vulcan Hot Springs area to the headwaters of the South Fork of the Salmon.

In the 1890s the Vulcan area became part of the U.S. Forest reserve system, and consequently the area has never been homesteaded. The area was in fact not even surveyed until 1931.[56] A Forest Service Guard Station was built on the eastern side of Stolle Meadows (just east of the Vulcan Hot Springs KGRA), but no record of its original construction date is available. The Eureka Silver King Mine, 3 km south of the KGRA, has been in operation since 1940.[57] Thus, one should expect occasional use of the Vulcan Hot Springs as a picnic and camp area during the historic period, but such activity has probably left little in the way of archaeological or architectural remains.

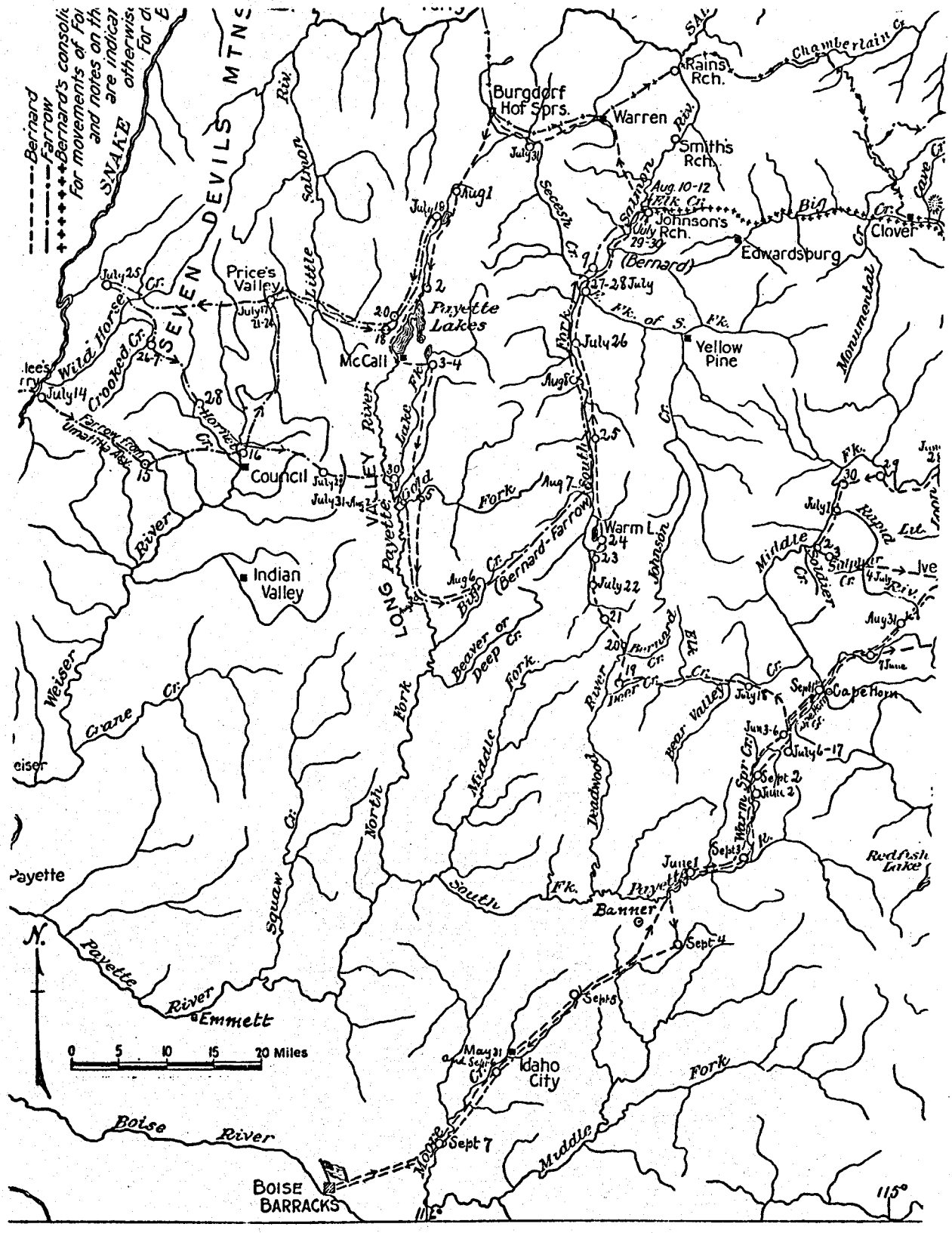

Figure 22. Map of Sheepeater Campaign.

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APPENDIX A

SNAKE RIVER BASIN OVERVIEW REPORTS AND SUPPORTING DOCUMENTS

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Reports prepared as part of the Snake River Basin environmental program are listed below. Copies of these reports are available from Information Processing of the Information Division at EG&G Idaho, Inc., Box 1625, Idaho Falls, Idaho 83401.

EGG-2001	"Potential Use of Geothermal Resources in the Snake River Basin: An Environmental Overview," S. G. Spencer, B. F. Russell, and J. S. Sullivan, editors.
EGG-GTH-5001	"Vulcan Hot Springs KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5002	"Crane Creek KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5003	"Castle Creek KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5004	"Bruneau KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5005	"Mountain Home KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5006	"Raft River KGRA: An Environmental Analysis," S. G. Spencer and B. F. Russell, editors.
EGG-GTH-5007	"Geothermal Development in Southwest Idaho: The Socio-economic Data Base," W. Cris Lewis, Lewis & Associates.

PG-G-79-001 "KGRA Comprehensive Completion Report: Seismicity," J. K. Applegate, GeoTechniques.

PG-G-79-002 "KGRA Comprehensive Completion Report: Subsidence," J. K. Applegate, GeoTechniques.

PG-G-79-003 "Snake River Basin KGRA Environmental Report: Soils," N. Savage, Idaho Water Resources Research Institute.

PG-G-79-004 "KGRA Comprehensive Completion Report: Air Quality," E. Bentley, GeoTechniques.

PG-G-79-005 "KGRA Comprehensive Completion Report: Meteorology," M. Delisio, GeoTechniques.

PG-G-79-006 "Heritage Resources and Known Geothermal Resource Areas in Idaho: A Preliminary Review," R. Knudson and M. Pfaff, Idaho Water Resources Research Institute.

PG-G-79-007 "Assessment of Hydrology and Water Quality Data of the KGRAs of the Snake River Basin," C. L. Miller and C. C. Warnick, Idaho Water Resources Research Institute.

PG-G-79-008 "Literature Review and Assessment of Terrestrial Ecology Data for Selected KGRAs in the Snake River Plain, Idaho," C. D. Jorgensen and R. L. Johnson, Brigham Young University.

PG-G-79-009 "KGRA Comprehensive Completion Report: Geology," R. Hardyman, GeoTechniques.

PG-G-79-010 "Aquatics of Five Snake River Basin KGRAs," K. P. McCarthy and J. F. Sullivan, EG&G Idaho, Inc.

PG-G-79-011 "A Summary of the Assessments of Geothermal Resource Use Limitations of Bruneau, Castle Creek, Crane Creek, Mountain Home, and Vulcan Hot Springs KGRAs," B. Moore, N. Savage, J. S. Gladwell, and C. C. Warnick, Idaho Water Resources Research Institute.

APPENDIX B

LANDTYPE DESCRIPTIONS FOR VULCAN HOT SPRINGS KNOWN GEOTHERMAL RESOURCE AREA

APPENDIX B

LANDTYPE DESCRIPTIONS FOR VULCAN HOT SPRINGS KNOWN GEOTHERMAL RESOURCE AREA[a]

The landtype descriptions contain useful information on topography, geomorphic features, bedrock characteristics, vegetation, and management guidelines as well as limited soil descriptions: texture, color, acidity of surface and subsurface layers, and depth of soil profile.

ALLUVIAL LAND

Location:	The low lands adjacent to the South Fork of the Salmon River.
Management Zone:	Mostly travel or water influence.
Extent:	Hectares: 1596. Percent of area: 1.6.
Topography:	Slope gradient: 0 to 5%. Aspect: All. Elevation: Dominantly 915 to 1220 m.
Geomorphic Features:	Alluvial lands are those lands immediately adjacent to streams and include river wash, bottom lands, and first terrace land positions. The alluvial lands are also mapped in the high mountain meadows and generally have a high water table, at least in the spring of the year.

a. From U.S. Department of Agriculture, Forest Service, Intermountain Region. 1969. Soil Hydrological Reconnaissance. Boise National Forest, Cascade Ranger District.

Bedrock Characteristics: This is a depositional landtype and it is generally quite deep to bedrock. Normally, these landtypes are at least 3.05 m to bedrock and may be as deep as 30.48 m or more.

Vegetation: The vegetation on this unit, because of the wide elevational range, is quite variable. The vegetation at the lower elevation consists mostly of ponderosa pine, with some areas having Douglas fir. The understories are generally pine grass and some of the warmer brush species. The ground covers at the lower elevations range from 30 to 60%. The crown cover densities range from 15 to 30% for the overstory, 20 to 50% for the understory. The vegetation at the higher elevation consists of lodgepole pine and spruce overstories, with understories of sedges and other meadow-like vegetation. The ground cover on these meadows is generally near 100%.

Soils: Because of the depositional nature of this landtype, soils are quite variable. The dominant soils at the lower elevations are 12 (70%) and 12a (30%). The soils in the high mountain meadows were not identified because of the vary small extent of these lands. Generally speaking, the soils in the meadow lands have thick, dark, sandy loam to loam surface horizons over lighter colored sandy loam and loam subsurface horizons. The number 12 soil has loamy sand textures throughout, and the number 12a soil has loamy sand textures throughout; however, it is stony throughout the profile. These soils are 1.83 m or more to bedrock.

Management Qualities: Engineering problems in this unit are mainly involved with stream encroachment in the bearing capacity of road prisms. Some of these lands will require considerable ballast to provide the bearing strength necessary for expected wheel loads during the wet season. These lands also provide an effective buffer from the sediment from the above slopes. The soils in these landtypes have a moderate to high productivity potential for timber and herbaceous vegetation.

ALLUVIAL FAN LAND

Location: Area near Stolle Meadows.

Management Zone: Travel and water influence.

Extent: Hectares: 422.
Percent of area: 0.4.

Topography: Slope gradient: 5 to 20%.
Aspect: All.
Elevation: 1067 to 1220 m.

Geomorphic Features: Alluvial Fan Land is relatively uncommon in the District. This landtype was mapped only where it could be delineated consistently at the limiting scale of the aerial photos used. Alluvial Fans are cone-shaped deposits of alluvium made by streams when they flow out onto a level plane or meet a slower stream.

Bedrock Characteristics: The granitic bedrock is generally from 1.22 to 1.83 m or more beneath the soil mantle and generally is slightly to moderately well fractured, hard, and unweathered.

Vegetation: Timber species in this unit are ponderosa pine and Douglas fir. Understories are ceanothus, snowberry, willow, prunis, huckleberry, and pine grass. Ground cover densities range from 70 to 100%. Crown cover densities for the overstory range from 20 to 30%, and 30 to 50% for the understory.

Soils: The dominant soils in this unit are 11a (40%), 1 (30%), and 7 (30%). The number 11a soil has loamy sand surfaces and subsurfaces. It is stony throughout the profile. The number 1 soil has loamy sand surfaces and subsoils and is nonstony. The number 7 soil has sandy loam surface horizons over sandy loam and loam subsurface horizons. Depth to bedrock for these soils is 1.83 m or more.

Management Qualitites: This landtype, because of its favorable topography adjacent to main access routes, provides favorable administrative sites for campgrounds and recreation areas. These lands provide little hazard to road construction except for cut slopes which will have a moderately high erosion hazard on the steeper slopes. The inherent erosion hazard for this unit is moderately low. These lands have moderate to moderately high productivity potentials for timber and herbaceous vegetation.

LATERAL MORAINE LAND

Location: Warm Lake area.

Management Zone: Crest and intermediate.

Extent: Hectares: 525.
Percent of area: 0.5.

Topography: Slope gradient: 10 to 35%.
Aspect: Dominantly northerly.
Elevation: 1830 to 2286 m.

Geomorphic Features: Lateral moraines are associated with the major alpine glaciated valleys. These lands were deposited above and on the lateral margins of the valley glaciers. Most of these lands have a total relief approaching 45.7 m and slope gradients ranging dominantly from 10 to 35%. Where mapped on the side of glacial troughs, the slope gradients may be as high as 40 to 45%.

Bedrock Characteristics: Depth to bedrock is generally 3.05 m or more.

Vegetation: These lands produce dominantly lodgepole pine, subalpine fir, and some Douglas fir. They have understories of low huckleberry, elk sedge, and pine grass. Ground cover density ranges from 15 to 30% for the overstory, and 15 to 20% for the understory.

Soils: The dominant soils in this landtype are 9b (50%) and 8b (50%). The number 9b soil has a bright colored sandy loam surface over sandy loam and

loamy sand subsurfaces. The number 8b soil has dark colored surface horizons, with sandy loam surface textures over sandy loam and loamy sand subsurface textures. Both the 9b and 8b soils are cobbly throughout the profile and on the surface. These soils are more than 1.83 m to bedrock.

Management Qualities: The inherent erosion hazard of the soils in this unit is moderate. The management qualities of this unit are similar to those of Moraine Land Undifferentiated, except that the surface erosion hazard for cut and fill slopes is somewhat higher because of the steeper topography.

GLACIAL PLASTERED MOUNTAIN SLOPE LAND

Location: Rice Creek, Lodgepole Creek, and Bear Creek.

Management Zone: Crest and intermediate.

Extent: Hectares: 5254.
Percent of area: 5.3.

Topography: Slope gradient: 35 to 45%.
Aspect: Dominantly north and east.
Elevation: 1676 to 2286 m.

Geomorphic Features: These landtypes are the glacially modified slopes which have had glacial material deposited on them rather than stripped away by the scouring of the glacier. These lands are generally benchy and have fairly thick soil mantles on them. Some are in the glacial troughs. These lands contain

considerable lateral moraine materials with typically subrounded, glacial-worked rock fragments.

Bedrock Characteristics: The granitic bedrock is generally moderately fractured and ranges from somewhat weathered to soft, well-weathered.

Vegetation: Vegetation on southerly and westerly slopes consists of moderately dense stands of Douglas fir, lodgepole pine, and some ponderosa pine, with understories of pine grass and elk sedge. Northerly slopes have lodgepole pine and Douglas fir with an elk sedge, pine grass, and tall huckleberry ground cover. The ground cover density ranges from 60 to 90%. The crown cover density for the overstory ranges from 25 to 35%, and 20 to 30% for the understory.

Soils: The dominant soils in this landtype are 9b (40%), 11a (25%), and 15 (25%). The numbers 9b and 15 soils have sandy loam surfaces and subsurfaces and are generally stony throughout. The number 11a soil has stony surfaces and subsurfaces and has loamy sandy textures throughout the profile. The numbers 9b and 15 soils are generally on the northerly aspects and produce moderately dense stands of Douglas fir and lodgepole pine. The number 11a soil is generally on the more southerly aspects and produces moderate stands of Douglas fir and ponderosa pine. The erodibility of these soils ranges from low to moderate. These soils average from 1.22 to 1.83 m to bedrock.

Management Qualities: These lands, because of the favorable gradation of soil materials and benchy slopes under 55%, present favorable road location chances. Wet spots are fairly common and they should be recognized as increasing the chances for mass failures of the cutslope. Road fills on these lands are fairly stable. On steep slopes, the fill slope erosion hazard is moderate to moderately high. The inherent erosion hazard is moderately low to moderate. Timber productivity is medium and herbaceous vegetation productivity is moderately low under conifer vegetation.

WEAKLY GLACIATED UPLAND

Location: Cupp Corral and East Mountain Lookout Areas.

Management Zone: Mostly crest; some intermediate.

Extent: Hectares: 7481.
Percent of area: 7.6.

Topography: Slope gradient: 25 to 40%.
Aspects: All.
Elevation: 1676 to 2286 m.

Geomorphic Features: Weekly Glaciated Uplands have not been subjected to the scouring action of the Strongly Glaciated Lands. These lands are near areas which have been strongly glaciated and are the result of the climatic change brought about by the glaciers. These lands have been formed by the processes and effects of permanent snow and ice field action and

any movement of material was only locally. Soil and rock materials were not carried by major ice currents, nor was the bedrock deeply stripped. These lands generally have not been dissected to any great degree by fluvial processes. This is due partially to the localized transportation of materials in snow and ice fields and partially to the dominant kinds of slope-forming processes presently active. The Weakly Galciated (periglaciated) Landscapes are mainly at elevations where nivation, freezing and thawing, and wetting and drying make mass wasting the chief process by which materials are moved down slope. This process keeps replacing materials which may have been removed by overland flow.

Bedrock Characteristics

The granitic bedrock is slightly to moderately fractured and moderately soft, moderately weathered.

Vegetation:

This landtype supports mixed stands of subalpine fir, lodgepole pine, and Engelmann spruce, with understories of low and tall huckleberry, elk sedge, and pine grass. The ground cover density ranges from 50 to 80%. The crown cover for the overstory ranges from 5 to 30%, and from 0 to 20% for the understory.

Soils:

The dominant soils on this unit are 9b (40%), 8b (20%), and 9b (20%). The numbers 9b and 8b soils are generally stony throughout and have sandy loam surfaces over loamy sand subsurfaces. The number 9b soil is nonstony on the surface and throughout the profile and has fine, sandy loam textures over

sandy loam and loamy sand subsurface textures. This soil is less than 508 mm deep to highly weathered bedrock. Depth to bedrock for the other soils averages 0.91 to 1.52 m, with some areas being up to 3.05 m. The number 9b soil generally supports timber stands and the number 8b soil generally has sparser stands of timber and more grass vegetation on it.

Management Qualities: Engineering-wise, these lands should provide few problems except for moderate to moderately high surface erosion hazards on cut and fill slopes and a moderate to moderately high mass failure hazard for the cut slope in areas of seeps and wet spots. Features such as trenches or substandard roads on these lands have less impact than on most other lands of comparable slope gradient in the Fluvial Lands. Generally, the main reasons for this are the stony nature of the soil mantle and the deeper subsurface flow line. Shallow cuts, therefore, are less apt to intercept the subsurface flow line. The inherent erosion hazard for this unit is moderately low to moderate. Productivity for timber and herbaceous vegetation on this landtype will range from moderately low to moderate. These lands are good regulators of sustained stream flow because they take in and percolate water readily.

CIRQUE BASIN LAND

Location: The head of Warm Lake Creek and Roaring Creek.

Management Zone: Crest.

Extent: Hectares: 1599.
Percent of area: 1.6.

Topography: Slope gradient: 10 to 30%.
Aspect: Dominantly north.
Elevation: 2124 to 2591 m.

Geomorphic Features: This landtype consists of amphitheater-like basins that are found at the heads of most of the glaciated valleys in the District. Some of the cirque basins have small lakes in them. Common inclusions in this landtype are narrow strips of Valley Train Land and Toe Slope Land. In the larger cirques there are usually small areas of wet Alluvial Lands near the lakes.

Bedrock Characteristics: The granitic bedrock is generally hard, unweathered, nonspalling, and slightly to moderately fractured.

Vegetation: This landtype supports dominantly lodgepole pine, subalpine fir, and some Englemann spruce in the low areas. Ground cover is mostly low huckleberry and elk sedge. Ground cover density, including litter, ranges from 30 to 60%.

Soils: Dominant soils in this landtype are 11a (30%), 9b (30%), 8b (20%), and 9c (20%). Soils are generally stony, with subangular coarse fragments from 102 to 305 mm in diameter. These soils have loamy sand and sandy loam surfaces over bright

colored loamy sands and sandy loam subsurfaces. Depth to bedrock averages 508 to 1016 mm. The numbers 9b and 9c soils are found on the lower north slopes and in the depressional areas and may support a good stand of Engelmann spruce over low huckleberry and elk sedge. The other soils support open-to-dense stands of lodgepole pine and subalpine fir, with elk sedge and low huckleberry the dominant ground cover.

Management Qualities: These lands are one of the chief regulators for sustained stream flow. The depressional nature of the landscape allows for deep percolation and the return of water as subsurface flow and ground water. Because of the short growing season, productivity of timber is generally low except for small stands of spruce, which may be medium. Potential for forage production is also low. The engineering characteristics of these lands are favorable in most respects, except for some of the Wet Alluvial Lands and wet meadows. These lands contain many lakes which have been stocked and provide excellent fishing and the areas also provide some favorable big game summer range. These lands, because they are easily traversed by foot or horseback, are an important part of the high value, dispersed recreational area associated with the rest of the landtype in the Strongly Glaciated Lands.

WEAKLY DISSECTED MOUNTAIN SLOPE LAND

Location: Big Creek.

Management Zone: Intermediate.

Extent: Hectares: 4169.
Percent of area: 4.2.

Topography: Slope gradient: 40 to 55%.
Aspect: North and east.
Elevation: 1220 to 1830 m.

Geomorphic Features: These lands consist of mountain slopes that are incised by drainages greater than 457 m apart and entrenched in the slope at depths ranging from 3.05 to 9.14 m. Drainages spaced closer than 457 m are generally less than 3.05 m deep; drainages spaced at distances greater than 915 m may be greater than 9.14 m deep. The fluvial process is the dominant slope-forming process on these lands. This landtype occasionally has evidence of weak glacial (periglacial) activities at the higher elevations.

Bedrock Characteristics: The granitic bedrock is moderately well-fractured, moderately hard, somewhat weathered to moderately soft, moderately weathered, and spalling.

Vegetation: Most of the timber species in the District occur on this landtype. The dominant ones are Douglas fir and ponderosa pine; larch and white fir are also common. The understory consists of brush and elk sedge and pine grass. The ground cover density for this unit ranges from 60 to 90%. The crown cover for the overstory ranges from 15 to 35%, and for the understory, 15 to 30%.

Soils:

The dominant soils in this landtype are 17 (30%), 1 (35%), 15 (20%), and 9 (15%). The numbers 11 and 9 soils generally occur at the higher elevations, with the number 9 soil on the northerly exposed slopes and the number 17 soil on the south aspects. The number 17 soil has sandy loam surfaces over loamy sand subsurfaces and is nonstony throughout. The number 9 soil has sandy loam surfaces over sandy loam and loamy sand subsurfaces. It may be stony or nonstony throughout. The numbers 1 and 15 soils are found at the lower elevations. The number 1 soil has sandy loam and loamy sand surface textures over loamy sand subsurface textures. The number 15 soil has sandy loam surface textures over sandy loam subsurface textures. The average depth to bedrock in this unit is 915 to 1524 mm. The number 1 and 15 soils support ponderosa pine, and the numbers 17 and 9 soils support stands of Douglas fir, white fir, and larch.

Management Qualities

The inherent erosion hazard of this unit is moderate. These lands are not as hazardous for road construction as are some of the more dissected lands because the slopes are not as steep and there are fewer drainages to cross with fills. However, there is a moderate to moderately high surface erosion hazard for cut and fill slopes. On the steeper portion of this landtype, the mass stability hazard for cut and fill slopes ranges from moderate to moderately high. This landtype has a moderate to moderately high productivity potential for timber and herbaceous vegetation.

MODERATELY DISSECTED MOUNTAIN SLOPE LAND

Location: Dollar and Six-Bit Creeks.

Management Zone: Intermediate.

Extent: Hectares: 14 742.
Percent of area: 14.9.

Topography: Slope gradient: 45 to 60%.
Aspect: Dominantly north and east.
Elevation: 1067 to 1830 m.

Geomorphic Features: These lands are dissected mountain slopes which are incised by drainages generally spaced between 153 and 457 m apart and entrenched in the slopes at depths ranging from 3.05 to 9.14 m. Drainages spaced at distances greater than 457 m may be deeper than 9.14 m and drainages spaced closer than 153 m may be less than 6.1 m deep.

Bedrock Characteristics: The granitic bedrock is moderately fractured and the weathering ranges from moderately hard, somewhat weathered to moderately soft, moderately weathered. Much of the bedrock is the spalling variety.

Vegetation: Most of the timber species in the District occur on this particular landtype; however, the dominant ones are Douglas fir and ponderosa pine over a shrub and grass ground cover. Larch and white fir are common at the higher elevations. The ground

cover density ranges from 50 to 80%. The crown cover for the overstory ranges between 15 and 35%, and between 15 and 30% for the understory.

Soils: The dominant soils in this unit are 2 (40%), 3 (30%), 7 (15%), and 17 (15%). These soils are generally nonstony on the surface and throughout the profile. Average soil depth is 0.91 to 1.52 m to bedrock. The number 2 soil has a dark colored loamy sand surface over a loamy sand subsurface. The number 3 soil has light colored loamy sand surfaces over loamy sand subsurfaces. The number 7 soil has sandy loam to loam surfaces over sandy loam or loam subsurfaces.

Management Qualitities: This landtype supports a large percentage of merchantable timber in the District and much of these lands have already been logged. These lands with deep soils and slopes over 60% have exhibited a moderate to moderately high hazard for road fill failures. The surface erosion hazard for road cuts and fills on this unit is moderate to moderately high, and the mass stability hazard for cuts and fills on this unit is moderate to moderately high. The inherent erosion hazard for this landtype ranges from low to moderate. This landtype has a moderate to moderately high productivity potential for timber and herbaceous vegetation.

FAULTED BENCH LAND

Location: Area between Cougar Rock and Stolle Meadows.

Management Zone: Intermediate.

Extent: Hectares: 1725.
Percent of area: 1.7.

Topography: Slope gradient: 30 to 50%.
Aspect: Mostly north and east.
Elevation: 1372 to 1981 m.

Geomorphic Features: These lands comprise a special group of lands which are remnants of block faulting activity in the District. The block faulting activity results in low, bench-like ridge systems which, in many cases, have been modified by glacial outwash deposits and have been moderately to weakly dissected.

Bedrock Characteristics: The fracturing of the granitic bedrock ranges from slightly to moderately well-fractured and the weathering ranges from moderately soft, moderately weathered to soft and well-weathered.

Vegetation: The dominant tree species are Douglas fir, white fir, and ponderosa pine. The understory is generally brush, tall huckleberry, elk sedge, and pine grass. The ground cover densities range from 50 to 80%. The crown cover for the overstory ranges from 15 to 35%, and from 15 to 30% for the understory.

Soils: The soils on this unit are 1 (30%), 9 (25%), 15 (25%), and 14 (20%). The number 1 soil is 914 to 1219 mm to bedrock and has loamy sand textures

throughout. The number 9 soil has sandy loam and loam surfaces over sandy loam and loamy sand subsurfaces and is generally 914 mm or more to well-weathered bedrock. This soil is found at the higher elevations. The number 15 soil has sandy loam textures throughout and is 914 to 1219 mm to bedrock. The number 14 soil has sandy loam or loam surface textures and sandy loam to sandy clay loam subsurface textures and is 762 to 1016 mm to well-weathered bedrock.

Management Qualities:

Timer and herbage productivity for this unit is moderately high. The inherent erosion hazard is moderate and the surface erosion hazard for road cuts, fills, and road surfaces ranges from moderate to moderately high. The fill slope mass stability hazard also in this unit would result in moderately high amounts of sediment to the drainages.

APPENDIX C

PROPOSED FEDERAL STATUS OF
THREATENED AND ENDANGERED PLANT SPECIES

APPENDIX C

PROPOSED FEDERAL STATUS OF
THREATENED AND ENDANGERED PLANT SPECIES[a]

This appendix shows status of threatened and endangered plant species existing in Valley County, Idaho. The plant species included are: Hackelia hispida, Draba argyraea, Draba sphaerocarpa, Allium madidum, Tofieldia glutinosa, and Castilleja oresbia.

BORAGINACEAE

Hackelia hispida

Location: Idaho: Idaho, Lemhi, Madison, and Valley Counties.
Oregon: Baker and Jefferson Counties.
Washington: Grant County.

Land Ownership: U.S.F.S. (Nez Perce, Payette, Salmon, and Wallowa-Whitman N.F.), Idaho Department of Lands, and private.

Vegetation Types: Probably associated with Agropyron spicatum/Poa sandbergii communities.

Habitat: Basalt talus slopes and other rocky habitats.

Hazards: Uncertain.

Herbarium Data: Number of sites by county: Idaho -- Idaho - 5, Lemhi - 1, Madison - 1, and Valley - 1.
Oregon -- Baker - 1 and Jefferson - 1.
Washington -- Grant - 2.

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a. From D. M. Henderson et al, Endangered and Threatened Plants of Idaho, University of Idaho Forestry and Wildlife Range Experiment Station Bulletin, 21, 1977.

Number of collections in herbaria searched: BOIS - 0, CIC - 0, ID - 7, IDF - 0, ORE - 0, OSC - 1, RENO - 9, UTC - 3, WILLU - 1, WS - 7, and WTU - 2.

Remarks: This species is relatively widely distributed and in some places (Snake River Canyon) is abundant. Although the species may be subject to grazing, man's present activities in its habitat do not appear to present problems. It is therefore suggested that this taxon be removed from the list of threatened species.

Recommendations: Remove from threatened list.

Compiler: Henderson.

BRASSICACEAE (Cruciferae)

Draba argyraea

Location: Idaho: Blaine, Boise, Custer, Elmore, and Valley Counties. Idaho endemic.

Land Ownership: U.S.F.S. (Boise, Challis, and Sawtooth N.F.).

Vegetation Type: Upper subalpine.

Habitat: In crevices and gravels of granitic rock.

Hazards: Very few due to type of habitat and inaccessibility.

Herbarium Data: Number of sites by county: Idaho -- Blaine - 3, Boise - 1, Custer - 2, Elmore - 5, and Valley - 2.

Number of collections in herbaria searched:
BOIS - 0, BS - 0, CIC - 1, ID - 2, IDF - 0,
INT - 0, RENO - 8, UTC - 7, WS - 10, and WTU - 3.

Remarks: Relatively wide distribution, threatened status appears unnecessary.

Recommendations: Remove from threatened list.

Compiler: Steele.

Draba sphaerocarpa

Location: Idaho: Boise, Custer, Elmore, and Valley Counties. Idaho endemic.

Land Ownership: U.S.F.S. (Boise, Challis, and Sawtooth N.F.).

Vegetation Type: Mostly subalpine to alpine, one site Pinus ponderosa/Purshia tridentata.

Habitat: Gravel bars and ridges and talus. Scree slopes on ridges and on sliding debris of Challis volcanics (Phillips 1976).

Hazards: Probably very few because of habitat and location.

Herbarium Data: Number of sites by county: Idaho -- Boise - 4, Custer - 4, Elmore - 2, and Valley - 5.

Number of collections in herbaria searched:
BOIS - 1, BS - 0, CIC - 2, ID - 2, IDF - 0,
IDS - 1, INT - 0, RENO - 7, UTC - 5, WS - 9, and
WTU - 12.

Remarks: This plant has a relatively wide distribution and occupies sites seldom disturbed by man. Threatened status appears unnecessary.

Recommendations: Remove from threatened list.

Compiler: Steele.

LILIACEAE

Allium madidum

Location: Idaho: Adams, Valley, and possibly Ada Counties
Oregon: Grant, Wallowa, Wheeler, and Umatilla Counties.

Land Ownership: U.S.F.S. (Payette, Mallieur, and Wallowa-Whitman N.F.), some private land and possibly Idaho Department of Lands.

Vegetation Type: Conifer forest zones, 1219 to 1676 m.

Habitat: Vernal wet spots in moist meadows near McCall -- "gravelly seepy slope"; Blue Mountains -- disturbed soil with annuals on edge of meadow.

Hazards: None evident.

Herbarium Data: Number of sites by county: Idaho -- Adams - 5 and Valley - 2.

Number of collections in herbaria searched:
BOIS - 0, BS - 0, CIC - 2, ID - 4, IDF - 3,
IDS - 0, RENO - 0, UTC - 1, WS - 3, and WTU - 0.

Remarks: Abundant in certain wet meadows near McCall, Idaho; some heavily used by sheep and/or cattle, and in one instance heavy use by motor bikes. Also found in soil overturned by pocket gophers.

Recommendations: If Oregon data corroborate those of Idaho, then the wide range, numerous collections, and apparent resistance to disturbance suggest that with a little more data on distribution and ecology, this species may be removed from the threatened list. Until then, retain as threatened.

References: Ownbey 1950.
Steele 1975.

Compiler: Johnson.

Tofieldia glutinosa var. *absona*

Location: Idaho: Bonner and Valley Counties. Idaho endemic variety.

Land Ownership: U.S.F.S. (Kaniksu and Payette N.F.); possibly Idaho Departments of Lands.

Vegetation Type: Bogs in *Abies lasiocarpa* zone.

Habitat: On sphagnum moss mats in openings at bog edges.

Hazards: Unknown, but this type of plant community is slow developing and on a very specialized habitat. Any activity which would promote drainage or a rise in water level would jeopardize this taxon.

Herbarium Data: Number of sites by county: Idaho -- Bonner - 1 and Valley - 1.

Number of collections in herbaria searched:
BOIS - 0, CIC - 0, ID - 0, IDF - 1, and WS - 1.

Remarks: This plant is a phytogeographic and taxonomic riddle. Piper collected it first near Priest Lake, Bonner County in 1901. Apparently no one else has collected it until recently when it was found in Valley County north of McCall, Idaho. The more widespread variety, montana, is found throughout the northern Rockies. Re-collection at the Valley County site revealed that the variety absona and the variety montana are apparently mixed. The pattern of distribution (Valley and Bonner Counties) is one which we (Steele and Johnson) have not encountered in studying the ranges of hundreds of disjunct and endemic plants. We expect, even from data this meager, that intermediate stations probably exist.

Recommendations: Retain as endangered. Taxonomic work is needed to validate the varietal status of absona. Obviously more populations should be sought and the ecology of the variety described.

Compiler: Johnson.

SCROPHULARIACEAE

Castilleja oresbia

Location: Idaho: Adams and Valley Counties.
Oregon: northeastern portion.

Land Ownership: U.S.F.S. (Payette N.F.) and some private.

Vegetation Type: Artemisia rigida/Poa sandbergii.

Habitat: Exposed, sometimes eroded slopes. Scabland sites with Penstemon gairdneri and Lomatium mudicaule (Phillips 1976).

Hazards: Grazing animals may reduce population.

Herbarium Data: Number of sites by county: Idaho -- Adams - 2 and Valley - 1. Oregon - 3.

Number of collections in herbaria searched: BOIS - 0, CIC - 0, ID - 0, IDF - 0, WS - 7, and WTU - 1.

Remarks: Should be field checked; low number of collections may indicate endangered status.

Recommendations: Retain as threatened.

Compiler: Steele.