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Support Document

For the EPA Designation of the Eastern Snake River Plain Aquifer as a Sole Source Aquifer

SUPPORT DOCUMENT FOR DESIGNATION OF THE EASTERN SNAKE RIVER PLAIN AQUIFER AS A SOLE SOURCE AQUIFER

PREPARED BY THE OFFICE OF GROUND WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 10
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SUPPORT DOCUMENT FOR DESIGNATION OF THE EASTERN SNAKE RIVER PLAIN AQUIFER AS A SOLE SOURCE AQUIFER

INTRODUCTION

Purpose

This document summarizes readily available information about the eastern Snake River Plain, and will serve as the technical basis for U.S. Environmental Protection Agency (EPA) designation of the Eastern Snake River Plain Aquifer as a sole source aquifer. Those interested in more detailed information may consult the references listed at the end of the report. Additional references may be found in a bibliography regarding the geology and hydrology of the Snake River Plain, which contains over a thousand entries, published by the U.S. Geological Survey (Bassick, 1986).

Sole Source Aquifer Program

The Sole Source Aquifer Program is authorized by the Safe Drinking Water Act of 1974 (Public Law 93-523 42 U.S.C. 300 et. seq.). Section 1424(e) of the Safe Drinking Water Act states:

> "If the Administrator determines, on his own initiative or upon petition that an area has an aquifer which is the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health, he shall publish notice of that determination in the Federal Register. After the publication of any such notice, no commitment for federal financial assistance (through a grant, contract, loan guarantee, or otherwise) may be entered into for any project which the Administrator determines may contaminate such aquifer through a recharge zone so as to create a significant hazard to public health; but a commitment for federal assistance may, if authorized under another provision of law, be entered into to plan or design the project to assure that it will not so contaminate the aquifer."

EPA currently has a longstanding policy of not initiating sole or principal source aquifer designations; the Agency only responds to petitions. Until 1987, EPA accepted sole or principal source aquifer petitions which contained a minimum amount of information. The Sole Source Aquifer Petitioner Guidance Document, released in February of 1987, set forth criteria which clarifies the definition of a sole or principal source aquifer, and describes how to petition EPA. The requirements of the new guidance only apply to petitions submitted after February of 1987.

EPA defines a sole or principal source aquifer as one which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer (U.S. EPA, 1987). Current EPA guidelines also stipulate that designated sole or principal source aquifer areas have no alternative source or combination of sources which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water (U.S. EPA, 1987). For convenience, all EPA designated sole or principal source aquifers are often referred to simply as "sole source aquifers".

Petition History

On March 16, 1977, the Region 10 EPA Office received a petition from Raleigh W. Stevens of the R Bar S Ranch near Hagerman, Idaho. The petition requested "aid of any and all types" to study and protect the aquifer which "feeds Gooding County and all of Hagerman Valley." In response, EPA met with Mr. Stevens and appropriate federal, state, and local government agencies on June 1, 1977, in Twin Falls, Idaho. At that meeting, sole source aquifer designation under Section 1424(e) of the Safe Drinking Water Act was discussed as one of many possible measures designed to protect the aquifer. A consensus emerged to develop a plan of study for the aquifer underlying the eastern Snake River Plain, and to seek funds from a combination of federal, state, and local sources. Mr. Stevens agreed to hold the sole source aquifer petition in abeyance while funds were sought for an extensive aquifer study with the understanding that the petition would be reinstated if funds were not obtained (Scott, 1977). EPA has no record of any federal, state, or local ground-water protection strategies developed in response to this meeting.

On July 1, 1982, EPA received a letter from John A. McDaniel, President of the Hagerman Valley Citizens' Alert, Inc., inquiring about the status of a "petition filed several years ago" to designate the "Snake Plain Aquifer as a 'Sole Source Aquifer' under Section 1424 of the Safe Drinking Water Act." EPA responded by pointing out that although the 1977 meeting participants had agreed upon the need for a comprehensive aquifer study, no funding had been made available (Burd, August 3, 1982). McDaniel wrote again on September 25, 1982, and formally requested that EPA reinstate the sole source aquifer petition filed by Mr. Stevens in 1977. The Hagerman Valley Citizens' Alert, Inc., submitted information requested by EPA to complete this petition on November 1, 1982.

EPA arranged a meeting in Twin Falls on December 8, 1982, to discuss the purpose and scope of the sole source aquifer program. The meeting was attended by 37 people who represented the Hagerman Valley Citizens' Alert, a number of federal and state agencies, several health districts, several irrigation companies, a local conservation group, and the news media (Marshall, December 20, 1982). Shortly after the meeting in Twin Falls, the petitioners formally notified EPA of their continued interest in sole source aquifer designation (McDaniel, December 10, 1982). In light of the petitioners' continued interest, a Federal Register notice announcing receipt of the petition and requesting public comment through April 11, 1983, was published on February 9, 1983.

Informational meetings were arranged for April 13, 1983, in Burley, Idaho and April 14, 1983, in Idaho Falls, Idaho in order to describe the sole source aquifer program and discuss the petition to designate the eastern Snake River Plain as a sole source aquifer area. The 23 people who attended the meeting in Burley, and the 19 who attended the Idaho Falls' meeting, represented local environmental groups, irrigation companies and other businesses, federal, state, and local government agencies, and the news media (Marshall, May 4, 1983).

A Federal Register notice, published on March 22, 1984, announced the draft publication of a support document for designating the "Snake River Plain Aquifer" as a sole source aquifer. The notice also announced that public hearings would be held only if sufficient public interest was expressed. Copies of the Federal Register notice and support document were sent to local, state, and federal officials, public libraries, and representatives of environmental and agricultural interest groups (Marshall, April 2-3, 1984). Press releases which summarized the Federal Register notice were issued by EPA and the Idaho Department of Water Resources (U.S. EPA, March 29, 1984 and IDWR, April 18, 1984).

Despite widespread notification about the proposed hearings, no requests were received for a hearing in the Idaho Falls area (Marshall, May 10, 1984). EPA received ten requests for a public hearing in Twin Falls from citizens who supported sole source aquifer designation. The supporters were agreeable to cancellation of the hearings (Marshall, May 10, 1984). Accordingly, both hearings were cancelled.

After cancellation of the hearings, EPA received a number of requests to reschedule them (Marshall, June 12, 1984). Consequently, hearings were rescheduled and conducted in Idaho Falls on August 13, 1984, and Twin Falls on August 14, 1984 (Barnes, August 1, 1984 and Sceva, August 17, 1984).

Shortly after completion of the public hearings, the Governor and Attorney General of Idaho sent EPA a joint letter, dated August 20, 1984, which expressed strong opposition to sole source aquifer designation. The EPA Region 10 Administrator responded with a letter to Governor Evans on September 19, 1984, and met personally with the Governor on November 7, 1984.

On January 16, 1985, the EPA Regional Administrator announced her decision to postpone making a decision on the sole source aquifer petition (U.S. EPA, January 16, 1985). The Magic Valley Aquifer Coalition wrote the EPA Regional Administrator on April 4, 1985, and asked her to reconsider her decision to postpone sole source aquifer designation (Couch, April 4, 1985).

The petitioners wrote EPA on November 10, 1986, to inquire about the status of their petition (Bowler, November 10, 1986). The agency responded by confirming that their petition was complete and would be processed at some point in time (Burd, December 16, 1986). The petitioners followed up this response with letters to either EPA or the state governor on the following dates: January 15, 1987; June 11, 1987; November 2, 1987.

The EPA Regional Administrator received an unsolicited letter from Governor Andrus on February 11, 1988. The letter requested that EPA continue to delay a decision on the eastern Snake River Plain sole source aquifer petition. Later that year, the Shoshone-Bannock Tribes and the Committee for Idaho's High Desert wrote the EPA Regional Administrator, and urged EPA to act upon the sole source aquifer petition (Osborne, April 1, 1988 and OCrowley, April 25, 1988).

On July 12, 1990, the Acting EPA Regional Administrator wrote Governor Andrus to inform him that EPA was proceeding with sole source aquifer designation for the eastern Snake River Plain. In response, the Region 10 Office of Ground Water has prepared this updated support document which makes use of information published in the last few years, and which more rigorously evaluates alternative drinking water sources.

GENERAL DESCRIPTION OF THE EASTERN SNAKE RIVER PLAIN

Geography

The eastern Snake River Plain of southeastern Idaho covers almost two-thirds of the greater Snake River Plain (fig. 1). The arc-shaped Snake River Plain, which contains most of the population of southern Idaho, extends from near the Wyoming border westward into eastern Oregon. The geologic and hydrologic rationale for division of the Snake River Plain into eastern and western portions are described in the "Description of Boundaries" section of this report.

The 45 to 60 mile wide eastern Snake River Plain cuts almost perpendicularly across the north-south trend of the surrounding mountain ranges and intermontane valleys. The mountain ranges rise thousands of feet above the area; mountain peak elevations vary from about 7500 feet to over 12,000 feet. The Snake River drainage area upstream from King Hill, Idaho, but outside of the Eastern Snake River Plain Aquifer boundary, is defined as the streamflow source area. The hydrologic significance of the streamflow source area is described in the "Ground-water Movement" section of this report.

The land surface of the eastern Snake River Plain exhibits little topographic relief compared to the surrounding mountains, but does contain some locally impressive buttes and rugged volcanic scabland areas (fig. 2). Overall, the surface of the area slopes westwardly from an elevation of about 6,000 feet near the eastern margin of the Plain to about 3,200 feet where the eastern and western parts of the Snake River Plain meet (Mundorff, 1967).

Climate

An arid to semi-arid continental climate prevails across the eastern Snake River Plain. Annual precipitation, which averages 6-12 inches over most of the area, tends to be evenly distributed throughout the year but often varies significantly from year to year (Mundorff et al, 1964). Considerably more precipitation (mostly as snow) falls on the mountainous drainage areas which surround the eastern Snake River Plain on three sides. The higher elevation areas north and south of the eastern Snake River Plain receive average annual precipitation of 20-35 inches, whereas higher elevations in the mountains east of the Snake River Plain average 50-70 inches of precipitation each year (Mundorff et al, 1964 and Kilburn, 1964).

Average temperatures vary across the eastern Snake River Plain according to elevation (table 1) (Mundorff et al, 1964). The average growing season ranges in length from about 150 days at the western part of the eastern Snake River Plain near Bliss to about 100 days near the eastern margin of the Snake River Plain at Ashton (Stearns et al, 1938).

Table 1.---Average Monthly Temperatures (Degrees Fahrenheit)

Station	Elevation(ft)	Jan.	Mar.	May	July	Sept.	Nov.
Twin Falls	3770	27	40	56	71	60	38
Idaho Falls	4830	19	34	53	69	57	34
Ashton	5220	18	29	50	65	54	32

Population

Approximately 273,000 people live in the eastern Snake River Plain (table 2), (Gaia Northwest, 1988). Population centers are clustered almost exclusively in a band within 10 miles of the Snake River. Cities with 2,500 or more people, defined as "urban" areas by the U.S. Census Bureau, contain just over half of the eastern Snake River Plain's population. Two cities, Idaho Falls (pop. 41,774) and Twin Falls (pop. 28,168) hold half of the eastern Snake River Plain's urban population and about one quarter of its total population. About 39 percent of the people in the eastern Snake River Plain live in unincorporated areas, many of them on farms and ranches.

People living in the streamflow source area of the eastern Snake River Plain reside almost exclusively in river valleys. The major population centers are Pocatello in the Portneuf River Valley (pop. 45,334), and the towns of The Wood River Valley (Bellevue, Hailey, Ketchum, and Sun Valley) in Blaine County, Idaho.

Table 2.--Urban and rural population

	People	Percent of Population
Idaho Falls and Twin Falls	69,942	26
Other Cities of at Least 2,500	74,391	27
Urban Subtotal	144,333	53
Unincorporated Areas	107,238	39
Towns of Less Than 2,500	21,077	8
Rural Subtotal	128,315	47
Eastern Snake River Plain Total	272,648	100

Economy

Irrigated agriculture and associated industries dominate the economy of the eastern Snake River Plain and many of its tributary valleys. The Idaho National Engineering Laboratory and an expanding recreation industry account for much of the remaining economic activity in the area.

Irrigated acreage covers about 3,200 square miles of the 10,800 square mile eastern Snake River Plain (Lindholm and Goodell, 1986). Crops grown include potatoes, wheat, dry beans, corn, barley, sugar beets, and hay (Cenarrusa, 1987). Livestock operations include beef and dairy cattle, sheep, and hogs (Cenarrusa, 1987). Trout farms are the principal aquacultural activity in the area (Cenarrusa, 1987). Irrigation began in the later half of the 19th century and grew rapidly after the Carey Act of 1894 and The Federal Reclamation Act of 1902 provided the "means and incentives" for building extensive surface irrigation networks (Norvitch et al, 1969). Use of ground water for irrigation was rare before 1945 but has expanded rapidly since then. Ground water now accounts for about one-third of the water used for irrigation within the eastern Snake River Plain (Kjelstrom, 1986).

The Idaho National Engineering Laboratory (INEL) and spinoff industries account for much of the economic development in the northeastern part of the Snake River Plain. Nuclear research and production activities within the 890 square mile reservation employ about 3,700 federal civilian and military employees, and contractor activity associated with the center brings the total work force directly dependent upon INEL to over 10,000 people (Cenarrusa, 1987).

Outdoor recreation and associated service industries provide the economic backbone of some higher elevation valleys in the streamflow source area. Recreation centers in the Wood River Valley of Idaho and Jackson Hole, Wyoming account for the strongest recent economic growth in the streamflow source area. For instance, the population of Blaine County, Idaho increased 34.2 percent from 9841 to 13,200 people between 1980 and 1986 (Cenarrusa, 1987).

HYDROGEOLOGY OF THE EASTERN SNAKE RIVER PLAIN

Hydrogeological characteristics of the eastern Snake River Plain are used for defining areal boundaries of the sole source aquifer system, in defining individual aquifers underlying the plain, and in understanding the ground-water flow system. Descriptions of each geologic map unit, water yielding characteristics, mapped structures, and ground-water flow patterns, are taken from the U.S. Geological Survey Regional Aquifer Study and Analysis of the Snake River Plain publications.

Stratigraphy

The eastern Snake River Plain is composed of volcanic rocks extruded during Tertiary and Quaternary Periods overlain by Quaternary alluvial deposits (Whitehead, 1986) (fig. 3). Volcanic rock map units include the following: "older silicic volcanics," "older basalt," "basalt," and "younger basalt." Quaternary alluvial strata include: "older alluvium," "windblown deposits," and "alluvium."

"Older silicic volcanics", underlie the entire Snake River Plain, and crop out at the land surface in three small isolated areas in the eastern part of the plain. The Idavada Volcanics are included in this map unit. These massive and dense rhyolitic, latitic, and andesitic rocks occur as thick flows, and blankets of welded tuff that contain fine- to coarse-grained ash and pumice beds. Jointing ranges from platy to columnar, with local areas of folding, tilting, and faulting in the streamflow source area. The maximum thickness is greater than 3,000 feet. A number of wells located on the plain withdraw water from the "older silicic volcanics". Hydraulic conductivity and well yields are highly variable. Principal production zones include joints, fault zones, and interstices of coarse-grained ash, sand, and gravel.

The "older basalt" consists of flood-type basalt flows that are dense, folded and faulted, and columnar jointed in many places. Flows of vesicular olivine basalt and some rhyolitic and andesitic rocks are included in this map unit. The age of these volcanic rocks (Miocene Epoch) is equivalent to the Columbia River Basalt Group and the Banbury Basalt of the Idaho Group. These basalt flows cover large areas of the streamflow source area but crop out in only one small area of the western end of the eastern Snake River Plain. Maximum thickness is greater than 1,000 feet. Where saturated, these rocks generally yield small to moderate amounts of water to wells. Hydraulic conductivity is variable, and may be high in places. Specific capacities of wells finished in the unit range from 3 to 900 gal/min/ft.

"Older alluvium" consists of compacted to poorly consolidated, subaerial and lacustrine deposits of clay, silt, sand, and gravel. The deposits are poorly to well stratified, and contain beds of ash with intercalated basalt. This map unit occurs predominantly along the southeastern boundary of the area, and has a maximum thickness greater than 5,500 feet. The "older alluvium" generally contains water under confined conditions, has variable hydraulic conductivity, and is an important source of water in some areas. Well yields range from a few gallons per minute from clay-rich intervals to several hundred gallons per minute from sand and gravel beds.

"Basalt" occupies small isolated areas throughout the plain, and consists of olivine basalt that has a well developed soil cover where exposed. Thickness is counted with the maximum thickness of the "younger basalt" below. Hydraulic conductivity and well yields are also similar to the "younger basalt".

"Younger basalt" covers the vast majority of the eastern Snake River Plain land surface. This map unit consists of many flood-type basalt flows of dense to vesicular, irregular to columnar jointed, olivine basalt. Maximum thickness is greater than 4,000 feet (including "basalt"). Individual flow thickness varies from 10 to 50 feet and averages 20 to 25 feet (Mundorff et al, 1964). Beds of basaltic cinders, rubbly basalt, and interflow sedimentary rocks occur between the flows. This deposit, along with the "basalt" unit, comprise the major aquifer units that contribute water to wells in the eastern Snake River plain. Transmissivity determined from aquifer pump tests averages 6.7×10^5 ft^2/d. Hydraulic conductivity is variable and extremely high in places where jointing and rubbly contacts between flows occur.

"Windblown deposits" include lake and glacial-flood deposits that mantle much of the lowland areas, and local occurrences of active sand dunes in the northern section of the eastern Snake River Plain. This unit is usually found above the water table. Maximum thickness is unknown, but estimated to be greater than 100 feet.

"Alluvium" consists chiefly of flood-plain deposits, but may contain some glacial and colluvium deposits in the uplands. These sediments occur on the surface of tributary valleys and flood plains of the main streams, and form alluvial fans at mouths of some valleys. The deposits are composed of a mixture of unconsolidated to well compacted clay, silt, sand, gravel, and boulders. Stratification ranges from unstratified to well stratified. Maximum thickness is estimated at greater than 250 feet. Hydraulic conductivity is variable, but moderately high in coarse-grained deposits. Sandy and gravelly alluvium yields moderate to large quantities of water to wells.

Structure

The eastern Snake River Plain is a structural downwarp filled with a thick sequence of the Tertiary and Quaternary sediments. Structural characteristics such as faults and fractures occur throughout the eastern Snake River Plain streamflow source area, but few are evident on the surface of the Plain (fig. 3). These structures can influence ground-water flow direction and velocity, and affect well-yield capacities. Faults may provide avenues for vertical movement of water, or impede and change the direction of horizontal movement of water (Lewis and Young, 1982).

Outcrops and well logs indicate that basalt flows underlying the plain are highly fractured. However, few major faults are mapped because they are obscured by Holocene basalt flows and sedimentary rocks that mantle much of the plain. Seismic studies suggest the presence of high angle vertical faults along much of the eastern plain boundary, with displacement being at least 13,000 feet along the northwestern boundary. Although these faults are not shown on published maps, the Great Rift zone and other rift zones shown on the maps may be indicative of such deep-seated faulting. If so, most of the rift zone faults are approximately perpendicular to the boundary faults of the plain.

Ground-water Movement

The ground-water flow regime beneath the eastern Snake River Plain is an important factor in determining the potential for ground-water contamination, and for predicting the movement of contaminants that reach the ground-water system. Ground-water movement under the plain is determined from water levels measured in the "regional aquifer system" in 1980 during the U.S. Geological Survey Regional Aquifer Study and Analysis, (Lindholm and others, 1986). This "system" includes all aquifers except those considered perched or parts of small, shallow systems, and is representative of the regional flow in the sole source aquifer.

Ground water moves generally horizontally near the center of the plain, and vertically in regions of recharge and discharge. Horizontal movement of ground water in the aquifer is from northeast to southwest, with deviations along gaining reaches of the Snake River and its tributary basins (fig. 4). Horizontal hydraulic gradients range from about 3 to 100 feet per mile and average about 12 feet per mile. Hydraulic gradients are lowest in the central part of the plain, which is underlain by thick highly transmissive basalt. Horizontal movement in basalt is primarily through rubbly basalt flow-tops where hydraulic conductivity values are high. Perched water tables have formed, particularly near the boundaries of the plain, where fine grained sedimentary rocks impede the vertical movement of water downward. These perched aquifers provide a significant source of water to the local inhabitants. Small, isolated flow regimes may be present in areas of intensive ground-water pumpage or high topographic relief.

Recharge to the ground-water system occurs from surface-water irrigation (60%), underflow from tributary drainage basins (25%), direct precipitation (10%), and Snake River losses (5%) (Kjelstrom, 1986). Surface-water irrigation recharges the aquifer via infiltration of water from irrigated fields, and losses through irrigation canals. Cross-sections showing vertical flow paths illustrate the influx of tributary drainage basin underflow that occurs along the aquifer boundaries (fig. 5).

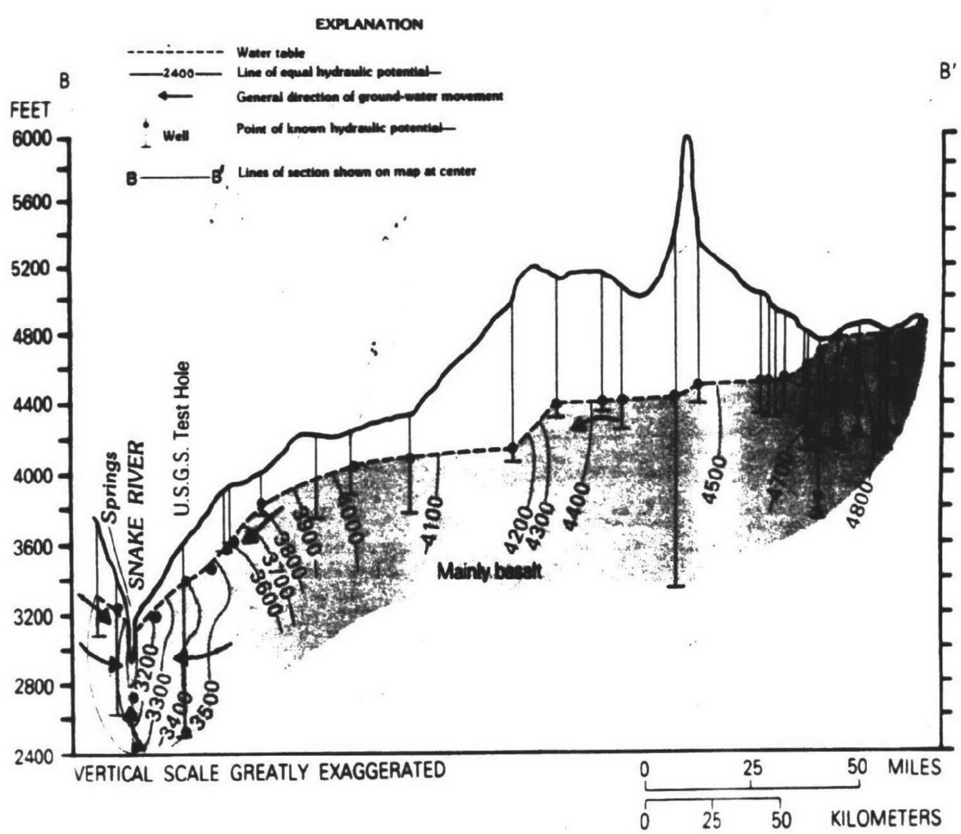

Figure 5.--Cross section of vertical ground-water flow through the eastern Snake River Plain aquifer (from Lindholm and others).

Discharge from the Eastern Snake River Plain Aquifer occurs as spring flow along the Snake River, direct seepage into the Snake River, and well pumpage. Although ground-water discharge from evapotranspiration of plants probably occurs where the water table is shallow, data on total volume released is unavailable. Total discharge from spring flow and Snake River seepage is estimated to be approximately 7.6 million acre-feet, with most outflow occurring along the Snake River between Milner and King Hill. Ground-water discharge from well pumpage equals approximately 1.92 million acre-feet (Gaia Northwest, 1988).

Present estimates of average annual surface and ground-water inflow and outflow on the eastern Snake River Plain are compared to pre-development estimates in a water budget analysis published by the U.S. Geological Survey (table 3) (Kjelstrom, 1986). Under present conditions, total inflow equals approximately 10.82 million acre-feet of water from recharge of the Snake River near Heise, Idaho, water yield from tributary basins, and direct precipitation on the plain. Outflow from the eastern Snake River Plain equals approximately 10.77 million acre-feet of water from discharge into the Snake River at King Hill, evaporation from the Snake River and reservoirs, and evapotranspiration of irrigation water. The remaining .05 million acre-feet contributes to ground-water storage. Irrigated agriculture and other development has resulted in an approximate 6% decrease in water circulating through the eastern Snake River Plain. Although ground-water recharge from irrigation and ground-water discharge from pumping have local impacts on the ground-water system, those volumes of water are each recycled within the plain, and thus are taken into account in the budget totals.

Ground-Water Quality

Non-thermal ground water beneath the eastern Snake River Plain is generally of naturally high quality relative to drinking water standards. Available data suggest that the background water quality of basalt and alluvial aquifers is similar. Concentrations of ground-water total dissolved solids average 282 milligrams per liter (mg/L) in basalt and 263 mg/L in Quaternary sediments (Yee and Souza, 1987). The relative proportion of dissolved solids are also quite similar; calcium accounts for about 50 percent of the cations and bicarbonate about 80 percent of the anions (fig. 6).

Man-induced contamination has been documented in widespread areas at levels below drinking water standards, and in more localized areas at levels which exceed drinking water standards. Documented instances of ground-water degradation above drinking water standards have occurred in both urban and rural areas, from a variety of land-use and waste water disposal practices.

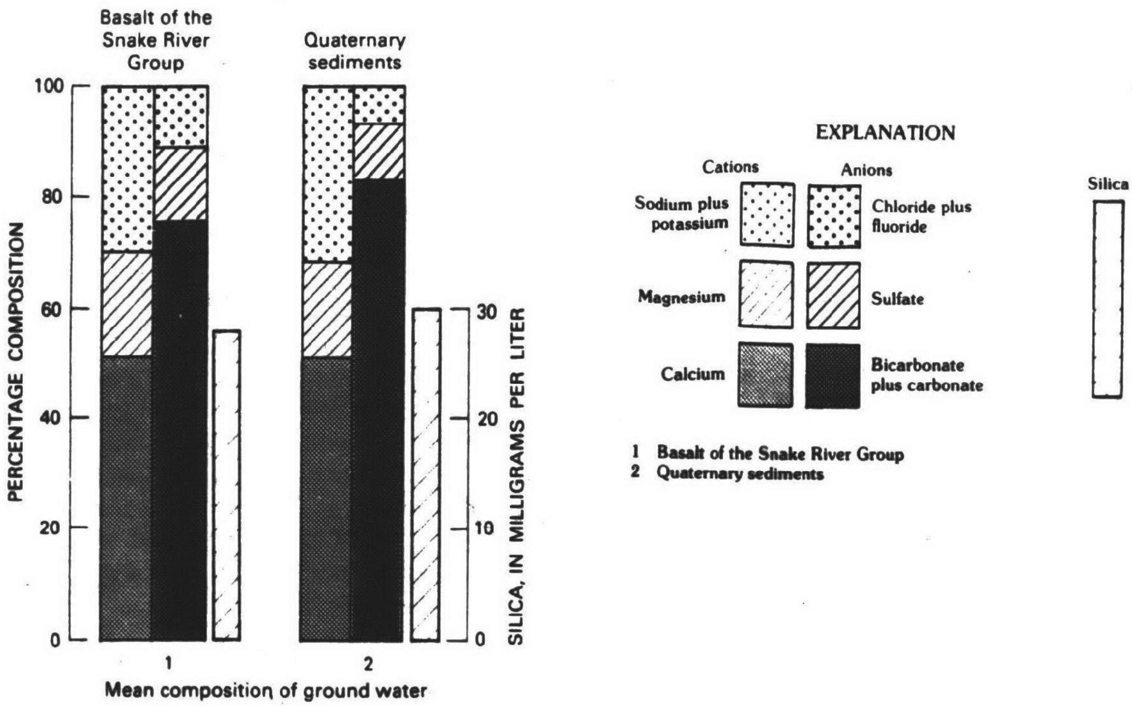

Figure 6.--Mean composition of ground water (from Yee and Souza, 1987).

Distinct and areally extensive differences in ground-water quality have been documented between areas of high and low population densities. A ground-water quality reconnaissance study published nearly 20 years ago shows that chloride levels of about 10 mg/L were widespread in remote areas of the eastern Snake River Plain whereas chloride levels of about 100 mg/L were common in ground-water beneath intensively irrigated areas (Dyer and Young, 1971). Likewise, nitrate levels of about 2 mg/L were common in remote areas but nitrate levels in excess of 15 mg/L were widespread in ground water beneath intensively irrigated areas (Dyer and Young, 1971). The documented chloride concentrations have no direct public health significance, but the elevated nitrate levels are of concern since the primary (health based) drinking water standard for nitrate is 10 mg/L. More recent studies have also documented high levels of nitrogen (usually as nitrate) in ground water beneath intensively irrigated areas (Young et al, 1987a; Young et al, 1987b).

Waste disposal practices at INEL have resulted in widespread and well documented ground-water contamination beneath part of the 890 square mile reservation. In 1978, a 28 square mile tritium plume was mapped (Barraclough et al, 1982). The plume was estimated to have advanced about five feet per day after radioactive waste disposal through injection wells began in 1952 (Barraclough et al, 1982). Injection of radioactive waste was halted in 1984, but waste disposal lagoons at INEL continue to leak contaminants to ground water.

INEL has received EPA designation as a National Priority List (NPL) "Superfund" site under the Comprehensive Environmental Remediation, Cleanup, and Liability Act (CERCLA). This EPA designation is not related to EPA sole source aquifer designation of the Eastern Snake River Plain Aquifer under the Safe Drinking Water Act. After EPA sole source aquifer designation, any federal financial assistance at INEL will be subject to review under Section 1424(e) of the Safe Drinking Water Act. However, as far as EPA knows, INEL operates entirely upon direct federal funding; the Agency is unaware of any federal financially-assisted projects at the facility.

Numerous spills associated with the transportation or storage of petroleum products and other hazardous materials have been documented on the eastern Snake River Plain by the Idaho Division of Environmental Quality (IDEQ). IDEQ began a Contamination Log in 1985 to keep track of spills which could adversely impact ground-water quality.

Local Health Districts and IDEQ regional field offices often receive complaints about suspected bacterial contamination of water from private well owners (IDEQ, 1985a). Documented instances of bacterial contamination have occurred in or near the cities of Paul, Groveland, Collins, and Blackfoot (IDEQ, 1985a).

Potential For Contamination

A combination of natural and man-made factors determine the potential for ground-water contamination within a given area. Natural factors, attributable to climate and geologic history, include the thickness and nature of the unsaturated zone, depth to ground water, and ground-water movement. Qualitative measures of some combination of natural factors is often called "hydrogeologic susceptibility". Man-induced factors include water withdrawal, waste-water disposal, hazardous material handling and disposal practices, and other land-use practices. Qualitative evaluation of man-induced factors combined with hydrogeologic susceptibility is often termed "ground-water vulnerability" or "potential for contamination".

Hydrogeologic susceptibility varies considerably within the eastern Snake River Plain. Significant differences in the thickness and nature of the unsaturated zone accounts for much of the variation. For instance, areas where fractured basalt crops out at the land surface are more susceptible to ground-water contamination than areas where thick deposits of clay-rich soil provide a degree of natural protection.

Some practices, such as the use of injection wells or inadvertent use of leaking underground storage tanks, partly or entirely override whatever degree of natural protection is afforded by the unsaturated zone. This is of particular concern in the eastern Snake River Plain because of the widespread use of drain wells (Class V injection wells) to dispose of excess irrigation water, urban storm runoff, and onsite sewage system effluent (Yee and Souza, 1987; Parliman, 1988).

Plumes of dissolved contaminants within the basalt tend to spread laterally, in the direction of ground-water flow, within zones of high hydraulic conductivity. Interflow zones of fine-grained sediment may almost entirely prevent vertical migration on a local scale (IDEQ, 1985a).

Open-hole well construction is a common practice in the eastern Snake River Plain which may have ground-water quality impacts. When much of the borehole is uncased, water can mingle freely between producing zones. This could be a significant concern wherever hydraulic head relationships are such that a stratigraphic interval of poor quality water could contaminate zones of high quality water.

IDEQ has ranked most known and potential sources of ground-water contamination (statewide) on the basis of human health risk (IDEQ, 1985b). From greatest risk to least risk, the ranking is as follows: petroleum handling and storage; feedlots and dairies; landfills and hazardous waste sites; land application of waste-water; hazardous material handling; pesticide handling and use; land spreading of sludge and solid or liquid septic tank pumpage; surface runoff; pits, ponds, and lagoons; radioactive substances; fertilizer application; septic tank systems; mining, including oil and gas drilling; wells (injection, geothermal, and domestic); and forestry practices. Within the eastern Snake River Plain, injection and geothermal wells would be of higher concern than on a statewide basis. In fact, the U.S. Geological Survey has emphasized the importance of ground-water quality concerns associated with drain wells and geothermal resource development (Yee and Souza, 1987).

DESCRIPTION OF BOUNDARIES

Areal boundaries of the Eastern Snake River Plain Sole Source Aquifer and streamflow source area (fig. 1) are coincident with the boundaries of the eastern Snake River Plain and contributory drainage area as delineated in the U.S. Geological Survey Snake River Plain Regional Aquifer Study and Analysis. The U.S. Geological Survey used a combination of geologic contacts and topography to delineate the eastern Snake River Plain (Whitehead, 1986).

Generally, the aquifer boundary is the contact between Quaternary sedimentary and volcanic rocks and the surrounding Tertiary and older rocks (fig. 3). Where rocks equivalent in age to those in the eastern Snake River Plain extend up river valleys, a topographic contour was chosen to define the boundary. The boundary separating the eastern and western portions of the Snake River Plain follows a drainage divide from the northern boundary of the plain to the Snake River at King Hill, follows the Snake River to Salmon Falls Creek, and follows Salmon Falls Creek to the southern boundary of the plain. Distinct changes in geology and hydrology that occur along the dividing line make a hydrogeologic division feasible. The sole source aquifer area extends vertically from the land surface through all geologic units that have the potential to supply significant amounts of drinking water to wells.

The streamflow source area boundary coincides with the topographic divides that delineate the eastern part of the Snake River Plain drainage basin (fig. 2). The boundary encompasses the drainage area that contributes surface and ground-water recharge to the Eastern Snake River Plain Aquifer. Contaminated recharge water originating in the streamflow source area could adversely affect ground-water quality of the eastern Snake River Plain aquifer. Therefore, the project review area includes both the aquifer and streamflow source areas.

DRINKING WATER USE

Ground water, withdrawn from wells and springs, supplies 100 percent of the drinking water consumed within the eastern Snake River Plain (Gaia Northwest, 1988). Total domestic water consumption is approximately 46,000 acre-feet per year. Twin Falls obtains about 50 percent of its summer water supply from springs along the north side of the Snake River; all other public drinking water purveyors in the eastern Snake River Plain withdraw ground water from wells. About 39 percent of the eastern Snake River Plain's population live outside of incorporated areas. Almost all rural residents rely upon private wells for drinking water, but some receive drinking water from wells operated by small water systems.

ALTERNATIVE DRINKING WATER SOURCES

Under EPA's 1987 Petitioner Guidance, an aquifer which serves as the sole or principal source of drinking water for an area may not be designated as such if an alternative source or combination of alternative sources can physically, legally, and economically supply all those who depend upon the petitioned aquifer for their drinking water (EPA, 1987). Aquifers petitioned before 1987 are not subject to this formal alternative source feasibility criteria, but the feasibility of using alternative drinking water sources has long been a consideration in sole source aquifer designation decisions.

In the past, EPA has considered that alternative sources of drinking water could not economically supply the entire population of the eastern Snake River Plain. This determination rested largely upon the informal assessment that the large numbers of small towns, farms, and ranches in the area could clearly not be economically served from other drinking water sources. A formal definition of "economical" did not seem necessary to make this assessment.

In response to those who questioned EPA's alternative source determination, the Agency hired a contractor to assess the legal and economic feasibility of supplying drinking water from an alternative source or combination of sources to all those living in the eastern Snake River Plain. This analysis was conducted as if the petitioned aquifer were to be evaluated using the 1987 EPA Petitioner Guidance, which contains a formal definition of economic feasibility, to determine its eligibility for sole or principal source aquifer designation.

The alternative drinking water source study conducted for EPA concluded that alternative drinking water supplies are physically and legally available from surface streams, such as the Snake River, and from aquifers within the streamflow source area (Gaia Northwest, 1988). However, the study concludes that those living on farms or ranches, and in towns of less than about 7000, cannot be served drinking water economically from an alternative source. Therefore, only about 40 percent of the people living in the eastern Snake River Plain can economically be supplied by an alternative drinking water source.

CONCLUSIONS

An aquifer must supply 50 percent or more of the drinking water consumed over the aquifer area in order to receive EPA designation as a sole or principal source aquifer. Ground water supplies 100 percent of the drinking water consumed within the eastern Snake River Plain. Further, no alternative source or combination of sources can economically supply all those who obtain drinking water from the Eastern Snake River Plain Aquifer. Therefore, the Eastern Snake River Plain Aquifer meets the criteria for EPA designation as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act.

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