



U.S. Department of Energy  
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# **Potential Use Of Geothermal Resources In The Snake River Basin: An Environmental Overview**

VOLUME II — ANNOTATED BIBLIOGRAPHY

Susan G. Spencer  
Brent F. Russell  
Jacquelyn F. Sullivan  
Editors

September 1979

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**Published September 1979**

**PREPARED FOR THE  
DEPARTMENT OF ENERGY  
UNDER CONTRACT NO. DE-AC07-76-IDO 1570**

# CONTENTS

INTRODUCTION .....	1
TERRESTRIAL ECOLOGY .....	1
AQUATIC ECOLOGY .....	27
HERITAGE RESOURCES .....	30
SOCIOECONOMICS AND DEMOGRAPHY .....	44
GEOLOGY .....	47
GEOTHERMAL .....	66
SOILS .....	70
HYDROLOGY AND WATER QUALITY .....	72
AIR QUALITY .....	78
SEISMICITY .....	82
SUBSIDENCE .....	84

# POTENTIAL USE OF GEOTHERMAL RESOURCES IN THE SNAKE RIVER BASIN: AN ENVIRONMENTAL OVERVIEW VOLUME II — ANNOTATED BIBLIOGRAPHY

## INTRODUCTION

EG&G Idaho, Inc., has completed an environmental analysis of seven known geothermal resource areas (KGRAs) 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 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.

This volume is a partially annotated bibliography of reference materials pertaining to the seven KGRAs. The bibliography is divided into sections by program element. Cross-referencing is available for those references which are applicable to specific KGRAs.

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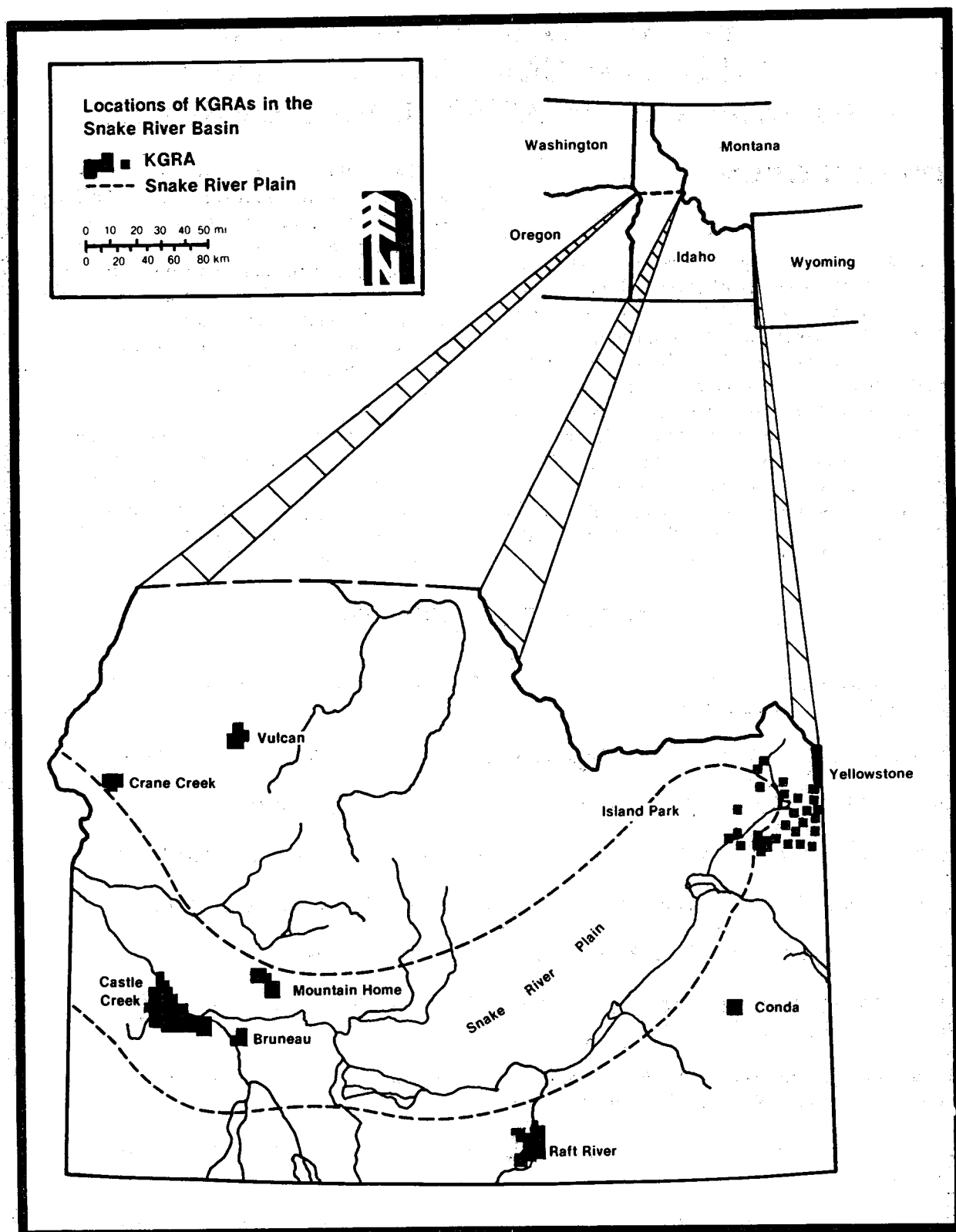


Figure 1. Locations of KGRAs in the Snake River Basin.

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a. Key

1. Vulcan Hot Springs KGRA
2. Crane Creek KGRA
3. Castle Creek KGRA
4. Bruneau KGRA
5. Mountain Home KGRA
6. Raft River KGRA
7. Island Park/Yellowstone KGRAs.

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- R. L. Speth, L. D. Weber, and O. D. Simpson, *Trace Element-Neutron Activation Analysis Results* (unpublished report, 1976). 6.
- Indicates some trace element accumulation in desert plants and aquatic organisms.
- D. Stefan, *Unpublished Field Notes for Castle Creek, Catherine Creek and Brown's Creek* (1976-1978). 3.
- G. W. Suter, *Effects of Geothermal Energy Development on Fish and Wildlife*, FWS/OBS-76/20.6, U.S. Department of the Interior, Fish and Wildlife Service (October 1978).
- USEPA, *Water Quality Assessment, Middle Snake River Basin*, Surveillance and Analysis Division (no date). 3.
- U.S. Fish & Wildlife Service, *Yellowstone Fishery Investigations*, U.S. Dept. of the Interior (1976). 7.
- U.S. Forest Service, *South Fork Salmon River Planning Unit, Final Environmental Statement and Land Management Plan, Boise and Payette National Forests, and Matrix Source Data*, (June 1977).
- U.S. Forest Service & Bureau of Land Management, *Environmental Statement of the Island Park Geothermal Area*, 01-15-79-02 (1979).
- H. W. Young and W. A. Harenberg, *Water Resources of the Weiser River Basin, West-Central Idaho* (1977), Idaho Department of Water Resources Water Information Bulletin No. 44.

## HERITAGE RESOURCES

C. M. Aikens, D. L. Cole, and R. Stuckenrath "Excavations at Dirty Shame Rockshelter, Southeastern Oregon," *Tebiwa*, Miscellaneous Papers of the Idaho State Museum of Natural History No. 4 (1977).

This site has provided a basic cultural chronology for the Owyhee area of the northern Great Basin, including both southeastern Oregon and southwestern Idaho, and is a model of possible resources within the selected Idaho KGRAs in that region.

L. D. Agenbraod "Buffalo Jump Complexes in Owyhee County, Idaho," *Tebiwa*, Miscellaneous Papers of the Idaho State Museum of Natural History No. 1 (1976).

Two sites in southern Owyhee County have been interpreted to be prehistoric or protohistoric bison jumps, again serving as a model for potential cultural resources within the selected KGRAs in that general region.

N. R. Anderson, *Upper Cenozoic Stratigraphy of the Oreana, Idaho, 15' Quadrangle*, University of Utah Doctoral dissertation, 1965. 3.

This unpublished dissertation delineates the paleontologically significant formations of part of the Castle Creek KGRA, and lists localities where fossils have been collected.

D. Ballard, Report of Mr. Ballard to D. M. Cooley, on the Indian Tribes of the Territory of Idaho, In "Report of the Commissioner of Indian Affairs," pp 189-191. 39th Congress, 2nd Session, *House Executive Documents (Serial No. 1284)* (1867).

This report does not pertain to any specific KGRA, but only mentions that Indians occupied the Owyhee County area.

F. R. Barber and D. W. Martin, *Idaho in the Pacific Northwest*, Caldwell, Caxton Printers, Ltd., 1956.

P. L. Barnes, *Archaeology of the Dean Site: Twin Falls County, Idaho*, Washington State University, Laboratory of Anthropology, Reports of Investigations No. 25 (1964). 3,4.

The Dean site on Brown's Bench in the Upper Salmon Falls drainage has 8000-10,000 years of occupation represented within its sediments and again is a model of potential cultural resources within the Bruneau and Castle Creek KGRAs especially.

M. D. Beal and M. Wells *History of Idaho, Vol. I*, New York: Lewis Historical Publishing Co., Inc., 1959.

This book is an excellent introduction to general Idaho historical research. It summarizes significant events in Idaho history but does not give data specific to the KGRAs. It does provide good bibliographic references.

P. R. Bjork, "The Carnivora of the Hagerman Local Fauna (Late Pliocene) of South Western Idaho," *Transactions of the American Philosophical Society* 60(8): 3-54 (1970). 3,4.

This description of fossil fauna in the Hagerman area is relevant to evaluation of the paleontological resources of the Bruneau and Castle Creek KGRAs.

B. Blyth, "Northern Paiute Bands in Oregon, In Tribal Distributions in Eastern Oregon and Adjacent Regions," by Verne F. Ray and others, *American Anthropologist* 40:384-415 (1958) pp 402-405. 2.

Blyth puts the Paiute Salmon Eaters on the lower Malheur River with spring and summer camps on both sides of the Snake River about at the mouth of the Malheur as of 1840-50; mixed Paiute-Shoshoni groups wintered near the Boise River. "People Eaters" were in the hills above the Boise River, either to the north or south; if north, this has implications for evaluating the cultural resource potential of the Crane Creek KGRA.

J. G. Bond, Compiler, and J. D. Kauffman, D.A. Miller, and R. Venkatakrishnan; C. H. Wood, Cartographer, with P. J. Hearn, G. E. Kirby, and G. McManus, *Geologic Map of Idaho*, Moscow, ID: Idaho Department of Lands, Idaho Bureau of Mines and Geology, with U.S. Geological Survey, 1978.

This geologic base map was just revised recently and has been published before its companion explanatory volume (Idaho Bureau of Mines and Geology Information Circular 31) is available. It does have a full legend explaining the mapping units and labels, but unfortunately was poorly printed so that the underlain cultural and geographic features (rivers, lakes, towns, county lines) are nearly invisible making the map difficult to use.

- R. Bonnichsen, "The Rattlesnake Canyon Cremation Site, Southwest Idaho," *Tebiwa* 7 (1) (1964) pp 28-38. 3,4.

This site is on the north side of the Snake River, north of the Bruneau KGRA and east of the Castle Creek KGRA; it is one of the few excavated sites in that area and is evidence of the excellent preservation of archaeological materials from the early historic period there.

- K. Boreson, "A Bibliography of Petroglyphs/Pictographs in Idaho, Oregon, and Washington," *Northwest Anthropological Research Notes* 10 (1) (1976a) pp 123-146. 5.

- "Rock Art of the Pacific Northwest," *Northwest Anthropological Research Notes* 10 (1) (1976b) pp 90-122. 5.

These companion papers document the known record of prehistoric pictograph and petroglyph sites in Idaho, none of which is from the selected KGRAs. Several rock art sites are noted just north of the Mountain Home KGRA, and such resources should be expected in areas such as the Castle Creek KGRA especially.

- A. W. Bowers, *Archaeological Excavations in the Spangler Reservoir and Surveys in Washington County, Idaho*, Ms, Interagency Archaeological Services-San Francisco (HCRS, USDI) and the Archive of Pacific Northwest Archaeology, University of Idaho, Moscow (1967). 2.

This 107 page (with illustrations, 4 large maps) manuscript is a report to the National Park Service and the National Science Foundation of the 1964-1965 survey and test excavations of sites in the Spangler (Mann Creek) Reservoir in the Weiser River drainage and in Washington County in general. It unfortunately has rarely been available and is rarely cited, but does contain a valuable overview of archaeological resources in the area of the Crane Creek KGRA.

- A. W. Bowers and C. N. Savage, *Primitive Man on Browns Bench — His Environment and His Record*, Idaho Bureau of Mines and Geology, Information Circular No. 14 (1962). 3,4.

This is an earlier report on the Brown's Bench Dean site in the Upper Salmon Falls drainage east of the Bruneau and Castle Creek KGRAs, and provides basic data for developing a model of expected cultural resources within those KGRAs.

- G. F. Brimlow, *The Bannock Indian War of 1878*, Caldwell, ID: The Caxton Printers, Ltd., 1938. 2.

Brimlow's map of the campaign documents the military movement through the Weiser valley, but there is no specific discussion of the Crane Creek KGRA.

- W. C. Brown, "The Sheepeater Campaign, Idaho-1879," *Tenth Biennial Report of the State Historical Society of Idaho for Years 1925-26*, (1926) pp 25-53. 1.

This report of the military campaign against "small renegade bands of Bannocks, Shoshones (Sheepeaters) and Weisers" includes a map that indicates that Captain Bernard's regiment camped in the Vulcan KGRA on 21 July 1879.

- D. R. Bucy, "A Technological Analysis of a Basalt Quarry in Western Idaho," *Tebiwa* 16 (2) (1974) pp 1-45. 2.

The Midvale basalt quarry is ca. 15 km north of the Crane Creek KGRA and provides a useful model of the prehistoric sites to be expected in the general area.

B. R. Butler, "The Emergence of the Modern Sagebrush — Grass Steppe Biome in the Eastern Snake River Plain," *Holocene and Ecological Change in the Great Basin*, edited by Robert Elston, Director, Nevada Archaeological Survey, Reno, 1975. 1,2.

B. R. Butler, "The Holocene or Postglacial Crisis on the Eastern Snake River Plain," *Tebiwa 11 U* (1972) pp 1-30. 1,2.

B. R. Butler, "The Origin of the Upper Snake Country Buffalo," *Tebiwa, Idaho State University Museum*. 14, 2 (1971) pp 1-20.

B. R. Butler, *A Guide to Understanding Idaho Archaeology*, 2nd edition, Pocatello: Idaho State University Museum, 1968.

This volume is now out-of-print and the 3rd edition by the same title is limited to a discussion of southeastern Idaho rather than the entire state. Though dated, the 1968 edition of Butler's synthesis is still the most useful introduction to the archaeology of the state and to southwestern Idaho.

B. R. Butler, "The Evolution of the Modern Sagebrush Steppe Biome on the Eastern Snake River Plain," *Nevada Archaeological Survey, Reno, Nevada, Northern Division of the Nevada Archaeological Survey*, 8 (1967) pp 1-39.

S. A. Chalfant, "In Nez Perce Indians, Aboriginal Territory of the Nez Perce Indians," edited by David Agee Horr, New York: Garland Publishing Company (1974) pp 25-164. 1,2.

This synthesis of information relating to Nez Perce territorial claims was compiled for presentation to the Indian Claims Commission, who essentially accepted its findings as fact. Thus, the Crane Creek KGRA is included within the southern boundaries of Nez Perce territory, being a marginal area shared with the Shoshoni. Vulcan KGRA is not within this area, but is assigned to the Shoshoni.

T. J. Cinadr, *Mount Bennett Hills Planning Unit: Analysis of Archaeological Resources*, Idaho State University Museum of Natural History, Archaeological Reports No. 6 (1976). 4.

This 96 page (with illustrations) technical report of Idaho State University's survey of the Mount Bennett Hills Planning Unit was submitted to the Bureau of Land Management and is difficult to find; its sample survey does include a small portion of the Mountain Home KGRA. No sites were found within those sampled areas of the KGRA, but the report does provide a model of prehistoric site distributions within the general Mt. Bennett Hills area.

M. O. Cross, A report, in the form of a journal, to the Quartermaster General, of the march of the regiment of mounted riflemen to Oregon, from May 10 to October 5, 1849. In "Report of the Quartermaster General," pp 128-321. 31st Congress, 2nd Session, Senate Executive Documents No. 1, Pt. 2, No. 3 (Serial No. 587) (1850). 2.

Osborne's regiment traversed the Castle Creek KGRA, and also camped on the Bruneau River just downstream from the Bruneau KGRA. However, he has no specific comments about inhabitants or characteristics of those areas. 3,4.

W. H. Danilson, Report of Lt. Danilson to Col. Jones, on the Indian tribes of the territory of Idaho. In "Report of the Commissioner of Indian Affairs, Accompanying Papers," pp 729-730. 41st Congress, 2nd Session, House Executive Documents Vol. I, Pt. 3, No. 75 (Serial No. 1414) (1870). 4.

This report of the population of Fort Hall Indian Reservation includes comments about the Bruneau, Boise, and Western Shoshoni then resident at Fort Hall. However, it includes no comments about their original non-reservation territory or settlement pattern.

W. Dort, Jr., "Geology of the Midvale Site Complex, Idaho," *Tebiwa* 7(1) (1964) pp 17-22.

2.

This original description of the Midvale archaeological site complex, which is focused approximately 15 km north of the Crane Creek KGRA, is the basic discussion of the potential age of those cultural deposits. Again, it serves as a model of potential archaeological resources within the KGRA.

W. Dort, Jr. and S. Miller, *Archaeological Geology of Birch Creek Valley and the Eastern Snake River Plain, Idaho*, Geological Society of America, Division of Archaeological Geology, Field Guide (1977).

Though this report is on sites in eastern Idaho, well outside any of the KGRAs, it does include a radiocarbon determination of the age of Folsom projectile points in Idaho; it thus provides comparative information for evaluation of resources around the Crane Creek KGRA in particular.

T. C. Elliott, (ed.) "Journal of John Work Covering Snake Country Expedition of 1830-31," *Quarterly of the Oregon Historical Society*, Vol. 14, (1913) pp 287-314.

R. P. Erwin, "Indian Rock Writing in Idaho," *Twelfth Biennial Report of the State Historical Society of Idaho for the Years 1929-30*, pp 2, 35-111 (1930).

This original survey of Idaho pictographs and petroglyphs does not include any of the selected Idaho KGRAs, but is an excellent overview of the varieties and locations of materials that might be expected to be found in central and southern Idaho especially.

T. J. Farnham, *Travels in the Great Western Prairies, the Anahuac and the Rocky Mountains, and in the Oregon Territory*, New York: Greeley and McElrath, Tribune Buildings, 1843.

This 1838 journal reports Shoshoni living along the Snake River but does not specifically locate them within any of the selected KGRAs.

F. Foster, "Old Ferries," *Twentieth Biennial Report of the Idaho State Historical Society*, pp 45-53 (1946).

3.

This report gives locations of early Idaho ferries and notes the presence of the Grandview Ferry across the Snake River (within the Castle Creek KGRA).

J. G. Gallagher, *The Archaeology of the Sheepeater Battleground and Redfish Overhand Sites: Settlement Model for Central Idaho*, Idaho State University Master's thesis, (1975).

This hard-to-find thesis uses the 7000 years of cultural sequence at the Sheepeater Battleground site north of Stanley as a basis for outlining the prehistoric settlement patterns in the area, and is a first model for the Vulcan KGRA resources as well.

C. L. Gazin, "A Study of the Fossil Horse Remains from the Upper Pliocene in Idaho," *U.S. National Museum Proceedings*, 83 (1936) pp 281-320.

3,4.

Gazin's early description of the Hagerman Fossil Beds found along the Snake River valley in south central Idaho, is a basic reference for predicting the occurrence of similar materials in the Castle Creek and Bruneau KGRAs.

C. L. Gazin, "Annotated List of Pleistocene Mammalia from American Falls, Idaho," *Journal of the Washington Academy of Sciences*, 25 (1935). pp 297-302.

J. P. Green, *Archaeology of the Rock Site, 10-CA-33, Sawtooth National Forest, Cassia County, Idaho*, Idaho State University, M. A. Thesis, 1972.

R. Gruhn, "The Mecham Site: A Rockshelter Burial in the Snake River Canyon of Southern Idaho," *Tebiwa* 3(1,2) (1960) pp 3-19.

This site is well east of the selected Idaho KGRAs, near Twin Falls along the Snake River, and is evidence of occupation of the canyon between approximately AD 700-1200.

"Test Excavations at Sites 10-OE-128 and 10-OE-129, Southwest Idaho," *Tebiwa* 7(2) (1964) pp 28-36.

These sites appear to date approximately 4000-2500 years ago but while relatively close to each other seem to have different cultural components. The sites are downriver along the Snake from the Castle Creek KGRA, and while small also serve as models of the cultural variation that might be expected within the Castle Creek area.

K. R. Harper, *Geology of the Hot Spring Quadrangle, Owyhee County, Idaho*, University of Oregon, Master's Thesis (1963). 4.

This unpublished thesis contains geological descriptions pertinent to understanding the significance of paleontological materials in the Bruneau KGRA.

J. Harris, "Western Shoshoni," In "Tribal distribution in Eastern Oregon and Adjacent Regions," edited by Verne F. Ray and others, *American Anthropologist* 40(3) (1938) pp 384-415. 4.

Harris places the White Knife Shoshoni on the Bruneau occasionally, perhaps for anadromous salmon fishing in the lower reaches.

"The White Knife Shoshoni of Nevada," *Acculturation in Seven American Indian Tribes*, edited by Ralph Linton, New York: D. Appleton-Century Co., Inc., 1940, pp 39-166. 4.

Again, Harris comments on the White Knife Shoshoni exploitation of the upper Bruneau canyon.

C. W. Hibbard and J. Zakrewski "Phyletic Trends in the Late Cenozoic Microtine *Ophiomys* Gen. Nov. from Idaho," *Contributions of the Museum of Paleontology, University of Michigan* 21(12) (1967) pp 255-271. 3,4.

This report of fossil voles from the Glens Ferry Formation exposures near Twin Falls is relevant to evaluation of the paleontological resources of the Bruneau and Castle Creek KGRAs.

E. A. Hoebel, "Bands and Distributions of the Eastern Shoshone," *Tribal Distributions in Eastern Oregon and Adjacent regions*, edited by Verne F. Ray and others, *American Anthropologist*, 40 (1940) pp 384-415. 3,4,5.

Hoebel puts the Row of Willows Shoshoni on Willow Creek in the Weiser drainage and notes that they are the western most group of Shoshoni; he locates the Big Salmon Eaters or "Those Who Do Not Roam" in the Snake River canyon from the mouth of the Bruneau to the mouth of the Boise. These comments are relevant to the evaluation of potential cultural resources in the Bruneau, Castle Creek, and Crane Creek KGRAs.



M. L. Hopkins et al, "The Stratigraphic Position and Faunal Associates of Bison (*Gigantobison Latifrons*) in Southeastern Idaho," *Tebiwa* 12:1 (1969) pp 1-8.

D. A. Horr, (ed.), *Shoshone Indians*, New York: Garland Publishing, Inc., 1974.

This documentation of the various Shoshoni tribal entities' claim against the Federal government for redress of territorial losses includes the general area of all the selected KGRAs discussed in this report. The conclusion of the Indian Claims Commission was that this region was not used exclusively by any single Shoshoni or other tribal group, and that instead there was constant sharing of territory and resources there aboriginally.

G. C. Hough, Report of Mr. Hough to Mr. D. Ballard, on the Indian tribes of the territory of Idaho. In "Report of the Commissioner of the Indian Affairs," pp 188-189. 39th Congress, 2nd Session, House of Executive Documents No. 72 (Serial No. 1284) (1867).

3,4.

This report records 125 Shoshoni camped at the mouth of the Bruneau and settlers on both Castle and Sinker Creeks.

Idaho Department of Highways *Route of the Oregon Trail in Idaho*, Boise: Idaho Department of Highways, with the Bureau of Public Roads, U.S. Department of Transportation (1963).

This brief and popular description of the Oregon Trail and its route is a handy introduction to the topic.

Idaho State Historical Society, *Sawtooth Range* (rev. 1), Idaho State Historical Society, Reference Series No. 282 (1972).

1.

This brief summary of the historic Euroamerican exploitation of the Sawtooth Mountains is relevant to evaluating the potential cultural resources of the Vulcan KGRA.

Idaho State Historical Society, *Shoshoni and Northern Paiute Indians of Idaho*, Idaho State Historical Society, Reference Series No. 484 (1970).

This brief reference summarizes the identities of the various Shoshoni and Northern Paiute groups in Idaho in the late 1800s, and is relevant to understanding the ethnography of all five KGRAs.

Indian Claims Commission, Findings of Fact (11 Ind. Cl. Comm. 387). In *Shoshone Indians*, edited by David Agee Horr, New York: Garland Publishing, Inc., 1974, pp 259-288.

The Commission decided that the area of the Vulcan KGRA was the western boundary of Lemhi Shoshoni territory, and that the Crane Creek, Castle Creek, Bruneau, and Mountain Home vicinities were all used by both Northern Paiute and Shoshoni and hence the exclusive territory of no single group. However, Merle Wells and Sven Liljebl place the Sheepeater Shoshoni at Vulcan, the Bruneau Shoshoni at Castle Creek and Bruneau, and the Boise Shoshoni at Mountain Home and Crane Creek (with perhaps some mixed bands of Northern Shoshoni and Paiutes in the latter area.)

W. Irving, *The Adventures of Captain Bonneville*, New York: Thomas Y. Crowell & Company, 1843a.

Bonneville in 1835 recorded Bannocks along the Boise and Payette Rivers, but makes no comments about populations specific to the selected KGRAs.

W. Irving, *Astoria, or Anecdotes of an Enterprise Beyond the Rocky Mountains*, New York: Thomas Y. Crowell & Company, 1843b.

Irving documents the presence of William Price Hunt of the Pacific Fur Company near Weiser in 1811.

D. Jackson and M. L. Spence, (ed.), *The Expeditions of John Charles Fremont. Vol. I, Travels from 1838 to 1844*, Urbana: University of Illinois Press, 1970.

Fremont recorded several Indian camps along the Boise River, but has no comments about them within a specific selected KGRA.

L. Jones, *Kelton Road*, Idaho State Historical Society, Reference Series No. 74 (1972).

This brief summary of the Kelton road, which crossed the corner of the Mountain Home KGRA, is one of the few available descriptions of the road. 5.

R. Keeler and D. Koko, *An Archaeological Survey of the Proposed Guffey-Swan Falls Reservoir, Southwestern Idaho, Ms, Idaho Water Resource Board, Boise* (1971).

The Reservoir would extend from Walter's Ferry to Grandview on the Snake River, including the riverine portion of the Castle Creek KGRA. The manuscript is available only on a "need to know" basis and includes many prehistoric and historic site locations along the Snake River. 3.

P. G. Kimmel, "Fishes of the Miocene-Pliocene Deer Butte Formation, Southeast Oregon," *University of Michigan Museum of Paleontology, Papers on Paleontology No. 14; Claude W. Hibbard Memorial Volume 5* (1975) pp 69-87. 3.

Fossil fish localities on the Oregon-Idaho border yield information relevant to evaluating the paleontological resources of the Castle Creek KGRA.

J. M. Kirkpatrick, Report of Mr. Kirkpatrick to Mr. Rector, on the Indian tribes of the territory of Idaho. In "Report of the Commission of Indian Affairs," pp 409-412. 37th Congress, 3rd Session, House Executive Documents Vol. I, Pt. 2, No. 55 Serial No. 1157) (1863). 3.

This reports that many Indians live along the Snake River (including the general area of the Castle Creek KGRA), but gives no specific locational data.

R. Knudson, *Overview of Middle Fork Salmon Environment and Culture History*, University of Idaho Anthropological Research Manuscript Series, (In press). 1.

This overview, prepared as part of the Idaho State Historic Preservation Plan, is a summary of current knowledge of the cultural resources of this central Idaho region and is a model of expected resources in the Vulcan KGRA.

W. S. Lewis and P. C. Phillips, Editors, *The Journal of John Work*, Cleveland: Arthur H. Clark Company, 1923. 2.

In 1832 John Work of the Hudson Bay Company Snake Brigade camped on the tributaries of the Weiser River, south of the Crane Creek KGRA, and described the Shoshoni who were also camped in that area. His brigade also travelled north and east into the Stanley Basin area.

S. Liljeblad, *Boise Shoshoni*, Idaho State Historical Society, Reference Series No. 499 (1979).

This brief statement is relevant to the ethnography of the Crane Creek and Mountain Home KGRAs, and peripherally to the Castle Creek KGRA.

S. Liljeblad, *Indian Peoples in Idaho*, Idaho State College Study Series (1957) pp 1-128.

This mimeographed paper, available in the Office of the Idaho State Archaeologist, is a general statement of Native American populations within Idaho but does not contain data specifically relevant to the selected KGRAs.

S. Liljeblad, *The Idaho Indians in Transition, 1805-1960*, Pocatello: Idaho State University Museum, 1972.

Liljeblad places the Shoshoni throughout southern Idaho as early as 8500 years ago (see Swanson 1972), but has no data specifically relevant to the selected KGRAs.

A. D. Linder, "Fossil Sculpins (Cottidae) from Idaho," *Copeia* 1970 (4) (1970) pp 755-756.

A. D. Linder and D. G. Koslucher, "A partial *Diastichus* (*Cyprinidae*) skeleton from Plio-Pleistocene Lake Idaho," *Northwest Science* 48(3) (1974) pp 180-182.

Both these papers are relevant to evaluating the paleontological resources of the Bruneau and Castle Creek KGRAs. 3,4.

T. F. Lynch and L. Olsen, 1964 "The Columbet Creek Rockshelter (Owyhee County, Idaho)," *Tebiwa* 7(1) (1964) pp 7-16.

This rockshelter is located in the headwaters of the Bruneau River and records at least 7000-8000 years of human exploitation of that area. 4.

C. Lyon, Report of Mr. Lyon to Mr. D. M. Cooley, on the Indian tribes of the territory of Idaho. In "Report of the Commission of Indian Affairs," p 187. 39th Congress, 2nd Session, House Executive Documents No. 71 (Serial No. 1284) (1867).

This report only generally mentions that Indians occupied the Owyhee County area and does not provide data specific to the KGRAs.

H. E. Malde, "Stratigraphy of the Glenns Ferry Formation from Hammett to Hagerman, Idaho," *U.S. Geological Survey Bulletin* 1331 (1972) p 1-19.

This is the basic statement of stratigraphy in the western Snake River Plain, and is relevant to evaluations of the paleontological resources of the Mountain Home, Bruneau, and Castle Creek KGRAs.

H. E. Malde and H. A. Powers, "Upper Cenozoic Stratigraphy of Western Snake River Plain, Idaho," *Geological Society of American Bulletin* 73 (1962) pp 1197-1219.

This basic outline of the stratigraphy of the area places the paleontological resources within a temporal framework and serves as a model for evaluating their potential within the selected KGRAs.

J. G. McDonald and E. Anderson, "A Late Pleistocene Vertebrate Fauna from Southeastern Idaho," *Tebiwa*, 18:1 (1976) pp 20-37.

S. J. Miller and W. Dort, Jr., "Early Man at Owl Cave: Current Investigations at the Wasden Site, Eastern Snake River Plain, Idaho," In *Early Man in America from a Circum-Pacific Perspective*, edited by Alan Lyle Bryan, pp 129-139 (1978). (Department of Anthropology, University of Alberta, Occasional Papers No. 1.)

This report is again on a site in eastern Idaho well outside the KGRAs, but does include a radiocarbon determination of the age of Folsom projectile points in Idaho; it thus provides comparative information for evaluation of resources around the Crane Creek KGRA in particular.

2.

G. M. Neudorfer, "Archaeological Resources of the Southern Raft River Valley," 1975.

1.

A discussion of an archaeological survey of the area, indicating seven sites of interest to be further investigated.

G. J. Olsen, "Bruneau Canyon Notes - 1937," *Report of the Historical Museum, University of Idaho, Southern Branch...1934-40, No. 1* (1940) pp 6-8.

Godfrey conducted an extensive survey of the Bruneau Canyon, locating over 200 archaeological sites; his notes and collections have been lost and hence are not available for evaluation of the Bruneau KGRA resources.

4.

Owyhee Avalanche, *A Historic Descriptive and Commercial Directory of Owyhee County, Idaho*, Silver City, Idaho: Press of the Owyhee Avalanche, 1898. (Facsimile reproduction, The Shorey Book Store, Seattle, 1966.)

3,4.

This directory provides useful comments on the late nineteenth century inhabitants, communities, and now historic structures of the Castle Creek and Bruneau KGRAs.

M. G. Pavesic, *The Archaeology of Hells Canyon Creek Rockshelter, Wallowa County, Oregon*, University of Colorado, Doctoral dissertation, 1971.

Pavesic has used the cultural sequence in the Hells Canyon Creek site and other nearby remains to establish a chronology for the Hells Canyon area that has relevance to the archaeology of the Crane Creek KGRA in particular.

2.

*Archaeological Observations on the Western Snake River Plain*, Paper presented at the 14th Great Basin Anthropological Conference, Carson City, Nevada. Ms, Department of Societal and Urban Studies, Boise State University, Boise (1974).

Pavesic disagrees with Swanson's (1965, 1974) concepts of an invasion of Plateau people into a Desert Culture area at AD 1300, but thinks that the architectural and artifact characteristics of the western Snake River Plain can be explained within a regional cultural model.

*Archaeological Overview of the Middle Fork of the Salmon River Corridor, Idaho Primitive Area*, Boise State University Archaeological Report No. 3 (1978).

This overview of the Middle Fork Salmon canyon provides a basis for evaluating the heritage resource potential of the Vulcan KGRA.

4.

M. G. Pavesic and R. Hill, *The Bruneau River Survey*, Ms, U.S. Bureau of Land Management, Boise District (1973).

This intensive survey was conducted in the Bruneau Canyon from the Nevada border to just south of the Bruneau KGRA, and its identification of intensive and extensive use of the canyon bottoms has relevance for evaluating the cultural resource potential in the KGRA. The 26 page manuscript is available from the Boise District Office on a "need to know" basis.

4.

M. G. Plew, *An Archaeological Inventory Survey of the Camas Creek Drainage Basin, Owyhee County, Idaho*, Boise State University Archaeological Reports No. 1 (1976). 3,4.

"The Rock Art of Upper Pole Creek, Owyhee County, Idaho," *Idaho Archaeologist* 1 (3) (1978) pp 9-12.

Both of these reports are of materials to the southwest of the Bruneau and Castle Creek KGRAs, in the Owyhee Uplands, and serve as a model of the expected prehistoric settlement systems in that general region.

C. F. Powell, Report of Mr. Powell to M. G. Taylor, on the Indian tribes of the territory of Idaho. In "Report of the Acting Commissioner of Indian Affairs," pp 251-253. 40th Congress, 2nd Session, House Executive Documents Vol. I, Pt. 5, No. 47 (Serial No. 1326) (1868).

C. F. Powell, Report of Mr. Powell to Mr. E. S. Parker, on the Indian tribes of the territory of Idaho. In "Report of the Commissioner of Indian Affairs," pp 728-729. 40th Congress, 3rd Session, House Executive Documents Vol. I, Pt. 3, No. 74 (Serial No. 1366) (1869).

These two reports note that various Shoshoni and Bannock camps were located along the Boise River, and that those people moved to Ft. Hall, but include no specific comments relevant to the selected KGRAs.

R. B. Randall, "Recollections of Early Bruneau," *Owyhee Outpost* 1:2 (1970).

This short article has comments on the history of the Hot Springs area and the Bruneau KGRA. 4.

J. E. Randolph, *Hells Canyon Archaeology, 1974, a Report of Investigations*, University of Idaho Anthropological Research Manuscript Series No. 26 (1976).

Randolph's survey is north of the Crane Creek KGRA, but documents a heavy use of the Hells Canyon area that has relevance for understanding the potential resources of the KGRA. Preliminary evidence in Hells Canyon is for intensive and long time use of anadromous fish. 2.

J. E. Randolph and M. Dahlstrom, *Archaeological Test Excavation at Bernard Creek Rockshelter*, University of Idaho Anthropological Research Manuscript Series No. 42 (1977).

Again, this rockshelter deep in Hells Canyon is peripheral to the Crane Creek KGRA but provides evidence of 8000 years of continuous human exploitation of that region. 2.

G. H. Reubelmann, *The Archaeology of the Mesa Hill Site, a Prehistoric Workshop in the Southeastern Columbia Plateau*, University of Idaho Anthropological Research Manuscript Series No. 9 (1973).

This site is north of the Crane Creek KGRA and documents extensive use of local basalts for stone tool production over perhaps 6000 years; the same basalts outcrop to the east of the KGRA. 2.

E. E. Rich, Editor, *Peter Skene Ogden's Snake Country Journals 1824-25 and 1825-26*, London: The Hudson's Bay Record Society, 1950.

G. R. Smith, "Fishes of the Pliocene Glens Ferry Formation, Southwest Idaho," *University of Michigan Museum of Paleontology, Papers on Paleontology No. 14; Claude W. Hibbard Memorial Volume* 5 (1975) pp 1-68. 3.

Fossil fish localities near the Castle Creek KGRA are described and discussed here.

D. Stapp, R. Knudson, W. D. Lipe, and S. Hackenberger, *Archaeological Reconnaissance in the Middle Fork Salmon Basin, Idaho, 1978*, University of Idaho Anthropological Research Manuscript Series, (In press). 1.

This summary of recent archaeological reconnaissance in the basin of the Middle Fork Salmon provides comparative information for evaluation of the potential archaeological resources in the Vulcan KGRA.

J. H. Steward and E. W. Voegelin, "The Northern Paiute Indians," In *Paiute Indians III*, edited by David Agee Horr, New York: Garland Publishing Inc. (1974). 4.

This manuscript report notes a Shoshoni and Bannock fishing site at the mouth of the Bruneau River, but has no comments specific to the KGRAs.

J. H. Steward, *Basin-Plateau Aboriginal Sociopolitical Groups*, Smithsonian Institution, Bureau of American Ethnology, Bulletin 120 (1938). (Reprinted 1970, University of Utah Press, Salt Lake City.) 4.

Steward recorded general ethnographic data for southwestern Idaho and mapped known villages; he does record one winter village that probably falls within the Bruneau KGRA.

J. H. Steward, "Ethnography of the Owens Valley Paiute," *University of California Publications in American Archaeology and Ethnology*, 33(3) (1933) pp 223-350.

O. C. Stewart, "Northern Paiute," *Tribal Distributions in Eastern Oregon and Adjacent Regions*, Verne F. Ray and others, pp 405-407. *American Anthropologist* 40 (1940) pp 384-415. 2,3,4.

Stewart puts the Koa'-agai band of Northern Shoshoni along the Snake River from approximately the mouth of the Bruneau north to the upper Weiser River area, which has implications for evaluating the cultural resource potential of the Bruneau, Castle Creek, and Crane Creek KGRAs.

T. Struthers, *Final Report on Archaeological and Historical Resources in the Bureau of Reclamation's Upper Snake River Project, Salmon Falls Division, Twin Falls and Cassia Counties, Idaho*, Idaho State University Museum Archaeological Reports No. 1 (1976).

This report of archaeological reconnaissance focuses on the Salmon Falls drainage to the southeast of the Bruneau and Castle Creek KGRAs, in a canyon and uplands environment similar to that of the study units. Thus, material in this report is relevant to evaluating the potential cultural resources in the KGRAs. 3,4.

L. L. Sudweeks, *The Raft River in Idaho History*, Pacific Northwest Quarterly, (July 1941). 6.

Documentation of use of the valley by trappers, pioneers, and suppliers.

E. H. Swanson, Jr., "Archaeological explorations in Southwestern Idaho," *American Antiquity* 31(1) (1965) pp 24-37.

This report of surveys of proposed Snake and Salmon River reservoirs notes a high density of prehistoric sites in the Snake canyon between the mouth of the Bruneau and the Weiser, including the reverine portion of the Castle Creek KGRA. The largest concentration of sites, however, was in the foothills. 3,4.

*Birch Creek: Human Ecology in the Cool Desert in the Northern Rocky Mountains 9,000 B.C.-A.D. 1850*, Pocatello: Idaho State University Press (1972).

While this monograph focuses on the Birch Creek valley, well to the northeast of the selected KGRAs under discussion in this report, one must evaluate the relative significance of the KGRA prehistoric resources within Swanson's cultural model. This Birch Creek paper serves as one of the most basic models for explaining cultural adaptation and development within the northern Great Basin.

*The Snake River Plain*, Idaho State Historical Society, Idaho Historical Series No. 11 (1974).

Swanson presented a model of cultural exploitation of southwestern Idaho in this paper, postulating the development of a South Hills Culture in the Owyhees with continuity to the present. He also felt that the Plain between the canyon and uplands was exploited before 6500 years ago but not used during the Altithermal (ca. 6500-3000 years ago), and that use of the Snake River Canyon as a habitation zone began only 3000 years ago.

E. H. Swanson, D. R. Yuohy, and A. L. Bryan, *Archaeological Explorations in Central and South Idaho-1958*, Idaho State College Museum Occasional Papers No. 2 (1959).

This description of surface collections is the basic typology used in southwestern Idaho archaeology ever since, and while it contains few data specific to the KGRAs it is relevant to understanding the general cultural chronology in that region.

E. H. Swanson, R. Powers, and A. L. Bryan, "The Material Culture of the 1959 Southwestern Idaho Survey," *Tebiwa* 7(2) (1964) pp 1-27.

This description of the materials recovered during the 1959 archaeological reconnaissance includes some information about the Castle Creek KGRA, but very little. It is useful for understanding the general range of cultural materials found in prehistoric sites in the Castle Creek and Bruneau KGRAs. 3,4.

R. G. Thwaites, *Original Journals of the Lewis and Clark Expedition*, New York: Dodd, Mead, and Company, 1904.

Lewis and Clark comment on the presence of Shoshoni villages on the Weiser River, which has implications for evaluating the potential cultural resources of the Crane Creek KGRA. 2.

*Early Western Travels 1784-1846*, Vols. 21, 28-30. Cleveland: Arthur H. Clark Company, 1905-06.

This multi-volume set of diaries and journals includes several general references to Indian populations in southwestern Idaho. However, because of variations in geographic place names and the absence of maps it is rarely possible to locate specific camps today. They do provide ethnographic and historic data for development of a model of expected cultural resources within several of the selected KGRAs.

G. C. Tucker, Jr., *The Archaeology of Salmon Falls Creek: A Study in Methodology*, Idaho State Museum of Natural History Archaeological Reports No. 4 (1976).

This study is well to the southeast of the Bruneau KGRA, but in a topographic setting similar to the Bruneau and Castle Creek KGRAs. It thus serves as another model for evaluation of potential cultural resources within those localities. 3,4.

D. R. Tuohy, "Shoshonean Ware from Idaho," *Davidson Journal of Anthropology* 2(1) (1956) pp 55-72.

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*An Appraisal of the Archaeological Resources of the Guffey Reservoir in Southwestern Idaho*, Ms, Office of the Idaho State Archaeologist, Boise, (1958).

This report of the 1958 Idaho State University reconnaissance of the Snake River Canyon around Guffey identifies several prehistoric archaeological sites that fall within the Castle Creek KGRA; it is available on a "need to know" basis.

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D. R. Tuohy, *Archaeological Survey in Southwestern Idaho and Northern Nevada*, Nevada State Museum Anthropological Papers No. 8 (1963).

This pipeline survey south of the Bruneau KGRA indicates that the area was originally occupied by both Northern Paiute and Shoshoni who used the Owyhee Uplands as a summer hunting ground.

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D. R. Tuohy and E. H. Swanson, Jr., "Excavation at Rockshelter 10-AA-15, Southwest Idaho," *Tebiwa* 3(1,2) (1960) pp 20-24.

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This small rockshelter is northwest of the Castle Creek KGRA, probably was occupied between several times over the past 4000 years, and indicates a continuing reliance on resources during that period.

U. S. Department of Agriculture, *Cultural Resources Inventory*, Ms, Boise National Forest, U.S. Forest Service, U.S. Department of Agriculture (n.d.)

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U.S. Forest Service, Bureau of Land Management, *Environmental Statement of the Island Park Geothermal Area*, 01-15-79-02 (1979). 7.

T. Uyeno, "Late Cenozoic Cyprinid Fishes from Idaho with Notes on Other Fossil Minnows in North America," *Michigan Academy of Science, Arts, and Letters Paper* 46 (1961) pp 329-344.

This description of the Glens Ferry Formation is basic to an evaluation of the paleontological resource potential in the selected Idaho KGRAs along the Snake River valley.

C. N. Warren, K. S. Wilkinson, and M. Pavesic, "The Midvale Complex," *Tebiwa* 14(2) (1971) pp 39-71.

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G. Webster, "Dry Creek Rockshelter: Cultural Chronology in the Western Snake River Region in Idaho," *Tebiwa, Miscellaneous Papers of the Idaho State University Museum of Natural History No. 15* (1975).

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- J. C. Chugg et al, *Special Soil Survey — Owyhee, County, Idaho*, Idaho Water Resource Board Report No. 15, USDA Soil Conservation Service/University of Idaho Agricultural Experiment Station, 1968. 3,4.

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Soil Conservation Service detailed soil surveys mapped on aerial photographs (1:20,000) on open file in county SCS offices. Soil descriptions and interpretive tables are provided by SCS central office in Boise, 304 N. 8th St.

- Mountain Home KGRA*. Soil survey covers Section 1, T4S, R8E and Sections 6 and 7, T4S, R9E. Legend is in Elmore County Handbook. Elmore County SCS Office, Mountain Home, Idaho. 5.

- Bruneau KGRA*. Soil survey covers portions of Sections 15, 23, and 26, T7S, R6E. Legend is in Owyhee County Handbook. Owyhee County SCS office, Grandview, Idaho. 4.

*Castle Creek KGRA*. Soil surveys include portions of 11 sections in Owyhee County (T3, 4, 5S, R1E), legend is in Grandview office; and Sections 23, 24, 25, 26, 35, and 36 in Ada County, legend in Meridian, Idaho. 3.

*Crane Creek KGRA*. Soil survey covers portions of Sections 17 and 18, T11N, R3W and Section 12, T11N, R4W. Legend is in Washington County SCS office in Weiser, Idaho. 2.

Soils are classified to series and phase. This is the most detailed type of soil survey and is adequate for all activities involving soil uses and impacts which would accompany geothermal development. Soil chemistry data is lacking except for pH, alkalinity, and salinity.

Soil Conservation Service land use maps, April, 1975 series. Blue line maps at the scale of 1:126,720 (1/2 inch:mile). Provided by SCS central office in Boise, Room 345, 304 N. 8th St.

*Mountain Home KGRA*. Elmore County, sheets 1 and 2. 5.

*Bruneau KGRA*. Owyhee County, sheet 6. 4.

*Castle Creek KGRA*. Owyhee County, sheets 1 and 3. 3.

*Crane Creek KGRA*. Washington County, sheet 1. 2.

The following land uses are denoted: surface and sprinkler irrigated cropland, nonirrigated cropland, rangeland, forest and woodland, water and wetland, recreation — nonurban land, and urban and built-up land. Up-to-date land use maps (agriculture oriented) are maintained by each SCS county field office.

R. L. Speth, L. D. Weber, O. D. Simpson, "Trace Element Deposition in Samples Collected from the Raft River Geothermal Site Using Neutron Activation Analysis," *Journal of the Idaho Academy of Science*, 12(1) (1976) pp 33-46. 6.

U.S. Bureau of Land Management land capability class surveys mapped on 7-1/2 minute (1:24,000) USGS topographic maps. Prepared by Boise District Office of BLM, 5th and Bannock, Boise, Idaho for Owyhee County (*Bruneau and Castle Creek KGRAs*). 3,4.

These maps constitute reconnaissance soil surveys designed to determine land capability class primarily for irrigability. Class is denoted by a system of symbols which summarize or code information on soil texture, depth, drainage, alkalinity/salinity, slope, parent materials, and limitations. These data are adequate only for determining suitability of the land unit for irrigation and for broad land use planning.

U.S. Bureau of Land Management soil association map for *Crane Creek KGRA* prepared by Boise District, BLM to provide baseline information for Environmental Analysis Report, 1976. 2.

Broad soil associations were delineated on a 1:24,000 USGS topographic map based on similarities in soil depth, texture, and land slope. Areas of erosion hazard are shown. This survey is adequate only for broad land use planning.

USDA, Forest Service, Intermountain Region, Soil Hydrological Reconnaissance, Boise National Forest, Cascade Ranger District, 1969. 1.

This is the working document soil and landtype characteristics within the KGRA. Landtype descriptions include subsections on: location, management zone, extent, topography, geomorphic features, bedrock characteristics, vegetation, soils, management qualities, and management evaluation. The soils subsection gives abbreviated information on texture, composition, and depth

and refers to the soil by number. These soil numbers are contained in a table giving classification of the soil and more detailed information on texture, composition, and depth.

This document is available on open file in the Boise National Forest Supervisor's Office in Boise or the Cascade Ranger District Office in Cascade.

USDA, Forest Service, *South Fork Salmon River Planning Unit, Final Environmental Statement and Land Management Plan*, Boise and Payette National Forests, 1977. 1.

Very general information on all aspects of the South Fork Planning Unit. General statements on soils but no specific information on the Vulcan KGRA. Copies available upon request at Boise and Payette National Forest Supervisors' Offices (Boise and McCall) and at the Cascade Ranger District Office.

USDA, Forest Service, *Environmental Analysis Report (Review Draft), Geothermal Installation (Vulcan Hot Springs)*, Boise National Forest, Cascade Ranger District, 1977.

This EAR attempts to address all aspects of the environment as they would be affected by geothermal development. A landtype map is included but the reader is referred to the Soil Hydrological Reconnaissance report for additional information on soils and landtypes.

U.S. Forest Service and Bureau of Land Management, *Environmental Statement of the Island Park Geothermal Area*, 01-15-79-02 (1979). 7.

## HYDROLOGY AND WATER QUALITY

C. F. Cooper, "Rainfall Intensity and Elevation in Southwestern Idaho, *Water Resources Research*, 3, 1 (1967) pp 131-137. 3,4.

Average precipitation in the Owyhee Mountains of southwestern Idaho ranges from 8 inches in the lower part of the Owyhee Mountains to 28 inches at the highest elevation. Total annual precipitation increases about 4 inches for each 1000-foot increase in elevation. Since high intensity rainfall is strongly localized, there is a high probability that it will not be sampled by a single randomly placed gage. The study reinforced previous observations that rain gage densities of 1 or 2 per 100 square miles are not adequate to determine probability of infrequent high intensity rains within reasonable time.

E. G. Crosthwaite, *Basic Data from Five Core Holes in the Raft River Geothermal Area, Cassia County, Idaho*, 1976.

This report presents the basic data from the core holes that had been collected to September 1975, and includes lithologic and geophysical logs, chemical analysis of water, and laboratory analysis of cores. 6.

D. L. Curtis, *Evaluation of Techniques for Determining Average Precipitation in Semiarid Valleys of Idaho*, M.S. Thesis, OWRR-A-034-IDA(1), University of Idaho, Moscow. Department of Civil Engineering (1973). 6,3.

The Raft River Basin in south-central Idaho and the Reynolds Creek experimental watershed in southwest Idaho were studied to determine precipitation distribution in an attempt to develop better isohyetal maps for semiarid mountain valleys. Two methods were used to determine precipitation distribution. The computer isohyetal method worked well, but should be used only where a dense gage network is available. The Thiessen method was preferred in areas where gages are spread out.

R. H. Frederick and R. J. Tracey, *Water Available for Runoff for 4 to 15 Days Duration in the Snake River Basin in Idaho*, NOAA Technical Memorandum, NWS Hydro-29, National Weather Service (1976).

Through adaptation of the National Weather Service River Forecast System (NWSRFS) Snow Accumulation and Ablation model, this study estimates the frequency of water available for runoff (WAR) from snowmelt and precipitation over the agricultural areas of Idaho's Snake River Basin. The report outlines the adaptation, testing, and use of the NWSRFS model, presents maps of 4- and 15-day WAR values at return periods of 2 and 100 years, and discusses seasonal variation of WAR and differences between WAR-frequency and precipitation-frequency values.

W. R. Hamon, *Agricultural Research Service Precipitation Facilities and Related Studies: Reynolds Creek, Idaho*, Report ARS 41-176, Agricultural Research Service, Boise, Idaho, Northwest Watershed Research Center (1971). 3.

A dense precipitation gage network is an integral part of the hydrologic studies in the Reynolds Creek experimental watershed located in southwestern Idaho. Overall, the study is to gain a better understanding of the role of the land and the influences of vegetation, climate, and land management on the movement of water and sediment. Accurate point measurements of precipitation at sufficient sites to determine the temporal and spatial variations in precipitation are needed to develop a predictive hydrologic model.

R. T. Littleton and E. G. Crosthwaite, *Ground-Water Geology of the Bruneau-Grand View Area, Owyhee County, Idaho*, U.S. Geological Survey, Water Supply Paper 1460-D (1957). 3,4.

The Bruneau-Grandview area is arid and irrigation is essential for stable agricultural development. Nearly all usable indigenous surface water in the area is appropriated, including flow from the Bruneau River, which is used for power generation at the C. J. Strike Dam. Sedimentary and igneous rocks underlie the area which contain economically important artesian aquifers. The chemical quality of the water is unsuitable for irrigation and domestic use due to moderate levels of dissolved solids, high percent sodium, and excessive concentrations of fluoride.

D. E. Meinzer, "Origin of the Thermal Springs of Nevada, Utah, and Southern Idaho," *Journal of Geology*, 32, (1924) pp 295-303. 6.

R. L. Nace et al, *Water Resources of the Raft River Basin, Idaho-Utah*, U.S. Geological Survey Water-Supply Paper 1587 (1961) p 138. 6.

A descriptive analysis of hydrology of the Basin in response to concern over overpumping of ground water for irrigation. Geographical background information is included.

R. L. Nace, S. W. West, R. W. Mower, *Feasibility of Ground-Water Features of the Alternative Plan to the Mountain Home Project*, U.S. Geological Survey Open File Report (1955). 5.

This is a brief abstract and summary of studies conducted in cooperation with the U.S. Bureau of Reclamation concerning ground water aspects of the alternative plan for irrigation of the Mountain Home Project. This mentions what has become known in the Sloan Plan for using ground water in Boise Valley and diverting some waters by exchange on to the Mountain Home desert.

National Oceanic and Atmospheric Administration, *Climatological Data*, NOAA, Environmental Data Service, National Climate Center, Asheville, N.C. (n.d.).

Climatological Data is published monthly by NOAA and reports daily temperature, daily precipitation, and snowfall data. The monthly reports are summarized in annual data summaries.

C. R. Nichols, C. E. Brockway, C. C. Warnick, *Geothermal Water and Power Resource Exploration and Development for Idaho*, Water Resources Research Institute, University of Idaho, Research Technical Completion Report, Project NSF — Geothermal 47-514 (1972).

The study concentrates on a consideration of the geologic factors in the evaluation of Idaho's geothermal potential, and on the assessment of the principal commercial uses of hot waters in the state. The investigation covered geochemical sampling of five of the most promising geothermal areas known, plus two additional that seemed to warrant further study, with location, temperature, and chemical data tabulated. Greater potential is seen in the use of such hot water for home heating and commercial greenhouse agriculture.

A. M. Piper, *Geology and Water Resources of the Bruneau River Basin, Owyhee County, Idaho*, Idaho Bureau of Mines and Geology Pamphlet 11 (1924). 4.

The report is based on two months of field work in 1922 which was conducted to determine potential of developing additional ground water for use in irrigation. The report is very general and serves as a reconnaissance study of the region.

A. M. Piper, *Geology and Water Resources of the Goose Creek Basin, Cassia County, Idaho*, Idaho Bureau of Mines Geology Bulletin 6 (1923) p 78. 6.

D. R. Ralston, Results of Pump Tests in the Raft River Basin, An Open-File Report to Aerojet Nuclear Company by the Idaho Bureau of Mines and Geology (1975). 6.

D. R. Ralston and S. Chapman, *Ground-Water Resource of the Mountain Home Area, Elmore County, Idaho*, Water Information Bulletin, 4, Idaho Department of Reclamation (1968). 5.

Ground water in the Mountain Home region is used as a primary source of domestic and irrigation supplies over most of the area. The Glenss Ferry Formation, a thick intertongueing deposit of lake and stream sediments, and the Bruneau Formation, sediment and basalts, comprise the primary aquifers in the region. The Bruneau Formation in the western portion of the study area yields large quantities of water to wells at pumping lifts at 390 feet. The Glenss Ferry Formation in the eastern portion of the study area yields only small quantities of water to wells with discharges of 20 to 100 gpm common. Hot artesian flowing wells have been developed near the Mt. Bennett Hills east of Mountain Home.

D. R. Ralston and S. Chapman, *Ground-Water Resources of Northern Owyhee County, Idaho*, Water Information Bulletin 14, Idaho Department of Reclamation (now the Idaho Department of Water Resources) (1969). 3,4.

Ground water is utilized as the primary source for domestic and irrigation supplies in northern Owyhee County. Four geologic formations are most important as aquifers in the nearby area: Tertiary Silicic Volcanics, Poison Creek Formation, Banbury Basalt, and Glenss Ferry Formation. The study area has been divided into seven hydrologic subareas. Each subarea is discussed in detail with respect to current ground water utilization and development. The quality of the ground water in much of the study area is only fair for irrigation and domestic use because of a salinity hazard and excessive fluoride concentrations.

D. R. Ralston, "Utilization of Hot Groundwater in Elmore and Owyhee Counties, Idaho," *Transactions of the Thermal Effluent Information Meeting — Boise, Idaho, July 9, 1970*, Idaho Nuclear Energy Commission, Idaho Falls, Idaho (1970) pp 29-34 (1970). 3,4,5.

Hot ground water may be found in many parts of Idaho. The history and present use of the resource provides useful insight into the utilization of thermal effluents. Water from 32 to 85°C is piped into greenhouses for heat dissipation and then used for irrigation and water ranging from 29 to 38°C is piped through hot water lines and heaters in homes for residential heating. Hot water is applied directly or after cooling in a pond to hay and grain crops which lengthens the growing season providing the farmers with an extra cutting of hay.

H. C. Riggs and Harenberg, *Flood Characteristics of Streams in Owyhee County, Idaho*, Water Resources Investigation 76-88, Open File Report, U.S. Geological Survey (1976). 3,4.

Channel-width measurements were used to estimate annual peaks with a recurrence interval of 10 years at 79 sites in Owyhee County, Idaho, and adjacent areas. These discharges and those from 33 gaging stations are plotted on a map of the area. The map is provided to allow a user to interpolate between sites or otherwise transfer the data to a site of interest.

S. H. Ross, "Geothermal Potential of Idaho," in "Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept. 22 — Oct 1, 1970," *Geothermics* 1970, Special Issue 2, 2, 2 (1973) pp 975-1008.

The first comprehensive inventory and evaluation of thermal ground water in the state of Idaho since 1925 shows that such water can be expected in wells and springs almost anywhere along the margins of the Snake River Plain or in valleys south of the Plain. Although no steam has been observed, water in a few wells is boiling, and temperatures of many springs are only slightly lower. Sodium and bicarbonate are the dominant ions in most waters, although a few highly mineralized springs are the sodium-chloride type.

J. J. Rowe, R. O. Fournier, G. W. Morey, *Chemical Analysis of Thermal Waters in Yellowstone National Park, Wyoming, 1960-65*, U.S. Geological Survey Bull. 1303 (1973). 7.

I. C. Russell, *Preliminary Report on Artesian Basins in Southwestern Idaho and Southeastern Oregon*, U.S. Geological Survey Water Supply Paper, 78 (1903). 4.

This is a report of Russell's reconnaissance surveys of artesian well situations in Idaho and Oregon. Flowing wells reported on included those near Hot Spring, the Whitson Ranch on the east side of the Bruneau River Valley, those in Little Valley 9 miles west of Bruneau, a well near Guffey in a small valley cut by Dry Creek, and wells near Barnard Ferry 7 to 9 miles northwest of Guffey.

R. J. Schott, *Benthic Insect Community Structure and Response in Vulcan Hot Springs, South Fork Salmon River*, M.S. Thesis, Department of Entomology, University of Idaho (1978). 1.

The Vulcan Hot Springs KGRA is a potential site for power generation with geothermal energy. Insect communities in Vulcan Hot Springs (VHS) and the South Fork Salmon River (SFSR) above and below its confluence with the thermal flow were investigated.

J. L. Shupe, A. E. Olson, H. B. Peterson, *Incidence of Human Dental Fluorosis in the Raft River Geothermal Area in Southern Idaho*, 1978. 6.

Results of a survey for dental fluorosis in the valley indicating almost half of those surveyed had some type of dental anomalies possibly associated with drinking water of the area.

H. G. Sisco, *Ground-Water Levels and Well Records for Current Observation Wells in Idaho, 1922-73*, Idaho Department of Reclamation (now the Idaho Department of Water Resources) Parts A, B, and C (1974).



The development of Idaho's ground-water resources has expanded at a very rapid rate in recent years which has been accompanied by a decline of local and, in some cases, ground-water levels. The ground-water-level data presented in this report were collected to provide the basic data needed by agencies and individuals interested in developing, managing, and administering the ground-water resources in Idaho. A statewide network of observation wells, established by the U.S.G.S. in cooperation with the Idaho Department of Water Resources, serves to monitor the seasonal and long-term water-level changes occurring in the many aquifers of Idaho.

H. G. Sisco, *Ground-Water Level and Well Records for Discontinued Observation Wells in Idaho 1915-1972, Part A*, Idaho Department of Reclamation (now the Idaho Department of Water Resources) (1973).

Systematic depth-to-water measurements were begun about 1912 in Idaho by the U.S. Reclamation Service in connection with drainage problems on the Boise and Minidoka projects. A comprehensive investigation of the ground-water conditions of the Snake River Plain and Tributary drainage basins in southern Idaho was begun in 1928 by the Geological Survey in cooperation with the Idaho Department of Reclamation and the Idaho Bureau of Mines and Geology. The observation-well network changes continually, as wells are added and deleted occasionally for various regions. This report contains all data for discontinued observation wells from 1915-1972 and should make the information more useful to investigators, planners, developers, and administrators.

S. G. Spencer, J. F. Sullivan, N. E. Stanley, Annual Report: INEL Geothermal Environmental Program, TREE-1340, 1979.

6.

Summarizes monitoring and research efforts conducted in 1978 to characterize impacts due to geothermal development.

R. L. Speth and L. D. Weber, *Water Quality, Mercury, and Heavy Metal Deposition Studies in Biological Specimens and Sediments for Ecological Baseline Data in the Island Park Waterways System*, unpublished research report submitted to the Idaho Nuclear Energy Commission, 1973.

7.

R. L. Speth and L. D. Weber, *Mercury, Heavy Metals, and Elemental Deposition in Aquatic Organisms and Sediments in the Snake River for Ecological Baseline Data*, unpublished report submitted to the Idaho Nuclear Energy Commission, 1974.

G. R. Stephenson and R. A. Freeze, "Mathematical Simulation of Sub-Surface Flow Contributions to Snowmelt Runoff, Reynolds Creek Water-shed, Idaho" *Water Resources Research*, 10

3.

A mathematical model of subsurface flow complements a field study of snowmelt runoff in a small upstream source area in the Reynolds Creek experimental watershed near Boise, Idaho. The mathematical model provides a two-dimensional transient saturated-unsaturated analysis of the subsurface flow at the fluid site which is a valuable aid to generate a unified interpretation of the field measurements.

R. J. Sutter and G. L. Corey, *Consumptive Irrigation Requirements for Crops in Idaho*, Bulletin No. 516, Agricultural Experiment Station, University of Idaho, Moscow (1970).

This report is a compilation of information on consumptive use and irrigation requirements for various agricultural crops grown in Idaho. Over 80 separate stations where climatological data are collected have data reported on consumptive use per acre and consumptive irrigation requirements.

C. A. Thomas and W. A. Harenberg, *Magnitude and Frequency of Floods in Small Drainage Basins in Idaho — A Design Method*, Geological Survey Open-File Report (1973).

A method is described for estimating peak discharges at 10-, 25-, and 50-year recurrence intervals for most small streams in Idaho. Reliable estimates can be obtained using this method, but there are significant limitations and variations which should be considered.

U.S. Corps of Engineers, 1952. "Columbia River and Tributaries Northwestern United States, House Document No. 531 81st Congress, 2nd Session, Report referred to Committee on Public Works, March 22, 1950, 8 volumes Appendix H, Plate 4.

This is an extensive review report of the water and land resources of the Columbia River and its tributaries. The report contains extensive information on hydrology and land resources. Of particular value are detailed isohyetal maps of normal annual precipitation which is in greater detail than most other previous studies. Stream profiles are included that would be of use in detailed hydrologic studies.

U.S. Forest Service, and Bureau of Land Management, *Environmental Statement of the Island Park Geothermal Area*, 01-15-79-02 (1979). 1.

U.S. Geological Survey, *Surface Water Records, Idaho*.

U.S. Geological Survey, *Compilation of Records of Surface Waters of the Snake River Basin, Through 1950*, U.S. Geological Survey, Water Supply Paper 1317, Part B (1950).

This volume is one of a series of reports presenting monthly and yearly summaries of stream flow and reservoir data collected by the Geological Survey. Included with these data are some records furnished by other federal, state, and private agencies.

University of Idaho, *Preliminary Inventory of the Water Resources of Idaho* (1968).

Historical records, as well as current conditions, are utilized to identify the sources of water, the magnitude of yields and flows, the dependability of the supply, the character of the water, and the extent of water use. The report is organized into chapters on climatology (atmospheric water resources), surface water, ground water, water use and water control, and water rights. An atlas is included which delineates climatological and surface water supply information, availability of ground water to wells, presently irrigated land, locations of decreed water rights, and other hydrologic and water use information.

Utah State University Research Foundation, "Material for E.I.S. Raft River Geothermal Program: Project 85," 1976. 6.

This report deals with chronic fluoride toxicosis in domestic animals at Raft River, soils analysis, and water quality.

E. H. Walker et al, *The Raft River Basin, Idaho-Utah, as of 1966: A Reappraisal at the Water Resources and Effects of Groundwater Development*, U.S.G.S. Open File Report (1970). 6.

Much arable land in the Raft River Basin, Idaho lacks water irrigation, and the potentially irrigable acreage far exceeds the amount that could be irrigated with the basin's 140,000 acre-feet estimated annual water yield. Pumping more ground water is possible only if large additional ground-water storage depletion can be tolerated. Transmissivity of the composite aquifer is estimated to vary from about 10,000 gpd/ft to more than 45,000 gpd/ft. The depletion of ground-water storage during the years 1952 to 1965 was approximately 410,000 acre-feet, by the end of 1966 it was nearly 515,000 acre-feet.

M. M. Warner, "Geothermal Resources of Idaho," *Geothermal Overview of the Western United States, 1972, Proceedings of Geothermal Resources Council El Central Conference, Feb. 16-18, 1972*, Davis, California, Geothermal Resources Council Publication, Paper F (1972).

The U.S. Geological Survey has outlined two known geothermal resource areas (KGRAs) in Idaho. One of these is on the State's eastern border next to Yellowstone Park and the other is near the south-central border along the Raft River. Another reconnaissance has outlined 5 areas in addition to the two KGRAs of the USGS, which show indications of probable geothermal potential. Surface conditions in the 7 favorable areas indicate that most of the areas are of the hot water type system rather than the vapor dominated type.

H. W. Young, *Reconnaissance of Ground-Water Resources in the Mountain Home Plateau Area, Southwest Idaho*, U.S. Geological Survey Open File Report, Water Resources Investigations 77-108 (1977).

5.

Development of ground-water resources has caused water-level declines in several locations. The greatest declines are south of Mountain Home, where water levels dropped more than 20 feet in the last 9 years. Recharge to the ground-water system is from the Boise River drainage basin, precipitation on the plateau and adjacent mountains, and leakage from irrigation structures. The chemical composition of the ground water generally reflects water characteristics in the area of the source or recharge and is considered good. Additional large-scale ground-water development will probably result in economically prohibitive pumping lifts, which also would consume excessive amounts of energy.

H. W. Young, W. A. Harenbery, H. R. Seitz, *Water Resources of the Weiser River Basin, West Central Idaho*, Water Information Bulletin No. 44, Idaho Department of Water Resources (1977).

2.

The principal use of water in the basin are in the basalt of the Columbia River Basalt Group and the overlying Tertiary and Quaternary sedimentary rocks. Reported well yields in basin range from 1 to 1,835 gallons per minute (0.063 to 122 liters per second). Ground water in the basin is generally of good chemical quality, with dissolved solids concentrations usually less than 200 milligrams per liter. Surface waters of the basin are also considered to be of good chemical quality.

H. W. Young and J. C. Mitchell, *Geothermal Investigations in Idaho — Part I, Geochemistry and Geologic Setting of Selected Geothermal Waters*, Idaho Department of Water Administration Water Information Bulletin 30 (1973).

## AIR QUALITY

Air Pollution Control Section, Idaho Department of Health, Idaho Pollution Control Commission in consultation with GCA Technology Division, Air Bureau, State of Idaho, *Implementation Plan for the Control of Air Pollution in the State of Idaho* (1971).

EPA requirements, emissions inventory, mitigations, monitoring system in Idaho.

"Air Quality and Stationary Sources Emission Contract," *A Report by the Commission on Natural Resources, National Academy of Sciences, National Academy of Engineering, and National Research Council*, Prepared for the Committee on Public Works, United States Senate, Office of U.S. Weather Bureau, Boise, Idaho (March 1975) p 909.

Extensive report dealing with many aspects of SO<sub>x</sub> and NO<sub>x</sub>, including environmental impacts on soil, forest, and fisheries. Notes on social and real costs of emissions. Discusses some problems associated with geothermal and related projects.

H. P. Altshuller, "Atmospheric Sulfur Dioxide and Sulfate. Distribution of Concentration at Urban and Non-Urban Sites in the United States," *Environ. Sci. Technol.* 7 (1973) pp 709-712.

Indicates the relationship of SO<sub>2</sub> with population centers as compared to rural areas. Discusses diffusion rates.

E. L. Currier, J. B. Knox, T. V. Crawford, "Cooling Pond Steam Fog," *Journal of the Air Pollution Control Association*, 24, 9 (1974).

D. D. Davis, G. Smith, G. Klauber, "Trace Gas Analysis of Power Plant Plumes Via Aircraft Measurement: O<sub>3</sub>, NO<sub>x</sub>, and SO<sub>2</sub> Chemistry," *Science*, 186 (1974) pp 733-736.

Discusses gas measurement through indirect monitoring practices.

Environmental Committee of the Western Systems Coordinating Council, Idaho Public Utilities Commission, *Environmental Guidelines*, Los Angeles, California, 1971, p 96.

General statement covering aspects of power generation. Excellent bibliography on state-of-the-art, emission control.

Federal Power Commission, Idaho Public Utilities Commission, *Federal Power Commission Interests in Environmental Concern Affecting the Electric Power and Natural Gas Industries*, Washington, D.C. (1969) p 33.

One chapter devoted to air quality. Indicates federal laws and interpretation as they relate to air quality.

C. E. Findley and D. C. Bray, *Attainment of Ambient Particulate Matter Standards in Idaho*, U.S. Environmental Protection Agency, Region X, Seattle, Washington, Paper 73-AP-35, Bureau of Air Quality, State of Idaho (1973).

Reported on five stations in Idaho. Identified sources, levels, and diffusion of particulates.

Geothermal Abstracts, Part B (University of Idaho Library)

Published six times a year. Has section on reports and papers dealing with air quality.

M. Goldsmith, *Geothermal Resources in California: Potentials and Problems*, California Institute of Technology, Environmental Quality Laboratory, Report 5, C.I.T., Pasadena, California (1971).

Reviews the emissions problems associated with the Geysers Geothermal Project, California. Discusses noise, air pollution, mitigation.

G. C. Holtzworth, "A Study of Air Pollution Potential for the Western United States," *Journal of Applied Meteorology*, 1 (1962) pp 366-382.

Discusses probability of quasi-stationary anticyclones. Southern Idaho has high probability of air stagnation.

H. F. Johnstone and A. J. Moll, "Formation of Sulfuric Acid in Fogs" *Ind. Eng. Chem.* 52, (1960) pp 861-863.

Outlines alteration of SO<sub>2</sub> to H<sub>2</sub>SO<sub>4</sub> in fog.

C. E. Junge, "The Distribution of Ammonia and Nitrate in Rainwater Over the United States," *Amer. Geophys. Union Trans.* 39 (1958) pp 241-248.

Indicates presence and distribution of gases as they are associated with energy production and population centers.

C. E. Junge, E. Robinson, F. L. Ludwig, "A Study of Aerosols in Pacific Air Masses," *Journ. Applied Meteor.* 8 (1969) p 340.

Discusses the presence of aerosols in onshore air. Can be used to measure any increase.

Pacific Northwest River Basins Commission, Meteorology Committee, *Climatological Handbook Columbia Basin States*, Vancouver, Washington, 1968.

Large accumulation of meteorological data including upper air conditions. Data can be used to calculate stagnation possibilities.

J. R. Mather, *Air and Air Quality, Sourcebook on the Environment, A Guide to the Literature* (1975).

Source for literature on air quality.

J. R. Mather, *Climatology: Fundamentals and Applications*, New York: McGraw-Hill Book Company, 1974.

Discusses applied techniques for microclimatology and climate change associated with industrial and population centers.

J. T. Peterson, *The Climate of Cities, A Survey of Recent Literature*, National Air Pollution Control Administration (1969).

A survey of literature dealing with climate change, microclimates.

V. J. Schaefer, "The Inadvertent Modification of the Atmosphere by Air Pollution," *Bulletin of the American Meteorological Society*, 50, 4 (1969) pp 14-17.

Discusses microclimate and changes that occur when pollutants are concentrated.

D. H. Slade (ed.), *Meteorology and Atomic Energy 1968*, U.S. Atomic Energy Commission (1968).

Snake River Regional Studies Center, Donna Parsons, Director, College of Idaho, Caldwell, Idaho 83605.

Depository for papers written on subjects dealing with southern Idaho. Some papers on air quality.

G. E. Start, C. R. Dickson, L. L. Wendell, *Diffusion in a Canyon Within Rough Mountainous Terrain*, NOAA Technical Memorandum, ERL-ARL-38 (1973).

Discusses mixing and ventilation in mountain canyons. Information could apply to central Idaho.

G. E. Start, N. R. Ricks, C. R. Dickson, *Effluent Dilution Over Mountainous Terrain*, NOAA Technical Memorandum, ERL-ARL-51 (1974).

Discusses mixing and ventilation in mountain canyons.

State of Idaho, Department of Health and Welfare, Air Quality Bureau, *State of Idaho, Ambient Air Profile* (1977).

The most comprehensive document to date outlining air quality. Data are limited to problem areas.

State of Idaho, Health and Welfare, Division of Environment, Bureau of Air Quality, 700 West State St., Boise Idaho.

Monitor, collect, publish air quality data for the State of Idaho.

State of Idaho, Department of Health and Welfare, (Air Bureau, State of Idaho, *Rules and Regulations for the Control of Air Pollution in Idaho* (1975).

Comprehensive statement of all laws in Idaho relating to air quality. Includes aerosols, emissions, odor, etc.

State of Idaho Department of Budget, Policy, Planning and Coordination, State Clearing House, 700 West State St., Boise, Idaho.

Depository for all environmental impact statements of interest or pertaining to Idaho.

J. R. Swartz, Selective Guide to Published Climatic Data Sources Prepared by U.S. Weather Bureau: *Key to Meteorological Records*, Documentation No. 4.11, U.S. Department of Commerce, Weather Bureau.

A report providing information as to where information can be found. The reader may select specific topics.

U.S. Dept. of Commerce, NOAA, *Monthly Weather Review*, U.S. Government Printing Office, Washington, D.C.

Provides papers and information on meteorology, climate, atmospheric physics.

U.S. Department of Health, Education, and Welfare, Public Health Service, National Air Pollution Control Administration, *Report for Consultation on the Metropolitan Boise Intrastate Air Quality Control Region*, Washington, D.C. (1970).

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Provides emissions inventory for Boise area including Elmore Country.

U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Air Pollution, Cincinnati, Ohio, *Study of Air Pollution in the Interstate Region of Lewiston, Idaho, and Clarkston, Washington: (1964).*

Identifies problems, indicates lack of data to establish baseline studies. Provides good model.

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