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GROUND-WATER QUALITY IN EAST-CENTRAL IDAHO VALLEYS

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WELL-NUMBERING SYSTEM

The well-numbering system (fig. 1) indicates the location of wells sampled within the official rectangular subdivision of public lands, with reference to the Boise base line and meridian. The first two segments of the number designate the township (north or south) and range (east or west). The third segment gives the section number, followed by three letters and a numeral, which indicate the ¼ section (160-acre tract), the ¼-¼ section (40-acre tract), the ¼-¼-¼ section (10-acre tract), and the serial number of the well within the tract, respectively.

The U.S. Geological Survey in Idaho indicates quarter sections by the letters A, B, C, and D in counterclockwise order from the northeast quarter of each section. Within the quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. For example, well 8N-22E-6ABC1 is in the SW¼NW¼NE¼ sec. 6, T. 8 N., R. 22 E., and is the first well inventoried in that tract.

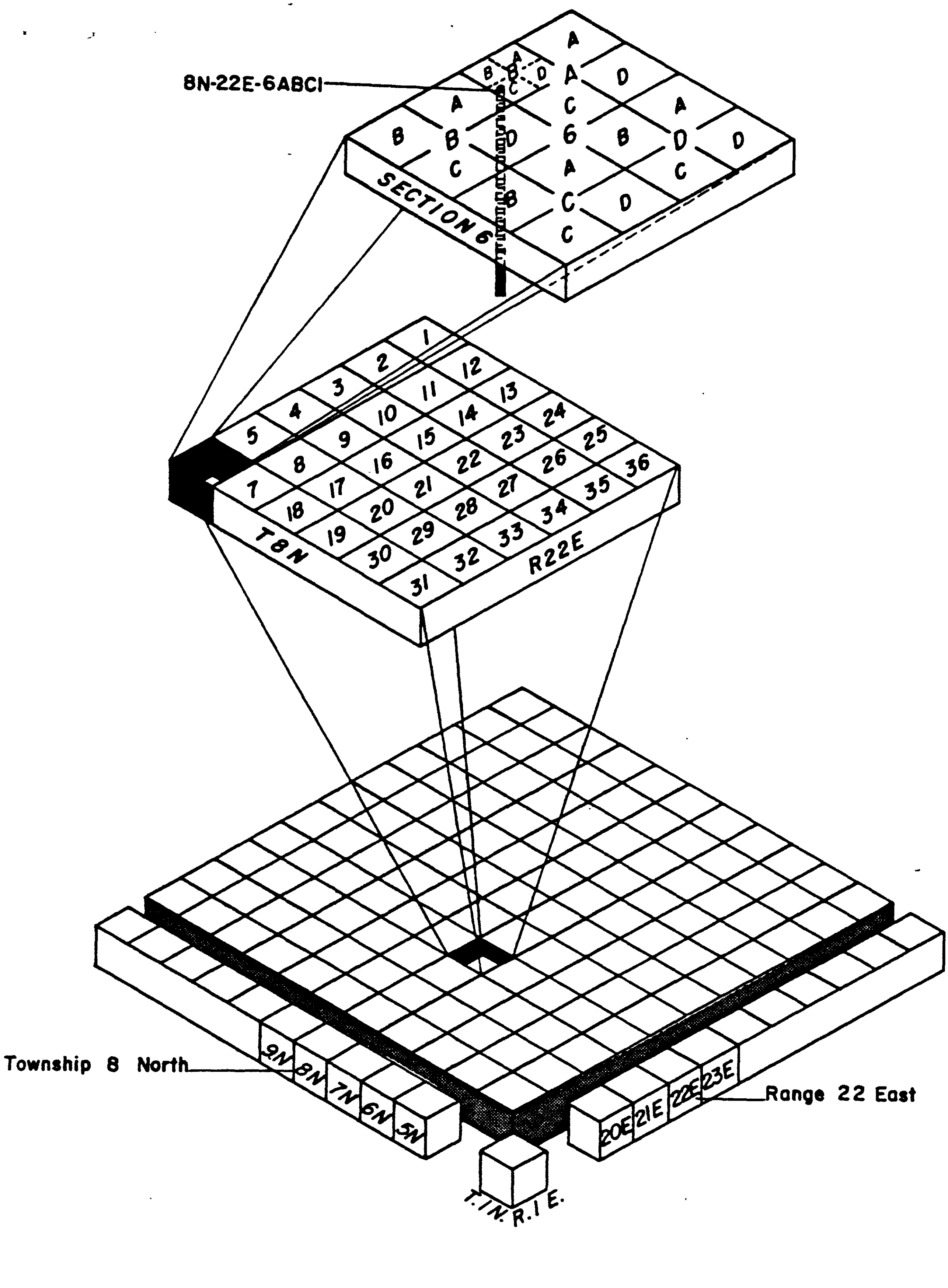

Figure 1.-- Well-numbering system.

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ABSTRACT

From May through November 1978, water quality, geologic, and hydrologic data were collected for 108 wells in the Lemhi, Pahsimeroi, Salmon River (Stanley to Salmon), Big Lost River, and Little Lost River valleys in east-central Idaho. Data were assembled to define, on a reconnaissance level, water-quality conditions in major aquifers and to develop an understanding of factors that affected conditions in 1978 and could affect future ground-water quality.

Water-quality characteristics determined include specific conductance, pH, water temperature, major dissolved cations, major dissolved anions, and coliform bacteria. Concentrations of hardness, nitrite plus nitrate, coliform bacteria, dissolved solids, sulfate, chloride, fluoride, iron, calcium, magnesium, sodium, potassium, or bicarbonate exceed public drinking water regulation limits or were anomalously high in some water samples. Highly mineralized ground water probably is due to the natural composition of the aquifers and not to surface contamination. Concentrations of coliform bacteria that exceed public drinking water limits and anomalously high dissolved nitrite-plus-nitrate concentrations are from 15- to 20-year old irrigation wells in heavily irrigated or more densely populated areas of the valleys. Ground-water quality and quantity in most of the study area are sufficient to meet current (1978) population and economic demands.

Ground water in all valleys is characterized by significant concentrations of calcium, magnesium, and bicarbonate plus carbonate ions. Variations in the general trend of ground-water composition (especially in the Lemhi Valley) probably are most directly related to variability in aquifer lithology and proximity of sampling site to source of recharge.

INTRODUCTION

This study was made as part of a continuing program, in cooperation with the Idaho Department of Water Resources, to obtain ground-water quality data in areas where land and water-resource development is increasing. Similar studies in this program were completed for southeastern Idaho (Seitz and Norvitch, 1979) and north Idaho (Parliman and others, 1980). Location of the east-central Idaho valleys study area is shown in figure 2.

Population and commercial development are predicted to increase in the study area, especially near the towns of Salmon, Challis, and Arco (Idaho Department of Water Resources and Boise State University, 1978). Recent construction of second home, recreational home, and urban subdivision developments near these towns is evident. Continued urban and commercial development, together with a probable increase in ground-water-irrigated acreage, may ultimately affect ground-water availability and quality in the area.

As demand for ground water increases in Idaho, ground-water availability and quality become more significant to water users. An understanding of the factors affecting ground-water quality is necessary to evaluate effects of stresses that will accompany changes in land and water use.

Purpose and Scope

The purposes of this study are to: (1) Define, on a reconnaissance level, ground-water quality in selected valleys of east-central Idaho river basins; and (2) assemble available geologic and hydrologic data to assist in understanding present (1978) and future water-quality conditions in east-central Idaho.

The scope of study is broad in that ground-water sampling is representative of all major aquifers (water-yielding rock units) in the study area. Reconnaissance-level sampling was limited, however, to wells in the valleys of the study area river basins where ground-water use and ground-water quality are generally most diversified. No attempt was made to sample specifically for point-source pollution.

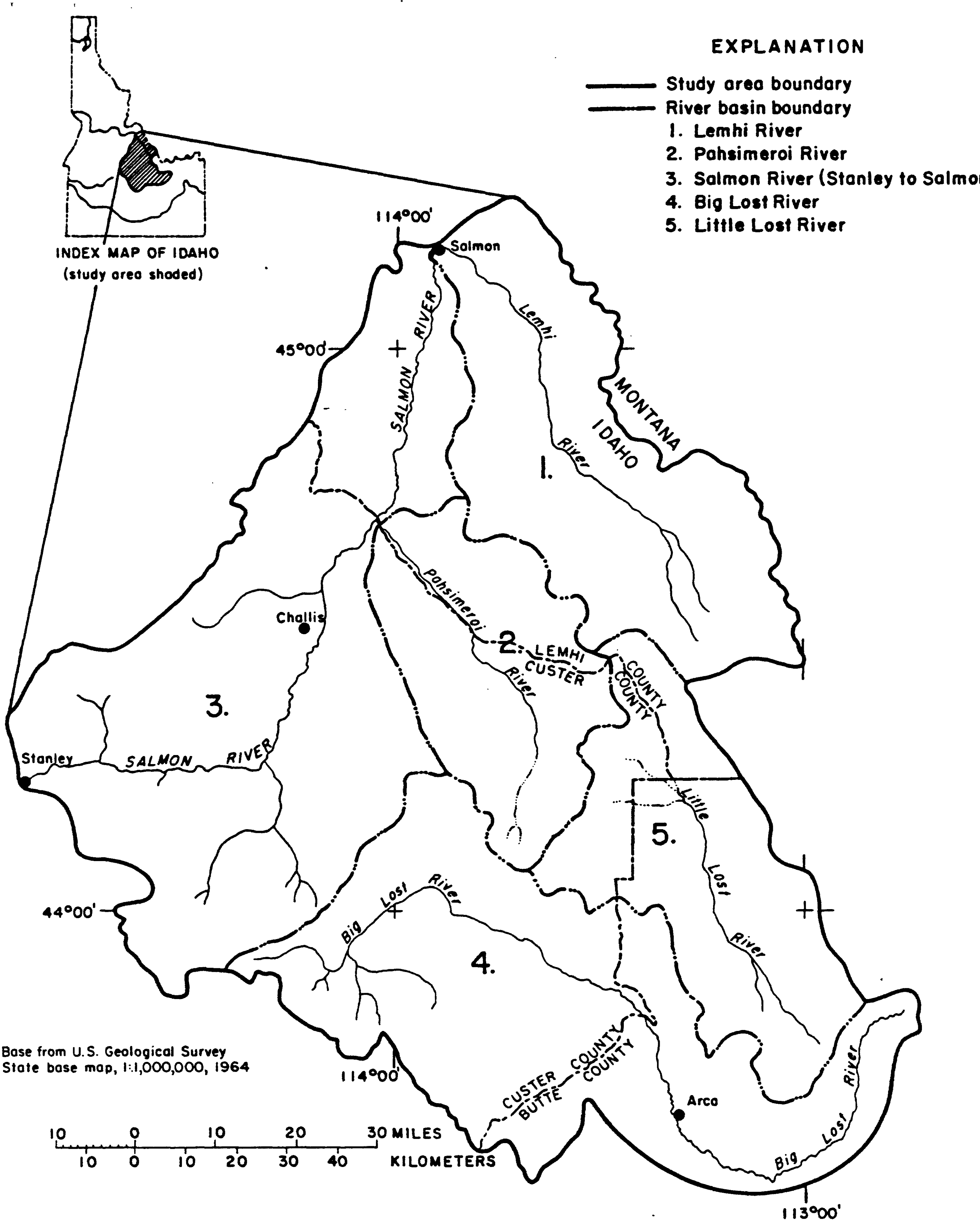


Figure 2.-- Study area and river basin boundaries.

Locations of Wells

During the period May to November 1978, well data and water samples were collected from 108 wells in the study area. Well data and ground-water quality information for 15 wells inventoried and sampled prior to 1978 are included in the report for areas in which current (1978) data are not available. Well locations are shown on plate 1. Well data and ground-water quality for these wells are presented in subsequent sections of this report.

Previous Investigations

Completed studies on the water resources of east-central Idaho include Crosthwaite and George (1965) on the Upper Lemhi Valley; Young and Harenberg (1973) on the Pahsimeroi River basin; Crosthwaite (1962) on Round Valley (Salmon River at Challis); Crosthwaite, Thomas, and Dyer (1970) on the Big Lost River basin; and Clebsch, Waite, and Decker (1974) on the Little Lost River basin. Surface-water and geologic data for the Salmon River basin upstream from Challis were discussed in Emmett (1975). Ground-water quality data in these studies are sparse, however.

DESCRIPTION OF STUDY AREA

The east-central Idaho study area comprises about 5,000 mi^2 and includes drainage basins of the Lemhi, Pahsimeroi, Salmon (between the towns of Stanley and Salmon), Big Lost, and Little Lost Rivers (fig. 2). Lemhi and Pahsimeroi Rivers are northwestward-flowing tributaries of the Salmon River. Big Lost River and Little Lost River are southeastward flowing tributaries of the Snake River.

Lemhi, Pahsimeroi, Salmon, Big Lost (upstream from Arco), and Little Lost (upstream from Howe) River basins are included in the Northern Rocky Mountain geomorphic province and are characterized by high, massive mountains and intermontane valleys that have variably thick accumulations of sediment. Big Lost (downstream from Arco) and Little Lost (downstream from Howe) River basins are included in the eastern part of the Columbia Plateau geomorphic province and are characterized by a relatively flat land surface underlain by a succession of lava flows and sediment deposits in a structural basin, the Snake River Plain. About 9,500 people live in the valleys of the river basins. Towns of more than 800 inhabitants include Salmon, Challis, and Arco. Economy of the study area is based on irrigated agriculture (primarily seed potatoes, hay, alfalfa, and grain crops), beef cattle and sheep production, tourism and recreational sports, and mining and logging operations. Because State and Federal agencies manage the majority of land in the study area, government employment is significant to the valleys' overall economies.

Climate

Land-surface altitude, relief, and prevailing wind patterns determine climate in the study area. High mountains receive heavy snowfall in winter. Valley lowlands are semiarid and have warm, relatively dry summers and cold winters with scant snowfall. Prevailing westerly winds, influenced by the Pacific Ocean, moderate the climate. Precipitation occurs when warm, moist air moving inland rises over mountain masses, is cooled, and moisture is precipitated as rain or snow at high altitudes. Moisture-deficient air moves down to the valleys and the air is warmed and dried, which results in scant valley-lowland precipitation.

Figure 3 shows isohyets (lines of equal precipitation) based on mean annual precipitation in east-central Idaho, 1930-57. The approximate locations of eight NOAA (National Oceanic and Atmospheric Administration) meteorological stations are also shown.

Mean monthly precipitation data from eight NOAA meteorological stations for January 1977 through December 1978 (fig. 4) show greatest valley-lowland precipitation between April and July and in September and December. Total valley lowland precipitation averaged less than 10 in. annually. Many lowland crops, therefore, require surface-water or ground-water irrigation throughout the growing season.

Valley air temperatures for January 1977 through December 1978 ranged from a winter low of -18.4°C (-1.1°F) in Leadore, to a summer high of 30.3°C (86.5°F) in Salmon. Daily temperatures of at least 4.4°C (40°F) are common

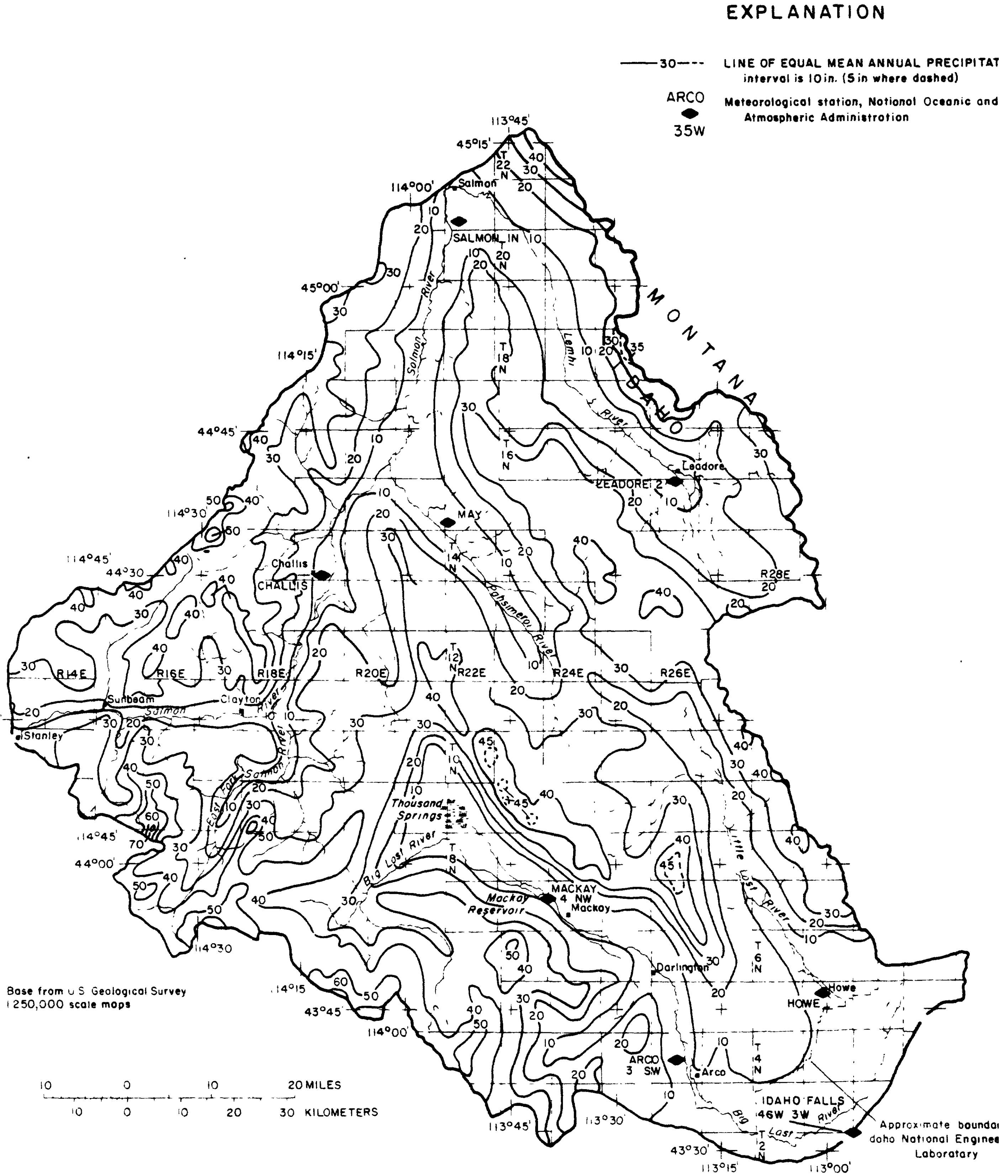


Figure 3.-- Distribution of mean annual precipitation in east-central Idaho, 1930 - 57.

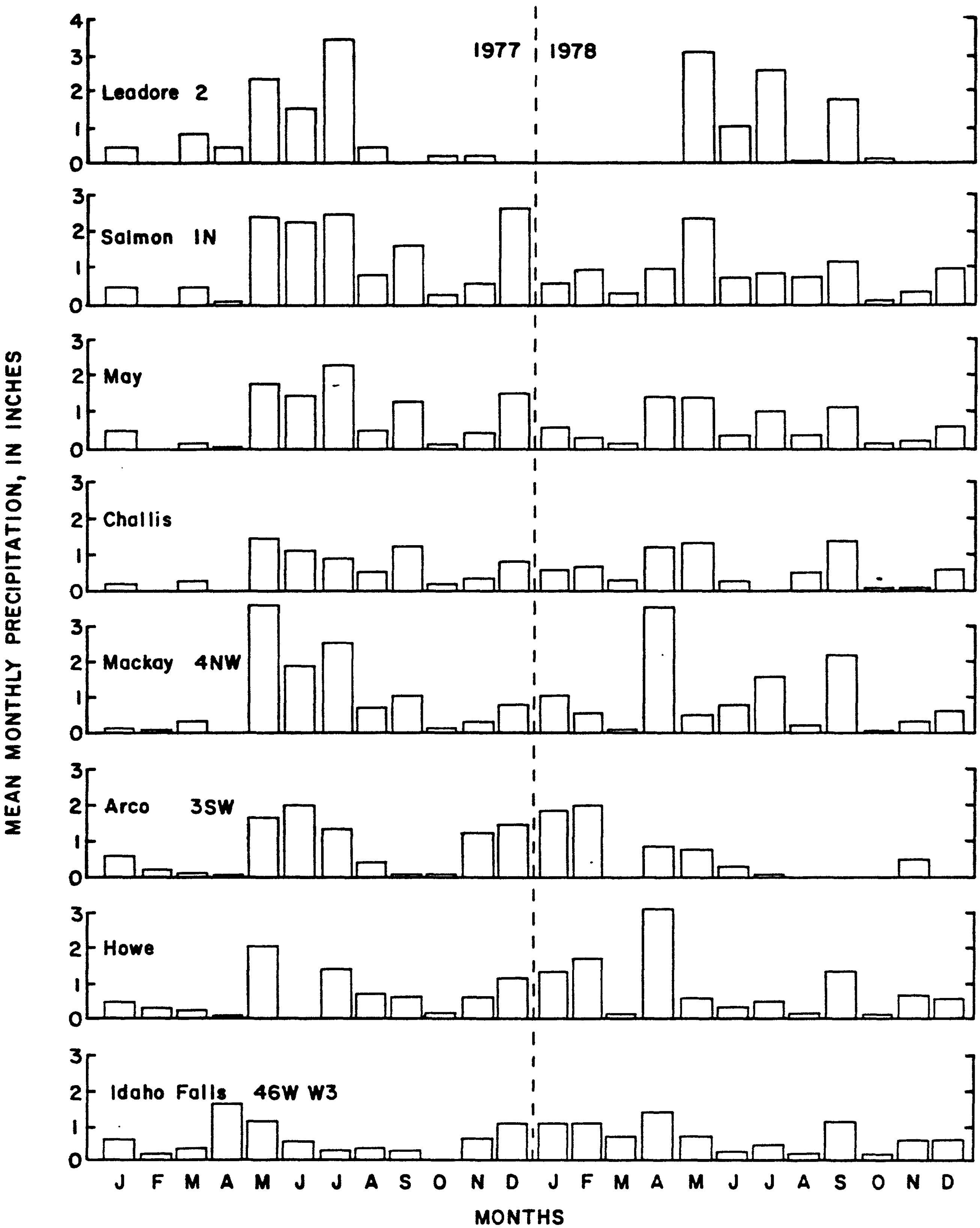


Figure 4.--Mean monthly precipitation, 1977-78 (by meteorological station).

during winter months. The frost-free growing season lasts from about mid- or late May to early September and limits agricultural use of valley lowlands.

Generalized Geology

Rock units in the study area include flood-plain alluvium of Quaternary age, sedimentary and volcanic rocks of Quaternary and Tertiary age, granitic rocks of Tertiary and Cretaceous age, marine sedimentary rocks of Paleozoic age, and undifferentiated rocks of Precambrian age. These units are grouped, on the basis of geologic age and rock type, to emphasize geology most important to east-central Idaho hydrology. Surficial geologic contacts for all units are from the Idaho State geologic map (Bond, 1978). Geology of the east-central Idaho study area and correlation, description, and water-yielding characteristics of rock units are shown on plate 2.

Valley fill in the study area consists of Quaternary flood-plain alluvium and Quaternary and Tertiary sedimentary rocks. Flood-plain alluvium consists of unconsolidated, poorly sorted deposits of cobbles, gravel, sand, silt, and local clay lenses. Sedimentary rocks consist of river, lake, and glacial deposits of boulders, cobbles, gravel, sand, silt, and clay.

Lithologic descriptions on drillers' logs are often not explicit, and at shallow depths (less than 50 ft), sedimentary rocks may not be easily distinguished from flood-plain alluvium. For purposes of this report, sedimentary rocks are distinguished from flood-plain alluvium by the presence of a "gravel hardpan," "sandstone," or "cemented sand" cap, as indicated by lithology on drillers' logs. Clay beds are generally thicker in sedimentary rocks than in flood-plain alluvium and may contain considerable organic matter. Sand and gravel stringers within clay lenses and clay beds are important to hydrologic and water-quality characteristics of study-area aquifers.

Quaternary and Tertiary volcanic rocks have two distinct origins and compositions: (1) Older (Paleocene? and Eocene) flows of silicic volcanic rocks and basalts interbedded with pyroclastic and sedimentary materials, generally identified as Challis Volcanics; and (2) younger (Pleistocene and Holocene) volcanic rocks of the Snake River Group--silicic to basaltic flows, cinder, ash, pumice, and welded tuff interbeds, and volcanic-cone deposits. Rocks of the Challis Volcanics commonly form both the foothills and mountains along the Salmon River and its tributaries and also crop out locally along all valleys north of Arco and Howe. These older volcanic rocks may be folded, faulted, and hydrothermally altered. Younger volcanic rocks occur mostly south of Arco and Howe on the Snake River Plain and are generally flat lying, well jointed, and unaltered.

Tertiary and Cretaceous granitic rocks form part of the Idaho batholith and crop out locally in the mountains north of Salmon, north and east of Stanley, and west of Mackay. The granitic rocks consist of granodiorite, quartz diorite, and quartz monzonite, and are commonly fractured and deeply weathered at the surface. Paleozoic marine sedimentary rocks and undifferentiated Precambrian rocks are the predominant mountain-forming units surrounding the Lemhi, Pahsimeroi, and Big Lost and Little Lost River valleys. These units compose the basement complex for most of the study area. Paleozoic marine sedimentary rocks, consisting of limestone, dolomite, shale, siltstone, and sandstone, are stratified and consolidated and are generally folded, faulted, uplifted, or jointed. Precambrian undifferentiated rocks are predominantly quartzite but locally contain interbedded marine sedimentary rocks.

Hydrology

Hydrologic, geologic, and well-construction data collected for 108 wells inventoried in 1978 and 15 wells inventoried prior to 1978 are shown in table 1. Hydrologic iata include onsite water-level measurement and well-use information. Well drillers' logs included discharge and pump-test measurement data. Geologic data from drillers' logs include lithologic description and thickness of geologic units penetrated. Well-construction information from drillers' logs includes diameter of borehole, diameter and depth of well casing(s), type and depth of surface seal, and manner of well completion, such as perforated casing or open hole.

Table 1. Well data

Aquifer(s): Qal - Flood-plain alluvium
QTs - Sediments
QTv - Volcanic rocks, undifferentiated
TKi - Granitic rocks, undifferentiated
p€ - Undifferentiated rocks

Altitude: From U.S. Geological Survey topographic maps

Well finish: O - Open end
P - Perforated
X - Opeo hole

Water level: P - Pumping
R - Recently pumped
* - Reported data

Use of water: H - Domestic
I - Irrigation
N - Industrial
P - Public supply
S - Stock
U - Unused

Notation: -- No data available

Well number	Aquifer(s)	Altitude of land surface (ft above National Geodetic Vertical Datum of 1929)	Reported depth of well (ft below land surface)	Casing: Diameter (in.)	Casing: Depth to first perforation or bottom of casing (ft below land surface)	Well finish	Water level: Depth (ft below land surface)	Water level: Altitude of water level (ft below National Geodetic Vertical Datum of 1929)	Water level: Date measured	Reported well yield (gal/min)	Specific capacity [(gal/min)/ft of drawdown]	Use of water	Date of well completion
Lemhi River Valley													
21N-22E- 5CCB1	QTs	3,950	250	8	76	P	12.0 *	3,938 *	7-31-65	17	1.0	I	7-31-65
8CBC1	QTs	3,965	33	8	25	X	7.65 P	3,957	8- 8-78	60	20.0	I	10-24-64
8CBC2	QTs	3,965	75	8	34	X	--	--	--	8	—	H	8-28-64
10ACC1	QTs	4,060	127	6	50	X	76.22 R	3,984	10-11-78	2	1.0	H	7-13-76
15BAC1	QTs	4,060	37	6	26	P	7.95 R	4,052	5- 3-78	15	3.8	H	4-12-73
16AAD1	Qal & QTs	4,060	70	8	20	P	56 * P	4,004 *	3-16-72	300	11.5	P	3-16-72
21N-23E-30DDB1	QTs	4,240	121	6	78	X	15 *	4,225 *	9- 5-73	1	1	H	9- 5-73
20N-23E- 3AAB1	QTs	4,470	68	6	56	X	30.33 R	4,440	10-11-78	2.5	1	H	4- 8-74
3CBB1	Qal	4,405	41	6	38	X	19.52 P	4,385	10-11-78	30	3.8	H	4-11-74
20N-24E-30CCC1	Qal	4,640	60	6	60	O	34.97 P	4,605	10-10-78	30	30	H	4- 3-75
31ADD1	QTs	4,740	150	6	120	P	71.03 R	4,669	10- 5-78	17	1	H	4- 3-74
19N-24E-19DDD1	QTs	4,850	63	6	60	X	10.05 R	4,840	10- 5-78	20	1	H	7-22-71
29ACA1	QTs	4,927	180	6	74.5	X	32.89	4,894	10- 5-78	4	—	H	12-20-73
31CAB1	Qal & QTv?	5,070	57	6	36	P	23.10 P	5,047	10- 5-78	15	1	H	9-28-72
18N-24E-21BCD1	Qal & QTs	5,150	45	6	34	P	28.02 R	5,123	10-17-78	20	20	H	11- 1-73
28BBA1	p€	5,150	43	6	43	O	1.70 R	5,148	10- 4-78	20	—	P	8-20-63
33DBA1	QTs	5,340	132	6	86	P	60.02	5,280	10- 5-78	5	1	P	2-18-75
17N-23E-14BAD1	QTv	5,780	175	6	168	P	73 *	5,707	9-22-78	25	—	H	9-22-78
17N-24E-35CBB1	QTs	5,980	80	6	63	X	55.55 P	5,924	10- 4-78	10	—	H	9-12-64
16N-25E- 3DAC1	Qal & QTs	5,680	75	6	46	P	12.95 R	5,667	10- 3-78	15	2.5	H	8- 4-72
22CDA1	Qal	6,100	34	6	27	P	6.0 R	6,094	10- 3-78	15	1.5	H	7-12-72
16N-26E-20ADB1	Qal	5,910	50	6	50	O	24.0 *	5,886	10- 1-68	--	—	H	10- 1-68
28DCB1	QTs	5,960	60	8	35	P	15.74 R	5,944	10- 3-78	120	4	P	1-18-62
Pahsimeroi River Valley													
16N-20E-25BDD1	QTs	4,700	115	6	60	X	31.39 R	4,669	9-15-78	800	--	H	5-10-67
25DBB1	Qal? & QTs	4,680	44	6	19	P	15.19 R	4,665	9-19-78	15	15	H	2-26-73
15N-21E- 6BAA1	QTs	4,760	85	6	85	O	52 *	4,700 *	6-15-75	--	--	H	6-15-75
7ACB1	QTs	4,760	52	8	45	X	20.44 R	4,740	9-15-75	33	--	H	7- 4-65
21ABC1	Qal? & QTs	4,820	130	6	115	P	Flowing	4,825 *	9-14-75	50-1,000	50	H	2- 9-68
15N-22E-30CDC1	Qal & QTs	5,110	105	10	62	P	37.81 P	5,072	9-15-78	300	20	I	9-20-75
31BCB1	QTs?	5,048	117	6	--	--	9.27 *	5,039 *	5-23-71	--	--	H	--
14N-21E- 3ABA1	Qal?	4,983	20	5	--	--	2.30 *	4,981 *	5-23-71	--	--	H	--
12BBA1	Qal & QTs	5,050	199	16	46	P	64.40 P	4,986	9-14-78	470	19	I	10-30-68
24CAB1	QTs?	5,290	170	6	--	--	138.85 R	5,151	9-13-78	--	--	H	69
14N-22E-17DCB1	Qal & QTs	5,130	70	6	55	P	29.82 R	5,100	9-14-78	--	--	H	5-12-72
22BAC1	Qal?	5,194	40	6	--	--	9.69 *	5,184 *	5-24-71	--	--	H	12- 1-69
14N-23E-22DCB1	QTs?	5,946	263	10	--	--	164.85 *	5,781 *	5-25-71	--	--	P	--
13N-22E-11AAC1	QTs?	5,423	49	6	--	--	28.68 *	5,394 *	5-24-71	--	--	H	--
13ADD1	Qal	5,510	40	6	27	P	5.79 R	5,504	9-14-78	20	20	H	12-15-74

Table 1. Well data (Continued)

Well number	Aquifer(s)	Altitude of land surface (ft above National Geodetic Vertical Datum of 1929)	Reported depth of well (ft below land surface)	Casing: Diameter (in.)	Casing: Depth to first perforation or bottom of casing (ft below land surface)	Well finish	Water level: Depth (ft below land surface)	Water level: Altitude of water level (ft below National Geodetic Vertical Datum of 1929)	Date measured	Reported well yield (gal/min)	Specific capacity [(gal/min)/ft of drawdown]	Use of water	Date of well completion
Salmon River Valley													
21N-22E-19ABB1	Qal & QTs	4,030	64	6	40	X	10 *	4,020 *	9- 1-78	200	200	H	9- 1-78
31DAA1	Qal	4,030	33	6	33	O	5.88 R	4,024	5- 3-78	15	5.6	H	8-19-71
32CBB2	QTs	4,033	62	6	41	X	10.34 R	4,023	10-12-78	5	--	H	10-28-67
20N-22E- 7BCD1	Qal	4,090	49	8	40	P	31.5 *	4,059	11-16-76	22	22	H	11-16-76
14N-19E- 9ADC1	QTV?	5,000	102	6	102	P?	55.75 R	4,944	10- 6-78	25	--	H	3- 1-60
26BCA1	Qal & QTs	4,915	46	6	35	P	15.95 R	4,899	9-21-78	50	--	H	1- 1-62
28AAA1	Qal & QTs	5,030	138	6	60	P	87.23 R	4,943	9-19-78	10	--	H	11- 3-67
28CCD1	QTv & TKi	5,190	355	6	155	P	30 *	5,160 *	8-17-66	55	1	P	8-17-66
34CAA1	Qal & QTs	4,995	79	6	79	O	42.89 R	4,952	10- 1-78	15	--	H	3-12-74
34DAA1	QTv	4,955	3,400	--	--	X	Flowing	4,962	7-12-72	50	--	S	7-12-72
36BDD1	QTs	5,000	80	6	70	P	38.95	3,961	10-18-78	20	--	H	8- 1-78
13N-19E- 1ADB1	QTs	5,080	162	8	152	P	97.66 R	4,982	10-31-78	--	--	H	3- 2-74
11CAA1	Qal & QTs	5,040	108	6	72	X	38.38 R	5,002	11- 1-78	--	--	H	4- 4-72
12CCC1	QTs & QTv?	5,103	205	6	30	X	96.39 R	5,007	9-21-78	--	--	H	--
15ABB1	Qal	5,025	65	6	--	X	--	--	--	--	--	H	62
15DBC1	QTv	5,120	147	6	135	P	105 *	5,015 *	4-12-74	30	--	H	4-12-74
11N-15E-20BCB1	TKi	6,010	106	6	103	X	85 *	5,925	10- 5-59	1	1	H	10- 5-59
10N-13E- 3CCB1	TKi	6,260	50	6	20	X	9.95 R	6,250	10-18-78	10	1	H	9-21-73
9AAC1	Qal	6,265	110	6	60	X	20 *	6,245 *	9-13-72	--	--	P	9-13-72
Big Lost River Valley													
9N-21E-25BCC1	QTs	6,380	250	16	150	P	73.51 *	6,306*	9-29-68	2,500	--	I	--
9N-22E- 6CCA1	Qal	6,340	32	48	--	--	14.85	6,325	8- 7-78	--	--	H	9-20-67
7ABC1	Qal?	6,340											
28CDB1	Qal?	6,291	51	6	33	P	30 *	6,261 *	8-13-76	32	32	H	8-13-76
8N-22E- 6ABC1	Qal	6,350	88	6	60	P	55 *	6,295 *	3- 1-68	800	--	H	3- 1-68
26CAB1	Qal	6,185	86	20	18	P	13.36 P	6,172	8- 7-78	2,439	163	I	8-25-55
8N-23E-29CAC1	Qal	6,120	105	12	50	P	52.36 P	6,068	7-25-78	450	50	I	7- 7-75
7N-24E-18AAA1	Qal	5,990	125	6	85	P	80.45 R	5,910	7-26-78	--	--	H	2- -77
18ABB1	Qal & QTs	5,950	146	20	11	P	25.19 P	5,925	8- 7-78	1,620	32.4	I	4-20-60
28BBD1	Qal & QTs	5,900	114	12	50	P	9.62 R	5,890	7-27-78	--	--	P	12-15-73
7N-25E-28ACD1	QTs	5,820	297	16	103	P	103 *	5,717 *	9-14-66	2,919	--	I	9-14-66
32BCB1	Qal	5,775	165	16	--	P	15.30	5,760	8- 7-78	--	--	I	59
6N-25E- 3DAB1	Qal	5,725	205	16	100	P	38.82 P	5,686	7-31-78	1,800	--	I	8-18-61
10BCC1	Qal	5,708	145	16	--	P	15.40 P	5,693	7-27-78	--	--	I	8-28-61
12BCB1	Qal & QTs	5,667	150	16	50	P	26.70 P	5,640	8- 1-78	1,980	28	I	7-19-61
13CBA1	Qal & QTs	5,645	175	16	--	--	49.82 P	5,595	8- 7-78	--	--	I	4-25-77
18ABC1	QTs	5,835	230	20	165	P	79.27 P	5,756	7-27-78	2,385	21.7	I	9- 3-55
35DCB1	Qal & QTs	5,635	194	18	60	P	23.29 *	5,612 *	7-19-67	1,300	18.6	I	6- 4-60
6N-26E- 6CCB1	QTs	5,727	195	16	100	P	78.07	5,649	7-31-78	2,250	75	I	5-25-61
19CDB1	Qal & QTs?	5,616	160	16	90	P	--	--	--	--	--	I	61
21DCB1	Qal & QTs?	5,694	220	16	80	P	106.79	5,587	8- 1-78	1,422	--	I	61
5N-25E- 1ACC1	Qal & QTs	5,651	200	16	50	P	77.50	5,574	8- 2-78	--	--	I	61
5N-26E- 7AAC1	QTs	5,620	177	8	143	P	141.14	5,479	8- 4-78	25	--	H	3-28-75
8CAB1	QTs?	5,597	202	20	184	P	118.52	5,478	8- 8-78	--	--	I	3- 5-60
15CAB1	Qal & QTs?	5,500	127	16	--	--	--	--	--	--	--	I	61
16ABB1	Qal & QTs	5,535	170	16	41	P	51.76 R	5,483	8- 3-78	--	--	I	7- 5-61
21BBC1	QTs	5,515	175	18	175	O	49.67	5,465	8- 4-78	2,700	300	I	5-24-56
27CCC1	Qal & QTs	5,450	160	20	20	P	21.92	5,428	8- 9-78	2,943	32	I	5- 4-77
28BBB1	Qal & QTs	5,485	162	16	40	P	27.80	5,457	8- 9-78	4,000	50	I	4-17-61
29DBD1	Qal & QTs	5,501	180	18	74	P	60.67 P	5,440	8- 9-78	--	--	I	9- -55

Table 1. Well data (Continued)

Well number	Aquifer(s)	Altitude of land surface (ft above National Geodetic Vertical Datum of 1929)	Reported depth of well (ft below land surface)	Casing: Diameter (in.)	Casing: Depth to first perforation or bottom of casing (ft below land surface)	Well finish	Water level: Depth (ft below land surface)	Water level: Altitude of water level (ft below National Geodetic Vertical Datum of 1929)	Water level: Date measured	Reported well yield (gal/min)	Specific capacity [(gal/min)/ft of drawdown]	Use of water	Date of well completion
Big Lost River Valley (Continued)													
32DBC1	Qal & QTs	5,555	250	20	50	P	122.38 P	5,433	8- 9-78	--	--	I	7-24-76
4N-26E- 3ABB1	Qal & QTs	5,432	170	16	50	P	7.79 *	5,424 *	10- 1-68	2,700	49	I	2- 6-61
4BBA1	Qal & QTs	5,444	160	16	55	P	30.71 R	5,413	8-10-78	--	--	I	61
5CDC1	Qal & QTs	5,452	215	20	60	P	69.52 P	5,382	8-10-78	2,863	195	I	5-25-61
27ABA1	QTs	5,390	114	--	--	--	41.87	5,348	8-10-78	--	--	H	9- 76
36ACB1	QTs (QTv?)	5,320	250	20	209	P	--	--	--	1,500	--	P	62
4N-27E-31DBD1	QTv	5,345	192	10	88	X	164.36 R *	5,181 *	4-12-60	10	1.25	H	5- 6-50
3N-26E- 1DAA1	QTs	5,295	225	6	205	P	132.47 R	5,163	9-12-78	15	--	H	7-21-56
3DAA1	QTs & QTv	5,349	240	16	50	P	102.29 *	5,247 *	6- 8-67	--	--	I	66
14DAA1	QTv	5,307	200	16	65	P	59.26 *	5,248 *	9-30-68	1,233	88	I	11- 1-62
3N-27E- 6ADC1	QTs	5,320	62	6	29	P	23.94 R	5,296	9-12-78	25	25	H	8- 8-74
9ABB1	QTv	5,318	503	12	299	X	400.41 *	4,918 *	4-18-52	60	3.3	P	4- -52
Idaho National Engineering Laboratory (Big Lost River Valley)													
5N-31E-28CCC1	QTv	4,795	717	12	535	X	--	--	--	419	419	N	8- -56
4N-30E- 7ADB1	QTv	4,821	563	12	563	O	--	--	--	420	84	U	50
22BDD1	QTv	4,835	498	6	438	P	--	--	--	--	--	N	8- -51
3N-29E-14DDA1	QTv	4,919	503	6	218?	X	--	--	--	--	--	U	6- -68
19CBB1	QTv	5,049	657	6	619	P	--	--	--	--	--	U	11- -51
3N-30E-19BCB1	QTv	4,913	586	16	460	P	--	--	--	1,260	663	U	11-28-50
2N-27E- 2DDC1	QTv	5,195	812	6	780	P	--	--	--	--	--	U	9- -50
2N-29E- 1DBB1	QTv	4,932	681	16	521	P	--	--	--	150	14.7	U	5- 1-44
18BDA1	QTv	5,016	640	6	585	X	--	--	--	--	--	U	10- -71
Idaho National Engineering Laboratory (Little Lost River Valley)													
5N-29E-23CDD1	QTv	4,800	399	6	285	P	--	--	--	--	--	U	10- -51
Little Lost River Valley													
10N-27E-19CAA1	Qal & QTs	6,037	128	16	54	P	45.65 P	5,991	7-18-78	2,250	225	I	9- 1-61
9N-27E- 4DBC1	QTs	5,875	155	16	142	P	59.06 P	5,816	7-18-78	500	--	I	8- -61
9BDB1	QTs	5,840	205	16	60	P	24 *	5,816 *	6- 9-72	300	--	I	6- 9-72
8N-28E-29BCC1	Qal & QTs	5,375	150	20	50	P	71.25 P	5,304	7-19-78	500	--	I	1- -78
30BDA1	QTs	5,410	220	20	112	P	107 *	5,303 *	12- -65	2,700	90	I	12- -65
6N-29E- 8BCC1	QTs	4,947	200	16	130	P	110 *	4,837 *	10-25-69	500	--	I	10-25-69
20DDD1	QTs	4,880	118	6	117	X	71.00 R	4,809	7-20-78	10	--	H	5-18-71
25ABB1	QTs	4,808	110	16	79	P	--	--	--	500	--	I	6- 3-69
27DBB1	QTs	4,838	132	16	132	O	82.00 P	4,756	7-20-78	500	--	I	1-29-68
6N-30E-31AAD1	QTv	4,790	524	20	360	X	246 *	4,544 *	2-23-66	4,000	--	I	3-21-66
5N-29E- 3BBB1	QTs	4,830	585	16	535	P	131.76 P	4,698	7-20-78	3,600	51.4	I	8- -66
3CCC1	QTs	4,818	265	6	235	P	194 *	4,624 *	9-14-57	--	--	H	9-14-57
15ABD1	QTv	4,805	540	8	520	X	262.36 R	4,543	9-11-78	--	--	H	39
5N-30E- 5BAC1	QTv	4,795	650	20	481	X	278.13 P	4,517	7-21-78	3,600	3,600	I	9- 2-69

Aquifer Recharge and Ground-Water Movement

Aquifers in the east-central Idaho valleys are recharged primarily by infiltration of precipitation on surrounding mountains and foothills adjacent to valley lowlands. Additional recharge occurs as (1) seepage losses from streams, irrigation canals, drainage ditches, reservoirs, and lakes; (2) infiltration of irrigation water; (3) interaquifer flow; and (4) leakage from septic tanks and drain wells.

Ground water-surface water relations in the valley lowlands are complex. Ground-water recharge from stream sources can occur where water-table altitudes are lower than stream-channel altitudes. Ground-water discharge to the stream can occur where the water table is at or above the river channel. In all study area valleys, areas of ground-water recharge or discharge occur intermittently along each river. In Lemhi, Pahsimeroi, and Salmon River valleys, upper reaches of the rivers are generally areas of ground-water recharge and lower reaches are areas of ground-water discharge. A distinctive feature of the Big Lost River and Little Lost River valleys is that both upper reaches and lower reaches of these rivers are areas of ground-water recharge. (For purposes of this report, the term Big Lost River valley includes the Big Lost River drainage basin downstream from Arco.)

Crosthwaite, Thomas, and Dyer (1970) reported that surface water and ground water in the Big Lost River and Little Lost River valleys are so closely related that neither can be considered as a separate source of supply. Flood-plain alluvium and sedimentary aquifers serve as conduits through which large amounts of water move down these valleys, ultimately leaving the river basins as ground-water underflow. Big Lost River and Little Lost River terminate at "Lost River Sinks," a topographic depression southeast of Howe, where surface water evaporates or infiltrates into sedimentary and basaltic aquifers in the Snake River Plain.

Ground-water movement in the study area is generally from areas of high altitude to areas of low altitude, valley head to valley mouth. Ground water in Lemhi, Pahsimeroi, and Salmon River valleys flows generally northwestward. Ground water in Big Lost River and Little

Lost River valleys flows generally southeastward. Altitude of the potentiometric surface (an imaginary surface representing the static head of ground water and defined by the level to which water will rise in a well) is shown in figure 5 by contour lines and is based on water-level measurements made in wells. Ground water moves approximately at right angles to the contour lines, as shown by arrows.

Yields From Wells

Reported yields from wells included in this study range from 1 to about 4,000 gal/min. Yields from wells completed in flood-plain alluvium and sedimentary rocks vary with degree of compaction, character of interbeds, and sorting. In undifferentiated volcanic aquifers, yield varies with degree of jointing and with continuity and consolidation of sedimentary or pyroclastic interbeds. In wells completed in undifferentiated granitic or basement complex aquifers, yield varies proportionally with intensity of fracturing and with depth of weathering in the saturated zone.

Highest yields generally are from wells completed in unconsolidated, well-sorted sand and gravel or in well-jointed basalt. Lowest yields generally are from wells completed in variably consolidated, poorly sorted sedimentary rocks, nonjointed volcanic rocks, weathered granite, or rocks of the basement complex. The ranges of reported yields and specific capacities of wells in selected aquifers in the study area are summarized in table 2.

In addition to the hydrologic properties of the aquifers described above, yield from a well depends on design characteristics of the well and efficiency of the pump system. Optimum well yield may be obtained by proper well completion, such as suitable well-development techniques and use of efficient well screens and casing perforations to inhibit passage of fine-grained material and to reduce turbulent flow through the casing openings. Highest pump efficiency, resulting from correct ratio of pump horsepower to pumping lift, and proper pump maintenance may also result in greater well yield. Current yields from

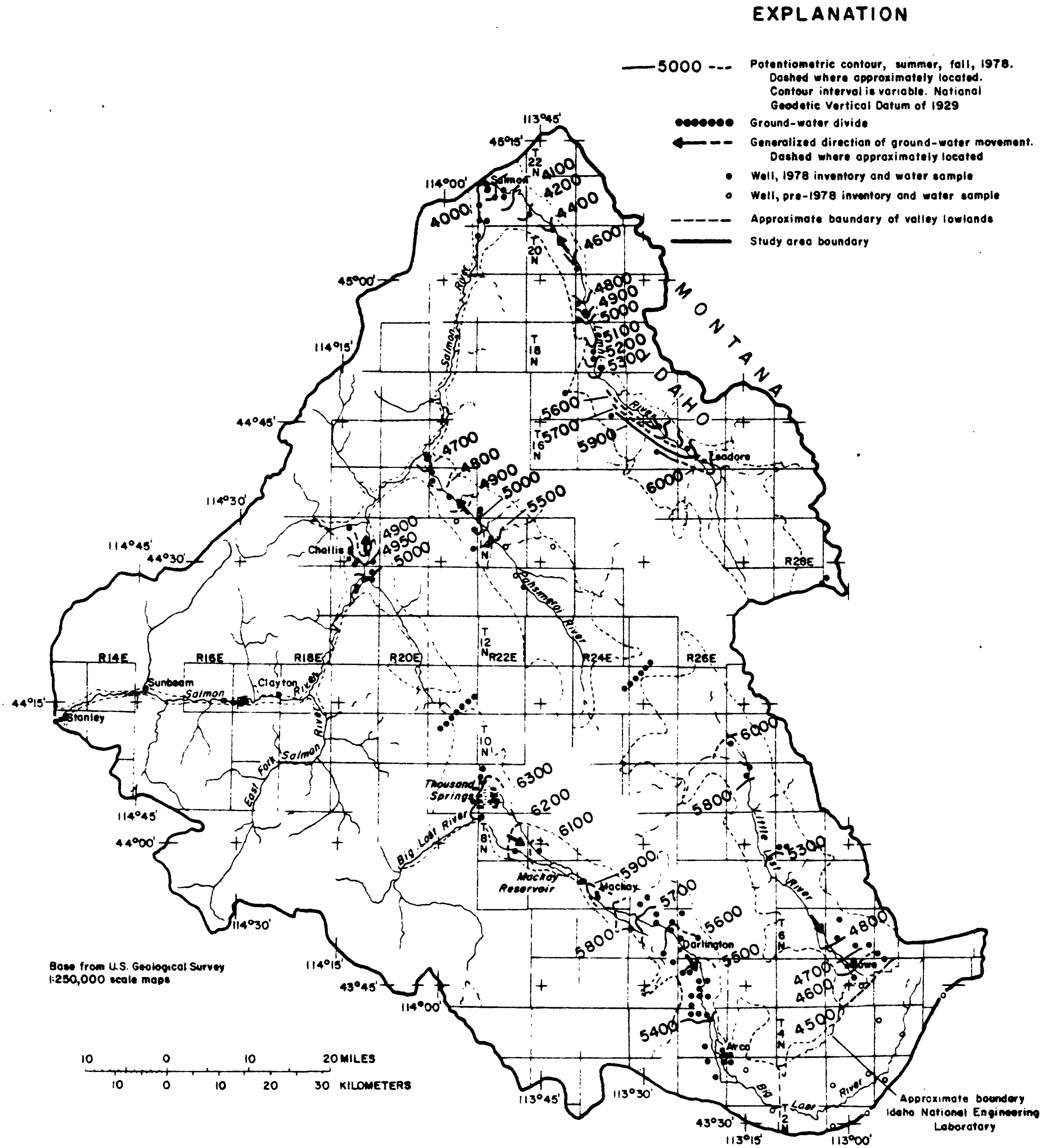


Figure 5.--Altitude of the potentiometric surface, summer-fall 1978, and generalized direction of ground-water movement.

Table 2. Yields and specific capacities of selected wells

Aquifer: Qal - Flood-plain alluvium
QTs - Sediments
QTv - Volcanic rocks, undifferentiated
TKi - Granitic rocks, undifferentiated
p€ - Undifferentiated rocks

Notations: -- No data available

Valley	Aquifer(s)	Range or value of well yield (gal/min)	Range or value of specific capacity [(gal/min)/ft] of drawdown	Sources of data
Lemhi	Qal	15 - 30	1.5 - 30	Drillers' logs, Table 1
	QTs	1 - 120	1 - 20	Drillers' logs, Table 1
	Qal & QTs	2,240	29	Pump test (Crosthwaite and George, 1965)
	Qal & QTs	300	4.6	Pump test (Crosthwaite and George, 1965)
	Qal & QTs	15 - 300	2.5 - 20	Drillers' logs, Table 1
	QTv	25	--	Drillers' logs, Table 1
	p€	20	--	Drillers' logs, Table 1
Pahsimeroi	Qal	20	20	Drillers' logs, Table 1
	QTs	33 - 800	--	Drillers' logs, Table 1
	Qal & QTs	15 - 470	15 - 20	Drillers' logs, Table 1
	Qal & QTs	332 - 3,850	106 - 203	Irrigation well (Young and Harenberg, 1973)
Salmon River	Qal	15 - 22	5.6 - 22	Drillers' logs, Table 1
	QTs	5 - 20	--	Drillers' logs, Table 1
	Qal & QTs	10 - 200	--	Drillers' logs, Table 1
	Qal & QTs	--	2 - 15	Domestic and stock wells (Crosthwaite, 1962)
	QTv	25 - 50	--	Drillers' logs, Table 1
	QTv	100	--	Crosthwaite, 1962
	TKi	1 - 10	1	Drillers' logs, Table 1
Big Lost River	Qal	32 - 2,439	50 - 163	Drillers' logs, Table 1
	QTs	25 - 2,700	21.7 - 300	Drillers' logs, Table 1
	Qal & QTs	1,300 - 4,000	18.6 - 195	Drillers' logs, Table 1
	Qal & QTs	500 - 3,500	--	Irrigation wells (Crosthwaite, Thomas, and Dyer, 1970)
	QTv	10 - 1,260	1.25 - 663	Drillers' logs, Idaho National Engineering Laboratory pump tests, Table 1
Little Lost River	QTs	10 - 3,600	51.4 - 90	Drillers' logs, Table 1
	Qal & QTs	500 - 2,250	--	Drillers' logs, Table 1
	Qal & QTs	303 - 2,475	12 - 123	Irrigation well (Mundorff, Broom, and Kilburn, 1960)
	QTv	3,600 - 4,000	--	Drillers' logs, Table 1
	QTv	4,250	236	Clebsch, Waite, and Decker, 1974

some study area wells may be increased by pump system or well design improvements. More detailed information on well construction and pump efficiency is in Campbell and Lehr (1973), Anderson (1971), Johnson Division, Inc. (1966), and Mundorff, Broom, and Kilburn (1960).

GROUND-WATER QUALITY

Analyses of water-quality characteristics of 108 ground-water samples collected between May and November, 1978, in east-central Idaho valleys are shown in table 3. Historical analyses for 19 sites are also shown in table 3.

Concentrations of chemical constituents are reported in mg/L (milligrams per liter) or μg/L (micrograms per liter). One milligram equals 1,000 micrograms. Milligrams and micrograms, within the range of values presented, are numerically equal to parts per million or parts per billion, respectively. Specific conductance is expressed as μmho/cm (micromhos per centimeter at 25°C). SAR (sodium adsorption ratio) values are defined by the equation:

$$SAR = \frac{(Na^{+})}{\sqrt{\frac{(Ca^{+})+(Mg^{+})}{2}}}$$

where,

Na^{+}, Ca^{++}, and Mg^{++} represent the concentrations of the respective ions, in meq/L (milliequivalents per liter), the milligrams of a constituent per liter divided by the atomic weight of the constituent and multiplied by the constituent charge.

Bacteria concentrations are reported in cols/100 mL (colonies per 100 milliliters of water).

Table 3. Water-

[AQUIFER(S): Qal - Flood-plain alluvium,
QTs - Sedimentary rocks,
QTv - Volcanic rocks, undifferentiated,
TKi - Granitic rocks, undifferentiated,
pC - Undifferentiated rocks;

WELL NO.	AQUIFER(S)	DATE OF SAMPLE	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)
											Lemhi
21N 22E 05CCB1	QTs	78-10-11	E12.00	1940	7.0	12.5	250	0	65	22	360
21N 22E 08CBC1	QTs	78-05-03	--	1280	7.0	10.0	200	0	55	16	200
		78-10-12	7.65	1270	7.3	10.5	190	0	54	14	210
21N 22E 08CBC2	QTs	78-10-12	E7.51	875	7.2	12.0	190	0	56	12	120
21N 22E 10ACC1	QTs	78-10-11	76.22	875	8.0	12.0	4	0	1.7	<.1	190
21N 22E 15BAC1	QTs	78-05-03	7.95	636	6.9	11.0	240	0	65	18	40
21N 22E 16AAD1	Qal & QTs	78-10-10	E30.00	782	7.4	14.0	270	3	80	18	60
21N 23E 30DDB1	QTs	78-10-17	E15.00	780	8.7	11.0	16	0	6.1	.1	190
20N 23E 03AAB1	QTs	78-10-11	30.33	2100	7.3	8.5	350	4	110	18	380
20N 23E 03CBB1	Qal	78-10-11	19.52	296	6.4	12.0	98	0	27	7.4	20
20N 24E 30CCC1	Qal	78-10-10	34.97	623	7.5	12.0	210	12	54	18	47
20N 24E 31ADD1	QTs	78-10-05	71.03	4070	7.2	11.5	1300	1100	380	85	390
19N 24E 19DDD1	QTs	78-10-05	10.05	1090	7.5	11.0	160	0	63	1.1	160
19N 24E 29ACA1	QTs	78-10-05	32.89	555	8.9	12.0	15	0	5.0	.7	120
19N 24E 31CAB1	Qal & QTv(?)	78-10-05	23.10	211	6.8	9.0	68	0	16	6.9	17
18N 24E 21BCD1	Qal & QTs	78-10-17	28.02	551	7.1	12.0	240	31	65	20	21
18N 24E 28BBA1	pЄ	78-10-04	1.70	628	7.6	10.0	240	0	64	20	37
18N 24E 33DBA1	QTs	78-10-04	60.02	3240	7.2	11.0	1600	1400	480	96	120
17N 23E 14BAD1	QTv	78-10-10	<78.00	502	8.2	11.0	150	0	40	11	55
17N 24E 35CBB1	QTs	78-10-04	55.55	137	6.8	10.5	52	0	14	4.2	5.2
16N 25E 03DAC1	Qal & QTs	78-10-03	12.95	361	7.5	10.5	190	14	53	14	5.9
16N 25E 22CDA1	Qal	78-10-03	6.00	325	7.7	10.5	81	0	20	7.6	46
16N 26E 20ADB1	Qal	78-10-17	E24.00	465	7.4	9.5	230	15	60	19	9.1
16N 26E 28DCB1	QTs	65-05-20	--	408	8.1	8.0	170	0	36	19	25
		78-10-03	15.74	422	7.3	9.5	160	0	34	18	27
											Pahsimeroi
16N 20E 25BDD1	QTs	71-10-12	--	434	7.5	12.0	180	0	47	15	21
		78-09-15	31.39	402	7.7	13.0	190	17	51	15	21
16N 20E 25DBB1	Qal(?) & QTs	78-09-20	15.19	541	7.7	13.0	190	0	47	17	44
15N 21E 06BAA1	QTs	78-09-14	E52.00	319	8.0	13.0	140	0	35	12	12
15N 21E 07ACB1	QTs	78-09-15	20.44	567	7.5	12.0	270	13	74	20	22
15N 21E 21ABC1	Qal(?) & QTs	71-10-11	--	323	7.7	10.5	150	16	39	14	5.5
		78-09-14	--	349	7.8	10.5	170	26	43	14	5.4
15N 22E 30CDC1	Qal & QTs	78-09-15	37.81	224	7.1	9.0	110	0	29	10	1.8
15N 22E 31BCB1	QTs(?)	71-10-11	--	206	7.1	10.5	85	0	16	11	7.2
14N 21E 03ABA1	Qal	71-11-15	--	562	7.3	12.5	150	0	37	14	64
14N 21E 12BBA1	Qal & QTs	78-09-14	64.40	452	7.3	10.5	220	46	56	19	5.8
14N 21E 24CAB1	QTs	78-09-13	138.85	510	7.7	13.0	240	68	60	22	9.8
14N 22E 17DCB1	Qal & QTs	78-09-14	29.62	491	7.6	9.0	230	9	56	15	7.6
14N 22E 22BAC1	Qal	71-10-12	--	--	7.6	13.5	190	5	53	14	8.0
14N 23E 22DCB1	QTs(?)	71-10-12	--	159	7.5	13.0	67	0	12	6.9	5.5
13N 22E 11AAC1	QTs(?)	71-10-12	--	516	7.4	12.0	250	0	58	20	10
13N 22E 13ADD1	Qal	78-09-14	5.79	486	7.4	13.0	240	21	59	17	6.4

quality analyses

COLIFORM: K - Less than ideal colony count;

NOTATIONS: -- No data available,
< - Less than,
E - Estimated or reported]

SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	ALKA-LINITY (MG/L AS CACO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SILICA, DIS-SOLVED (MG/L AS SIO2)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	COLI-FORM, TOTAL, IMMED. (COLS. PER 100 ML)	COLI-FORM, FECAL, (COLS./ 100 ML)	IRON, DIS-SOLVED (UG/L AS FE)
Valley													
9.9	37	990	0	810	120	80	1.3	1143	9.9	0.02	<1	<1	250
6.1	17	570	0	470	140	50	1.4	758	15	.34	--	--	40
6.6	15	530	0	430	160	53	1.3	766	17	.49	<1	<1	70
3.8	6.3	380	0	310	100	23	1.0	529	32	.93	<1	<1	30
40	1.0	180	0	150	5.1	180	1.6	493	26	.03	<1	<1	80
1.1	4.6	290	0	240	65	15	.4	376	29	.99	--	--	20
1.6	4.5	330	0	270	96	17	.3	470	37	1.6	<1	<1	<10
21	1.4	470	12	410	3.9	8.5	3.7	465	10	<.01	<1	<1	<10
8.9	7.3	420	0	340	730	39	.8	1497	16	.29	<1	<1	870
.9	3.2	140	0	110	20	6.1	.2	171	24	.44	<1	<1	300
1.4	2.8	240	0	200	63	24	.3	355	29	.49	<1	<1	40
4.7	4.7	270	0	220	890	730	.4	2620	13	6.9	<1	<1	80
5.5	6.6	360	0	300	200	48	.3	677	25	1.0	<1	<1	20
13	1.0	190	12	180	30	41	2.4	314	9.0	.80	<1	<1	70
.9	2.6	110	0	90	10	5.3	.2	129	20	1.0	<1	<1	20
.6	3.6	260	0	210	54	13	.4	323	24	.27	<1	<1	<10
1.0	4.2	300	0	250	73	13	.6	365	8.4	.02	<1	<1	460
1.3	22	280	0	230	1000	420	<.1	2300	46	3.3	<1	<1	30
2.0	.7	270	0	220	24	14	.4	309	33	.03	<1	<1	30
.3	3.3	73	0	60	3.8	2.5	.1	120	54	.26	<1	<1	50
.2	2.7	210	0	170	15	3.6	.1	214	19	.32	<1	<1	20
2.2	2.6	190	0	160	21	3.0	.2	200	13	.61	<1	<1	30
.3	2.3	260	0	210	24	7.3	.2	260	15	.43	<1	<1	<10
.8	1.5	230	0	190	17	12	--	219	14	--	--	--	37
.9	1.7	210	0	170	18	20	.1	233	14	.96	<1	<1	30
Valley													
.7	2.0	250	0	210	17	8.4	.2	257	23	--	--	--	--
.7	1.6	210	0	170	19	11	.1	228	8.7	.20	K8	<1	60
1.4	1.2	270	0	220	23	20	.3	302	19	.34	<1	<1	410
.4	1.1	170	0	140	11	8.0	.1	181	19	.56	<1	<1	50
.6	1.6	310	0	250	47	9.4	.2	343	21	.49	K14	<1	60
.2	.9	170	0	140	27	6.8	.2	190	14	--	--	--	--
.2	1.0	170	0	140	24	7.8	.1	192	14	.67	--	--	50
.1	1.3	140	0	110	2.7	.7	<.1	122	12	.41	K9	<1	60
.3	1.2	110	0	90	8.8	5.4	<.1	112	10	--	--	--	--
2.3	6.3	320	0	260	31	8.9	.9	337	26	.32	--	--	20
.2	1.3	210	0	170	30	16	.1	242	13	1.1	<1	K2	50
.3	1.8	210	0	170	66	6.2	.2	280	14	.63	<1	<1	70
.2	.9	270	0	220	21	6.4	.2	264	15	.96	<1	<1	100
.3	1.6	220	0	180	15	5.5	.1	220	16	.64	--	--	20
.3	.9	88	0	72	11	1.6	.2	90	7.7	17	--	--	30
.3	2.4	310	0	250	19	6.7	.2	291	17	--	--	--	--
.2	1.6	270	0	220	14	5.6	.2	259	15	.13	<1	<1	80

WELL NO.	AQUIFER(S)	DATE OF SAMPLE	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)
											Salmon
21N 22E 19ABB1	Qal & QTs	78-10-17	E10.00	307	7.2	14.0	130	2	41	7.4	11
21N 22E 31DAA1	Qal	78-05-03	5.86	344	6.9	10.0	160	0	46	9.8	22
21N 22E 32CBB2	QTs	78-10-12	10.34	529	8.9	11.5	11	0	3.8	.3	120
20N 22E 07BCD1	Qal	78-10-12	E31.50	234	6.5	12.0	93	0	26	6.9	11
14N 19E 09ADC1	QTv(?)	78-10-06	55.75	619	8.1	12.5	70	0	15	7.8	110
14N 19E 26BCA1	Qal & QTs	78-09-21	15.95	99	7.3	12.5	36	0	11	2.1	6.6
14N 19E 28AAA1	Qal & QTs	78-09-20	87.23	410	8.0	12.0	190	16	44	19	8.7
14N 19E 28CCD1	QTv & TKi	78-09-20	E30.00	357	7.4	11.0	110	0	33	7.8	28
14N 19E 34CAA1	Qal & QTs	78-11-01	42.89	234	7.6	11.0	110	1	29	8.5	6.2
14N 19E 34DAA1	QTv	72-07-12	--	378	8.5	40.0	220	38	55	21	45
		78-10-31	--	602	7.3	39.0	230	62	56	21	42
14N 19E 36BDD1	QTs	78-10-18	38.95	465	7.7	13.0	210	0	45	23	22
13N 19E 01ADB1	QTs	78-10-31	E120.00	492	7.5	11.5	200	45	49	19	31
13N 19E 11CAA1	Qal & QTs	78-11-01	38.38	472	7.7	11.0	190	0	47	17	27
13N 19E 12CCC1	QTs * QTv	78-09-21	96.39	1090	7.6	12.0	460	170	110	44	54
13N 19E 15ABB1	Qal	78-11-01	--	391	7.6	--	180	0	47	15	16
13N 19E 15DBC1	QTv	78-11-01	E105.00	667	7.8	10.0	200	75	43	22	63
11N 15E 20BCB1	TKi	78-10-02	E65.00	124	6.8	7.0	53	0	18	1.9	4.3
10N 13E 03CCB1	TKi	78-10-18	9.90	76	6.7	12.0	17	0	5.3	.9	8.4
10N 13E 09AAC1	Qal	78-09-22	E20.00	262	6.9	9.0	120	5	34	8.9	6.8
											Big Lost
09N 21E 25BCC1	QTs	78-07-26	E73.49	244	7.6	9.0	110	23	33	7.4	3.8
09N 22E 06CCA1	Qal	78-11-01	E14.85	553	7.3	8.0	290	30	76	25	2.2
09N 22E 07ABC1	Qal(?)	78-07-25	E4.66	397	7.3	7.0	190	35	50	16	5.6
09N 22E 28CDB1	Qal(?)	78-07-25	--	266	7.5	11.5	140	21	38	12	3.8
08N 22E 06ACB2	Qal	78-07-25	55.00	142	7.4	9.5	65	9	19	4.3	3.0
08N 22E 26CAB1	Qal	78-07-26	13.36	281	7.5	11.0	130	11	39	8.9	5.6
08N 23E 29CAC1	Qal	78-07-25	52.36	263	7.5	10.5	160	0	48	14	6.2
07N 24E 18AAA1	Qal	78-07-26	80.45	381	7.5	12.0	200	36	52	17	5.5
07N 24E 18ABB1	Qal & QTs	78-07-27	25.19	322	7.5	8.5	170	42	43	14	4.6
07N 24E 28BBD1	Qal & QTs	78-07-27	4.38	356	7.5	9.5	190	41	49	16	5.0
07N 25E 28ACD1	QTs	78-07-27	E103.00	360	7.5	8.5	160	30	48	10	6.5
07N 25E 32BCB1	Qal	78-07-27	15.30	399	7.5	9.5	200	23	55	14	5.1
06N 25E 03DAB1	Qal	78-07-31	38.82	467	8.1	10.5	220	25	58	19	5.1
06N 25E 10BCC1	Qal	78-07-27	15.40	484	7.6	10.0	250	27	70	18	6.7
06N 25E 12BCB1	Qal & QTs	78-08-01	26.70	452	7.6	9.0	210	0	61	15	3.3
06N 25E 13CBA1	Qal & QTs	78-08-01	49.82	499	7.6	9.0	250	12	71	17	10
06N 25E 18ABC1	QTs	78-07-27	79.27	470	7.5	9.5	170	0	59	5.4	31
06N 25E 35DCB1	Qal & QTs	78-08-02	23.29	105	8.0	9.5	150	27	47	7.5	4.5

SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	ALKA-LINITY (MG/L AS CACO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SILICA, DIS-SOLVED (MG/L AS SIO2)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	COLI-FORM, TOTAL, IMMED. (COLS. PER 100 ML)	COLI-FORM, FECAL, (COLS./ 100 ML)	IRON, DIS-SOLVED (UG/L AS FE)
River Valley													
0.4	1.8	160	0	130	15	3.8	0.6	175	19	0.43	<1	<1	20
.8	1.3	190	0	160	19	17	.4	230	20	.06	--	--	<10
16	.4	200	12	180	20	29	11	289	8.2	.03	<1	<1	40
.5	2.0	120	0	98	12	3.7	.3	145	27	.50	<1	<1	30
5.7	8.5	260	0	210	82	13	1.1	386	32	1.3	<1	<1	130
.5	.5	50	0	41	3.5	2.1	.1	75	25	.97	<1	<1	80
.3	1.2	210	0	170	17	6.1	.2	214	17	1.2	<1	<1	30
1.1	.7	160	0	130	25	8.3	.2	195	15	.47	<1	<1	110
.3	1.2	130	0	110	9.1	1.1	.4	139	19	.12	<1	<1	<10
1.3	7.6	230	0	190	130	4.0	1.1	392	23	.10	--	--	--
1.2	7.6	200	0	160	140	4.6	.9	--	--	.10	--	--	20
.7	6.6	280	0	230	19	3.9	.8	275	24	1.8	<1	<1	20
1.0	5.1	190	0	160	71	17	.5	302	19	1.2	<1	<1	20
.9	4.3	240	0	200	25	5.2	.6	263	22	2.3	<1	<1	<10
1.1	12	350	0	290	200	40	.9	637	15	3.8	<1	<1	30
.5	2.5	220	0	180	13	2.5	.6	226	24	.46	<1	<1	<10
1.9	1.4	150	0	120	140	35	.6	395	20	2.2	<1	<1	30
.3	.8	64	0	53	6.6	1.0	.1	79	15	.43	<1	<1	20
.9	.4	34	0	28	2.5	1.0	.5	560	21	.39	<1	<1	20
.3	.9	140	0	110	11	1.8	.3	147	18	.36	<1	<1	40
River Valley													
.2	1.0	110	0	90	14	2.6	.1	124	12	.21	K10	<1	60
.1	1.8	320	0	260	16	1.7	.3	293	16	1.0	--	--	<10
.2	.9	190	0	160	34	5.6	.4	219	12	.67	<1	<1	90
.1	1.1	150	0	120	14	3.9	.3	156	12	.58	<0	<0	70
.2	.8	69	0	57	9.3	1.6	.2	80	9.4	.29	<1	<1	140
.2	1.3	150	0	120	12	2.4	.3	153	13	.17	K690	<1	70
.2	1.5	220	0	180	16	4.0	.1	208	12	.23	<1	<1	50
.2	1.5	200	0	160	25	9.2	.2	216	11	.82	<1	<1	40
.2	1.0	150	0	120	28	11	.3	182	9.8	.59	K78	--	40
.2	1.3	180	0	150	25	8.0	.3	204	11	.85	<1	--	70
.2	.7	160	0	130	19	8.8	.3	180	9.6	.93	<1	--	70
.2	1.9	210	0	170	17	4.7	.3	210	12	.49	<9	--	130
.1	1.0	240	0	200	9.2	2.3	.1	227	13	.36	<1	<1	40
.2	1.5	270	0	220	18	5.4	.2	265	15	.76	K16	--	70
.1	.8	260	0	210	14	3.8	.1	238	15	.81	<1	<1	40
.3	1.2	290	0	240	23	6.6	.1	288	16	.97	<1	<1	50
1.0	1.9	250	0	210	14	4.4	.3	268	28	.38	<7	--	70
.2	1.2	150	0	120	18	3.6	.1	159	4.5	.09	<1	<1	50

Table 3. Water-

WELL NO.	AQUIFER (S)	DATE OF SAMPLE	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)
											Big Lost River
06N 26E 06CCB1	QTs	78-07-31	75.07	329	7.7	9.5	180	0	49	14	11
06N 26E 19CDB1	Qal & QTs(?)	78-08-01	--	308	7.6	9.5	120	0	37	7.7	4.8
06N 26E 21DCB1	Qal & QTs	78-08-01	106.80	390	7.8	11.0	180	16	39	19	5.2
05N 25E 01ACC1	Qal & QTs	78-08-02	77.50	445	7.8	9.5	220	23	66	13	8.0
05N 26E 07AAC1	QTs	78-08-04	141.10	329	7.9	10.5	130	0	41	5.7	13
05N 26E 08CAB1	QTs(?)	78-08-08	118.50	424	7.9	10.5	210	5	66	11	8.4
05N 26E 15CAB1	Qal & QTs	78-08-08	--	411	7.7	9.5	210	38	56	16	10
05N 26E 16ABB1	Qal & QTs	78-08-03	51.76	445	7.6	9.0	230	33	67	14	7.2
05N 26E 21BBC1	QTs	78-08-04	49.67	393	7.6	12.0	140	0	42	7.8	7.5
05N 26E 27CCC1	Qal & QTs	78-08-10	21.92	440	7.5	12.0	220	23	62	16	4.8
05N 26E 28BBB1	Qal & QTs	78-08-09	27.80	275	7.7	10.5	140	28	43	8.5	7.0
05N 26E 29DBD1	Qal & QTs	78-08-09	60.67	325	7.9	10.0	160	12	45	11	6.5
05N 26E 32DBC1	Qal & QTs	78-08-09	122.38	322	7.8	9.5	--	--	--	13	7.0
04N 26E 03ABB1	Qal & QTs	78-08-11	E7.02	402	7.7	10.0	230	25	69	15	7.6
04N 26E 04BBA1	Qal & QTs	78-08-10	30.71	445	7.6	10.5	240	35	69	16	11
04N 26E 05CDC1	Qal & QTs	76-08-10	69.52	478	7.6	9.5	240	27	71	15	13
04N 26E 27ABA1	QTs	78-08-10	41.87	447	7.6	11.0	240	27	73	14	7.2
04N 26E 36ACB1	QTs (QTv)	78-11-03	--	407	7.8	10.0	210	20	62	14	5.1
04N 27E 31DBD1	QTv	78-11-03	E164.60	546	7.4	12.5	210	0	60	14	20
03N 26E 01DAA1	QTs	78-09-12	132.50	435	7.8	12.0	210	14	63	13	5.6
03N 26E 03DAA1	QTs & QTv	78-08-04	E102.30	404	7.7	9.5	220	23	64	14	7.5
03N 27E 06ADC1	QTs	78-09-12	23.94	505	7.5	11.0	240	23	70	17	11
03N 26E 14DAA1	QTv	78-07-24	E59.23	456	7.5	11.5	210	5	62	13	20
03N 27E 09ABB1	QTv	72-08-09	--	569	7.2	35.0	260	0	64	24	31
		7b-09-13	--	580	7.4	27.0	210	0	51	21	33
											Idaho National Engineering
05N 31E 28CCC1	QTv	65-06-03	--	332	7.9	15.5	140	9	34	13	15
		65-06-13	265.50	332	7.9	15.5	140	9	34	13	15
		77-09-07	--	319	8.0	16.5	140	5	33	13	15
04N 30E 07ADB1	QTv	63-12-17	400.00	434	7.4	--	200	59	44	21	11
		65-06-08	329.00	507	7.7	11.5	270	90	71	22	12
		77-09-27	--	--	--	--	220	93	60	18	9.1
04N 30E 22BDD1	QTv	63-12-18	420.00	250	7.8	--	120	14	30	10	6.0
		65-06-08	354.00	246	7.9	12.0	110	12	29	8.7	8.1
		77-09-13	--	--	--	--	120	5	31	11	7.9
03N 29E 14DDA1	QTV	77-09-06	--	443	7.9	--	210	40	57	17	9.1
03N 29E 19CBB1	QTV	63-12-05	640.00	370	7.6	--	120	62	32	9.5	21
		65-06-02	600.00	550	7.5	--	170	63	46	14	39
		77-09-06	--	386	8.0	18.0	120	61	30	11	24
03N 30E 19BCB1	QTv	77-09-05	--	351	8.0	--	170	13	46	13	8.2
		77-10-07	--	--	--	--	160	28	46	12	7.4
02N 27E 02DDC1	QTv	65-06-08	--	351	7.8	11.0	170	24	45	14	6.4

SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	ALKA-LINITY (MG/L AS CACO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SILICA, DIS-SOLVED (MG/L AS SIO2)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	COLI-FORM, TOTAL, IMMED. (COLS. PER 100 ML)	COLI-FORM, FECAL, (COLS./100 ML)	IRON, DIS-SOLVED (UG/L AS FE)
Valley--Continued													
0.4	0.9	220	0	180	20	18	0.1	234	14	0.90	<1	<1	50
.2	.8	200	0	160	9.1	2.0	.1	168	12	.14	<1	<1	30
.2	.8	200	0	160	10	4.6	.1	183	9.3	.44	K2	<1	50
.2	1.8	240	0	200	20	3.3	.1	247	17	2.2	<1	<1	20
.5	1.2	170	0	140	20	4.8	.1	175	6.4	.28	K10	<1	50
.3	1.5	250	0	200	18	3.5	.1	242	15	E1.4	<1	<1	100
.3	1.1	210	0	170	16	4.8	.1	218	13	E.64	<1	<1	130
.2	1.4	240	0	200	18	4.7	.1	245	14	1.1	<1	<1	60
.3	1.2	220	0	180	8.0	2.3	.1	192	16	.54	K12	<1	30
.1	1.8	240	0	200	20	4.5	.1	241	14	E.60	K5	<1	110
.3	.9	140	0	110	13	3.2	.1	157	16	E.83	K8	<1	50
.2	1.2	180	0	150	18	6.0	.2	191	14	.70	<1	<1	1100
--	1.3	160	0	130	16	5.7	.2	--	13	.85	<1	<1	300
.2	1.4	250	0	200	17	5.1	.1	247	13	E.93	K1	<1	140
.3	1.5	250	0	200	25	6.0	.1	263	16	2.0	K2	<1	170
.4	1.7	260	0	210	24	6.9	.1	274	18	E2.3	<1	<1	170
.2	1.4	260	0	210	21	5.0	.2	260	14	E.75	--	--	110
.2	1.1	230	0	190	19	5.2	.2	233	14	1.2	<1	<1	<10
.6	2.4	260	0	210	35	10	.2	285	20	4.7	25	<1	<10
.2	1.2	240	0	200	20	5.7	.2	241	14	1.4	<1	<1	80
.2	1.3	240	0	200	21	6.5	.2	248	15	1.7	K1	<1	<10
.3	1.5	270	0	220	24	6.6	.4	282	21	1.6	<1	<1	50
.6	1.6	250	0	200	23	12	.3	267	17	2.4	<1	<1	30
.8	7.7	310	0	260	56	22	.8	386	33	.98	--	--	--
1.0	7.1	270	0	220	42	18	.5	327	30	.92	--	--	50
Laboratory, Big Lost River Valley													
--	2.8	160	0	130	24	9.0	.5	201	29	--	--	--	--
.6	2.8	160	0	130	24	8.0	.5	208	29	--	--	--	<10
.6	3.2	160	0	130	22	12	.5	233	31	--	--	--	<10
.3	2.0	160	--	130	31	39	.2	233	9.2	--	--	--	--
.3	2.1	220	0	180	43	44	.2	320	20	--	--	--	--
.3	1.9	160	0	131	23	21	.1	--	--	--	--	--	--
.2	2.3	120	--	98	19	6.5	.3	152	19	--	--	--	--
.3	2.5	120	0	100	16	58	.4	195	15	--	--	--	--
.3	2.6	140	0	110	14	5.3	.2	--	--	--	--	--	--
.2	2.2	210	0	170	45	14	.2	270	--	--	--	--	40
.8	6.3	70	0	57	25	63	.2	195	10	--	--	--	--
1.3	7.8	130	0	110	32	32	.2	301	22	--	--	--	--
1.0	5.7	73	0	60	19	71	.2	203	12	--	--	--	<10
.3	2.5	190	0	160	22	10	.3	218	23	--	--	--	<10
.3	2.1	170	0	139	18	13	.1	--	--	--	--	--	--
.2	1.7	180	0	150	22	9.0	.3	205	19	--	--	--	--

WELL NO.	AQUIFER(S)	DATE OF SAMPLE	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)
							Idaho National Engineering Laboratory,				
02N 27E 02DDC1	QTv	77-09-20	--	--	--	--	170	22	43	14	6.1
02N 29E 01DBB1	QTv	68-08-20	474.00	480	7.6	12.0	200	85	48	19	14
		68-08-29	473.60	--	--	--	--	--	--	--	--
		77-09-06	--	552	7.8	12.5	230	120	59	20	15
02N 29E 18BDA1	QTv	71-09-14	--	452	8.5	12.5	120	9	28	11	46
		71-11-20	--	--	--	--	--	--	--	--	--
		72-08-20	--	447	8.6	12.5	120	7	28	12	42
		72-10-12	--	435	8.6	12.0	110	0	24	11	44
		72-11-20	--	416	7.7	12.0	120	5	28	12	37
		77-09-06	--	349	8.0	13.0	140	21	36	13	17
											Little Lost
		78-10-12	--	--	--	--	--	--	--	--	--
10N 27E 19CAA1	Qal & QTs	78-07-18	45.65	302	7.4	9.0	150	15	37	13	5.0
09N 27E 04DBC1	QTs	78-07-18	59.06	360	7.7	8.0	180	16	44	16	10
09N 27E 09BDB1	QTs	78-07-18	E24.00	314	7.4	9.0	160	18	40	14	6.3
08N 28E 29BCC1	Qal & QTs	78-07-19	71.25	380	7.5	10.0	160	0	36	18	16
08N 28E 30BDA1	QTs	78-07-19	E107.00	259	7.8	14.5	150	11	35	14	2.7
06N 29E 08BCC1	QTs	78-07-19	E110.00	403	7.4	10.0	200	45	46	21	7.6
06N 29E 20DDD1	QTs	78-07-20	71.00	584	7.2	12.0	270	28	70	24	22
06N 29E 25ABB1	QTs	78-07-20	E10.00	733	7.2	9.5	270	0	64	27	62
06N 29E 27DBB1	QTs	78-07-20	82.00	696	7.3	10.5	290	32	70	27	37
06N 30E 31AAD1	QTv	78-07-21	E246.00	333	7.4	10.0	160	0	38	16	6.8
05N 29E 03BBB1	QTs	78-07-20	131.80	322	7.4	11.5	140	13	33	13	7.1
05N 29E 03CCC1	QTs	78-09-11	--	498	7.5	10.0	250	22	68	20	9.4
05N 29E 15ABD1	QTv	78-09-11	262.40	243	8.0	14.5	110	0	24	11	11
05N 30E 05BAC1	QTv	78-07-21	278.10	335	7.3	11.5	160	4	37	16	6.1
							Idaho National Engineering Laboratory				
05N 29E 23CDD1	QTv	63-12-18	310.00	417	7.6	--	200	52	50	19	8.5
		65-06-03	271.50	454	7.8	15.5	220	62	54	20	8.9
		77-09-06	--	407	7.8	17.0	190	15	47	17	11

SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	ALKA-LINITY (MG/L AS CACO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SILICA, DIS-SOLVED (MG/L AS SIO2)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	COLI-FORM, TOTAL, IMMED. (COLS. PER 100 ML)	COLI-FORM, FECAL, (COLS./ 100 ML)	IRON, DIS-SOLVED (UG/L AS FE)
Big Lost River Valley--Continued													
0.2	1.8	180	0	150	16	8.8	0.2	--	--	--	--	--	--
.4	3.0	140	--	120	29	58	.2	273	--	--	--	--	<10
--	--	--	--	--	--	--	--	--	--	--	--	--	--
.4	3.7	140	0	120	32	81	.2	307	28	--	--	--	<10
1.9	4.7	130	0	110	76	24	.3	281	32	2.0	--	--	<10
--	--	--	--	--	--	--	--	254	--	--	--	--	--
1.7	5.1	120	7	110	38	43	.3	260	31	1.1	--	--	90
1.9	6.0	130	4	110	40	40	.3	269	31	.86	--	--	<10
1.5	5.2	140	0	110	42	35	.3	265	31	1.2	--	--	100
.6	3.4	150	0	120	23	24	.2	210	25	--	--	--	<10
River Valley													
--	--	--	--	--	--	--	--	254	--	--	--	--	--
.2	1.0	160	0	130	11	4.2	.1	163	15	.35	<1	<1	80
.3	1.0	200	0	160	10	9.8	.1	201	15	.68	<2	<1	60
.2	1.1	170	0	140	9.0	7.2	.1	177	16	.53	<1	<1	70
.5	2.0	200	0	160	22	14	.1	218	16	.57	<1	<1	70
.1	.6	170	0	140	12	3.3	.1	158	7.1	.11	38	29	100
.2	1.1	190	0	160	21	23	.1	229	14	.77	<1	<1	50
.6	1.6	300	0	250	37	17	.1	337	17	1.1	<1	<1	70
1.6	1.8	330	0	270	61	28	.1	423	19	4.5	<1	<1	70
1.0	1.8	310	0	250	43	41	.1	385	17	2.8	<1	<1	70
.2	1.3	200	0	160	16	7.9	.1	192	18	.40	<1	<1	50
.3	.9	150	0	120	16	6.5	.1	167	19	.54	<1	<1	530
.3	1.6	280	0	230	20	13	.1	282	14	.83	<2	<1	50
.5	1.5	130	0	110	16	4.8	.1	150	17	.25	<1	<1	50
.2	1.3	190	0	160	17	9.5	.1	200	19	.58	<1	<1	50
Little Lost River Valley													
.3	1.4	180	--	150	32	23	.2	235	14	--	--	--	--
.3	1.4	190	0	160	34	28	.1	254	13	--	--	--	--
.3	1.7	210	0	170	25	14	.2	231	15	--	--	--	<10

Suitability of Water For Use

Factors such as geologic environment, contact time with aquifer materials, source of recharge, and activities of man affect the physical, chemical, and bacteriological quality of ground water in an aquifer and determine the water's suitability for use. In relation to human needs, water-quality criteria (U.S. Environmental Protection Agency, hereafter referred to as EPA, 1976) designate maximum, chemical constituents, physical properties, and bacterial concentrations that, when not exceeded, will not harm water users.

In contrast, drinking water regulations (EPA, 1977a and 1977b), which may use criteria as a basis, describe legally established mandatory (primary) and recommended (secondary) limits for chemical constituents, physical properties, and bacterial concentrations. Local natural conditions, esthetic or economic considerations, and resource protection considerations may result in variations of regulations in different areas. Federal drinking water regulations legally apply only to public water supplies, not supplies for private use. Regulation limits do, however, provide a comparative base for all water-quality discussion.

Selected water characteristics commonly important to water users are presented in table 4. Water-quality criteria and regulations are given where possible. Where concentrations of chemical constituents exceed EPA mandatory or recommended limits or are esthetically or economically undesirable, it may be possible to reduce, remove, or control concentrations through appropriate treatment. Some methods for treating water were discussed in Nordell (1961).

Drinking Water Quality

As shown in tables 3 and 4, ground water in parts of the study area contains chemical constituents and bacterial concentrations that could restrict the water's use. Although no public water supply limits have been established for hardness, very hard water in some areas may be esthetically or economically restrictive or a concern to public health. Nitrite plus nitrate concentrations do not exceed maximum EPA public drinking water limits, based on 1978 analyses, but are anomalously high in water samples from wells in all valleys in the study area. Coliform bacteria

Table 4. Selected water-quality characteristics and their relation to use
(Modified from Hobba, 1976)

Constituent or property	Source or significance	Range of concentrations in sampled wells (1978)	Effects upon usability
Specific conductance	An indicator of dissolved mineral content of water	76-4,070 μmohs/cm	Indicator of mineral content. A measure of the capacity of the water to conduct a current of electricity, and varies with the concentration and degree of ionization of the different minerals in solution; the more minerals, the larger the specific conductance.
pH	Hydrogen-ion concentration	pH 6.4-pH 8.9	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increased alkalinity; values lower than 7.0 indicate increased acidity. Corrosiveness of water generally increases with decreasing pH, but excessively alkaline water also may be corrosive. Recommended level for public water supplies ranges from 6.5 to 8.5.[1]
Hardness as Calcium carbonate ($CaCO_3$)	In most waters, nearly all hardness is due to calcium and magnesium	4-1,600 mg/L	Soap consuming capacity of a water. Forms white scale on teakettles and plumbing and rings in bathtubs. Although hardness is less of a factor with synthetic detergents than with soap, it is still desirable to soften hard water for esthetic as well as economic reasons.
Calcium (Ca), Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum	1.7-480 mg/L Ca <.1-96 mg/L Mg	Causes most of the hardness in water. Calcium and magnesium combine with bicarbonate, carbonate, sulfate, and silica to form heat-retarding, pipe-clogging scale in boilers and in other heat-exchange equipment. A high concentration of magnesium has a laxative effect, especially on new users of the supply.
Sodium (Na) Potassium (K)	Dissolved from practically all rocks and soils, especially feldspars, clay minerals, and evaporites. Present in sewage and commercial fertilizers	1.8-390 mg/L Na 0.4-37 mg/L K	More than 50 mg/L sodium and potassium in the presence of suspended matter causes foam in boilers, which accelerates scale formation and corrosion. Dissolved sodium concentrations may be important to sodium-restricted diets.
Sodium-absorption-ratio[2] (SAR)	Dissolved calcium, magnesium, and sodium from rocks and soils	0.1-40	Estimates the degree to which sodium in irrigation water tends to enter into cation-exchange reactions in soil. High values indicate that sodium replaces absorbed calcium and magnesium. This replacement damages soil structure and decreases permeability.
Bicarbonate (HCO^3), Carbonate (CO_3)	Action of carbon dioxide in water on carbonate cementing material and rocks, such as limestone, dolomite, and travertine	34-990 mg/L HCO_3 0-12 mg/L CO_3	Produce alkalinity. When heated in the presence of calcium and magnesium, can form scales in pipes and release corrossive carbon-dioxide gas. Aid in coagulation for the removal of suspended matter from water.
Alkalinity as calcium carbonate ($CaCO_3$)	Nearly all produced by dissolved bicarbonate and carbonate	41-810 mg/L	Measure of water's capacity to neutralize acids. May produce objectionable taste.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, sulfides, and other sulfur compounds. May be derived from industrial wastes, both liquid and atmospheric	2.5-1,000 mg/L SO_4	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate, in combination with other ions, imparts bitter taste to water. Some calcium sulfate is considered beneficial in brewing processes. Recommended maximum limit for public water supplies is 250 mg/L.[1]

Table 4. Selected water-quality characteristics and their relation to use--continued

Constituent or property	Source or significance	Range of concentrations in sampled wells (1978)	Effects upon usability
Chloride (Cl)	Disaolved from rocks and soils. Present in sewage and industrial wastes.	0.7-730 mg/L CL	A salty taste can be detected when concentrations exceed 100 mg/L. In large quantities, increases the corrosiveness of water. Present available removal methods not generally economical for most uses. Recommended maximum limit for public water supplies is 250 mg/L.[1]
Fluoride (F)	Diasolved in small quantities from most rocks and soils. Added to many public supplies	<.1-11 mg/L F	Fluoride concentrations in limited amounts have beneficial effect on the structure and resistance to decay of children's teeth. Excessive concentrations produce objectional dental fluorosis (tooth mottling). Optimum recommended limits for public water supplies range from 0.7 to 1.2 mg/L and are based on annual average maximum daily air temperatures.[3]
Dissolved solids (calculated sum)	Mineral constituents dissolved from rocks and soils	56-2,620 mg/L	Recommended maximum limit for public water supplies is 500 mg/L.[1] Water containing more than 1,000 mg/L of dissolved solids is unsuitable for many purposes.
Silica (SiO_2)	Dissolved from practically all rocks and soils	5.8-54 mg/L SiO_2	Together with calcium and magnesium, silica forms a low heat-conducting, hard, glassy scale in boilers and turbines. Silica inhibits deterioration of zeolite-type water softners and corrosion of iron pipes by soft (0-75 mg/L $CaCO_3$) water.
Nitrite (NO_2)-plus nitrate (NO_3) as nitrogen (N)	Atmosphere, legumes, plant debris, animal excrement, nitrogenous fertilizer in soil, and sewage	<.1-6.9 mg/L N	Small amounts help reduce cracking of high-pressure boiler steel. Encourages growth of algae and other organisms that produce undesirable taste and odors. Concentrations in excess of 10 mg/L are suspected as cause of methemoglobinemia (blue-baby disease) in infants. Mandatory maximum limit for public water supplies is 10 mg/L.[3]
Total coliform	Indicator of general bacterial pollution	<1.-690 colonies per 100 ml	Presence of coliform bacteria indicates possible pollution of water by pathogenic enteric bacteria or viruses. Indicates contamination from human or animal wastes. Mandatory maximum contaminant limits for public water supplies vary with sample method and frequency.[3]
Fecal coliform	Indicator of pollution, specifically from warm-blooded animals	<1-29 colonies per 100 ml	See total coliform.
Iron (Fe)	Dissolved from practically all rocks and soils, especially igneous and sandstone rocks. Also caused by corrosion of pipes, pumps and other cast iron or steel equipment or the presence of iron bacteria.	<.01-1.1 mg/L Fe (<10-1,000 μg/L Fe)	When concentrations are more than 0.1 mg/L (more than 100 μg/L), iron commonly precipitates on exposure to air, causing turbidity, staining of plumbing fixtures and laundry, and tastes and colors that are objectionable in food, beverages, textile processes, and ice manufacture. Recommended maximum limit for public water supplies is 0.3 mg/L, or 300 μg/L.[1]

[1]U.S. Environmental Protection Agency (1977b)

[2]U.S. Salinity Laboratory Staff (1954) $SAR = \frac{(Na+)}{\sqrt{\frac{(Ca^{+2})+(Mg^{+2})}{2}}}$, in meq/L

[3]U.S. Environmental Protection Agency (1977a)

concentrations exceed EPA public drinking water limits in several water samples. Concentrations of dissolved solids, sulfate, chloride, fluoride, and iron exceed EPA public drinking water limits in several samples, and dissolved calcium, magnesium, sodium, potassium, or bicarbonate concentrations were anomalously high in some water samples. Table 5 shows median and range values for selected ground-water characteristics by river valley.

Hardness

Water hardness is caused principally by dissolved calcium and magnesium and is expressed in milligrams per liter as calcium carbonate ($CaCO_3$). Water hardness is ofted defined in terms of grains of hardness: 1 grain per U.S. gallon=17.12 mg/L $CaCO_3$ hardness (Johnson Division, Inc., 1966). The consumer often judges hardness of water by the amount of soap required to produce a lather and by scale buildup in water-supply pipes, plumbing fixtures, and cookware.

On a national basis, EPA (1976) has established the following water hardness categories: 75 mg/L is soft, 76 to 150 mg/L is moderately hard, 151 to 300 mg/L is hard, and more than 300 mg/L is very hard.

Hardness in domestic supplies probably is not objectionable at concentrations less than 100 mg/L. Chemically softening water may be preferable for esthetic reasons or for industrial uses but may be expensive. Also, use of sodium compounds in some water-softening processes may increase the sodium content of drinking water, a concern to people on sodium-restricted diets (EPA, 1977a).

Until recently, few reports were available on water hardness and public health. An increasing number of research articles that discuss the importance of water hardness and health are being published. One recent report shows an inverse correlation between the incidence of cardiovascular disease and the amount of hardness in drinking water (EPA, 1977c).

Table 5. Median and range values of selected ground-water quality characteristics, by river valley
(Values calculated for 1978 data only)

[-- = all values are less than 1
< = less than
K = less than ideal colony count]

Water-quality characteristic	Lemhi Valley		Pahsimeroi Valley		Salmon River valley		Big Lost River valley		Little Lost River valley	
	Range	Median	Range	Median	Range	Median	Range	Median	Range	Median
Hardness ($mg/L\ CaCO_3$)	4-1,600	190	67-270	205	11-460	190	65-270	210	110-290	190
Nitrate ($NO_2 + NO_3$ mg/L as N)	<.01 6.9	0.47	0.20-1.1	0.53	0.3-3.8	0.47	0.09-4.7	0.82	0.11-4.5	0.58
Fecal coliform (colonies per 100 mL)	---	<1	<1-K2	<1	---	<1	---	<1	<1-29	<1
Total coliform (colonies per 100 mL)	---	<1	<1 K14	<1	---	<1	<1-K690	<1	<1-38	<1
Dissolved solids (calculated sum)	124-2,660	377	128-350	257	58-665	226	82-340	240	151-446	207
Sulfate ($mg/L\ SO_4$)	3.8-1,000	59	2.7-66	22	2.5-200	19	8.0-42	18	9.6-61	17
Chloride (mg/L Cl)	2.5-730	19	0.7-20	7.9	1.0-40	4.6	1.6-18	4.9	3.3-41	9.2
Fluoride (mg/L F)	<.1 3.7	0.40	0.0-0.3	0.15	0.1-11	0.50	0.1-0.5	0.20	0.1-0.2	0.10
Iron (µg/L Fe)	<10 870	30	50-410	60	10-130	20	10-1,100	65	10-530	70
Calcium (mg/L Ca)	1.7-480	55	29-74	54	3.8-110	41	19-76	56	24-70	39
Magnesium (mg/L Mg)	<.1 96	16	10-22	16.5	0.3-44	8.9	4.3-25	14	11-27	16
Sodium (mg/L Na)	5.2-390	58	1.8-44	8.7	4.3-120	22	2.2-33	6.6	2.7-62	8.5
Potassium (mg/L K)	0.7-22	3.3	0.9-1.8	1.3	0.4-12	1.4	0.7-7.1	1.3	0.6-3.4	1.3
Bicarbonate ($mg/L\ HCO_3$)	73-990	270	140-310	210	34-350	190	69-320	226	130-330	195

Hardness concentrations in ground water in the study area are represented in figure 6. Most ground water in east-central Idaho valleys is classed as hard to very hard. Median hardness concentration for all valleys and all aquifers sampled is 190 mg/L. Greatest ranges of values are from wells in the Lemhi Valley (4 to 1,600 mg/L) and Salmon River valley (11 to 460 mg/L) completed in flood-plain alluvium or sedimentary aquifers. Highest median concentrations (table 5) are from Pahsimeroi River valley (205 mg/L). In the Pahsimeroi, Big Lost River, and Little Lost River valleys, ground-water samples from wells completed in flood-plain alluvium and sedimentary and undifferentiated volcanic aquifers was generally hard to very hard. Few sample concentrations were less than 100 mg/L.

Nitrate and Coliform Bacteria

Dissolved nitrite plus nitrate, reported in milligrams per liter as dissolved nitrogen, is hereafter referred to collectively as nitrate. Natural sources of nitrate in ground water include atmospheric nitrogen, decaying plants, and soluble compounds or minerals in soils and rock materials. Natural sources are usually minor contributors of nitrogen to most ground water. Higher than average concentrations of nitrate may be an indication of man-caused contamination. Potential man-caused sources of nitrate in water supplies are municipal and industrial waste waters, septic-tank effluent, leachates from barnyards and feedlots, cropland and lawn fertilizers, animal wastes, leachates from garbage dumps and landfills, and certain kinds of mine drainage.

Current nitrate concentrations in the study area did not exceed maximum EPA public drinking water limits. Seventy-five percent of all sample concentrations were less than 1 mg/L nitrate. Nitrate concentrations that exceeded 1 mg/L were most common in wells located in heavily irrigated or densely populated areas near Challis, Salmon River valley; from Darlington to below Arco, Big Lost River valley; and near Howe in the Little Lost River valley.

Coliform bacteria in a water sample are considered indicators of the possible presence of enteric pathogenic bacteria or enteric viruses. Sixteen species of bacteria are included in the total coliform group. The presence of

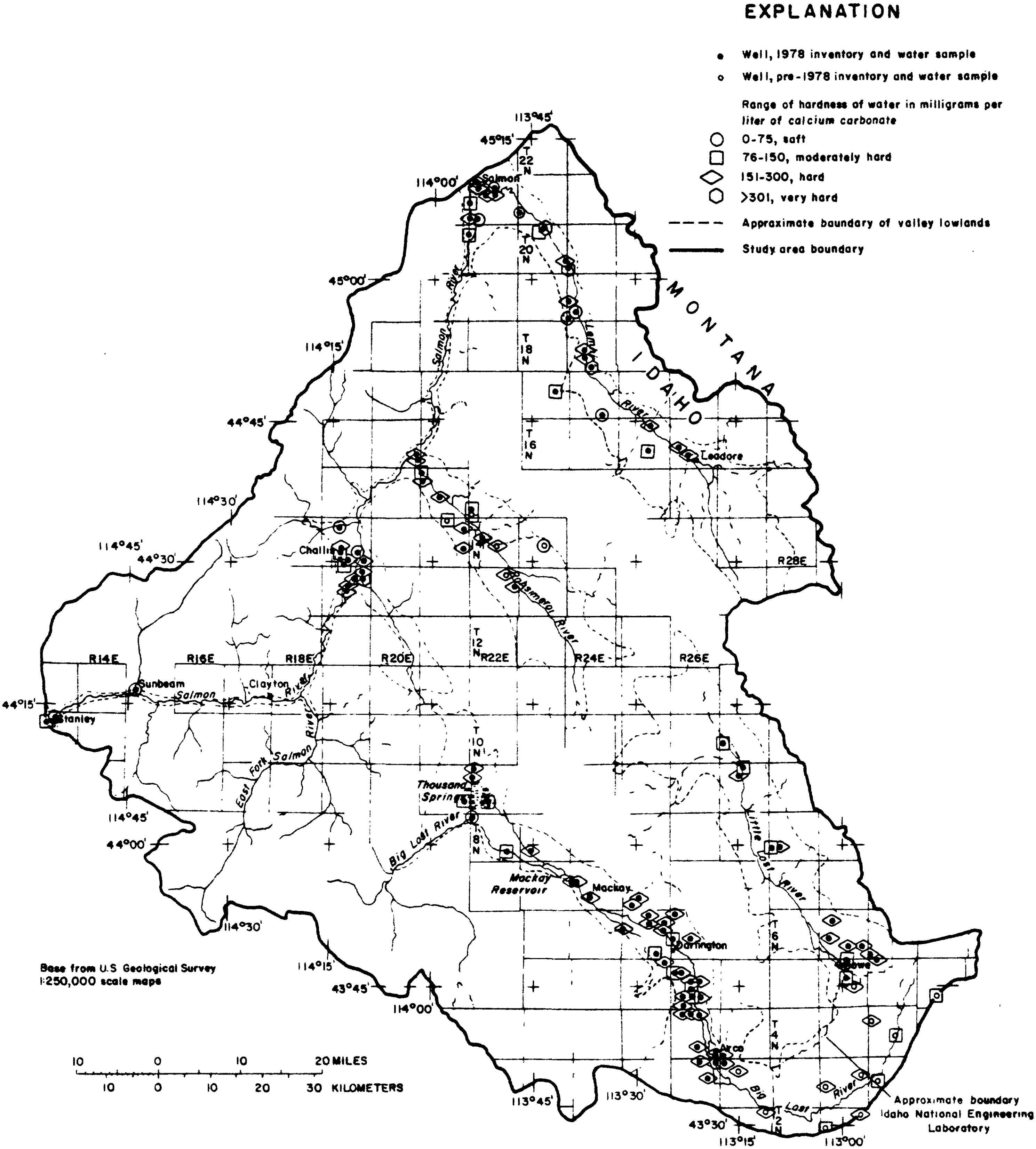


Figure 6.-- Hardness of ground water.

total coliforms in water indicates possible fecal waste contamination from a nonspecific source. Total coliform counts from current samples exceeded mandatory (1 colony per 100 mL of sample) public drinking water limits in water samples from 22 wells in the study area. High total coliform concentrations were most common from Darlington to Arco, Big Lost River valley.

The presence of fecal coliform bacteria, a subgroup of the total coliform bacteria, in a water sample specifically indicates fecal waste contamination by warmblooded animals. Fecal coliform counts from current samples exceeded 1 colony per 100 mL in a water sample from one well in the Pahsimeroi Valley and one well in the Little Lost River valley.

Common causes of bacteria in well systems are infiltration of contaminated surface water to shallow casing perforations, leakage around casing or pump base, leakage through a gravel pack or broken casing, or proximity to a subsurface contamination source, such as septic-tank effluent or a disposal well.

Distribution of ground water affected by bacteria contamination was similar to distribution of anomalously high nitrate concentrations. Most water samples that contained high coliform bacteria concentrations were from 15- to 20-year old irrigation wells. Depths of these wells averaged 149 ft, depths to perforations or end of casing averaged 85 ft, water levels averaged 57 ft, and all but one well are finished in flood-plain alluvium or sedimentary aquifers. Areally, the highest incidence of bacterial contamination was in the Big Lost River valley.

Nitrate and bacteria concentrations were generally not a health or water-use problem in well water sampled during this study. Distribution of anomalously high nitrate and bacteria concentrations in the valleys (fig. 7), however, may imply local influence on water quality by man's activities.

Dissolved Solids and Other Selected Chemical Constituents

DS (dissolved solids) concentrations represent the sum of the predominant mineral constituents calculated for each water sample. More specifically, DS concentrations are

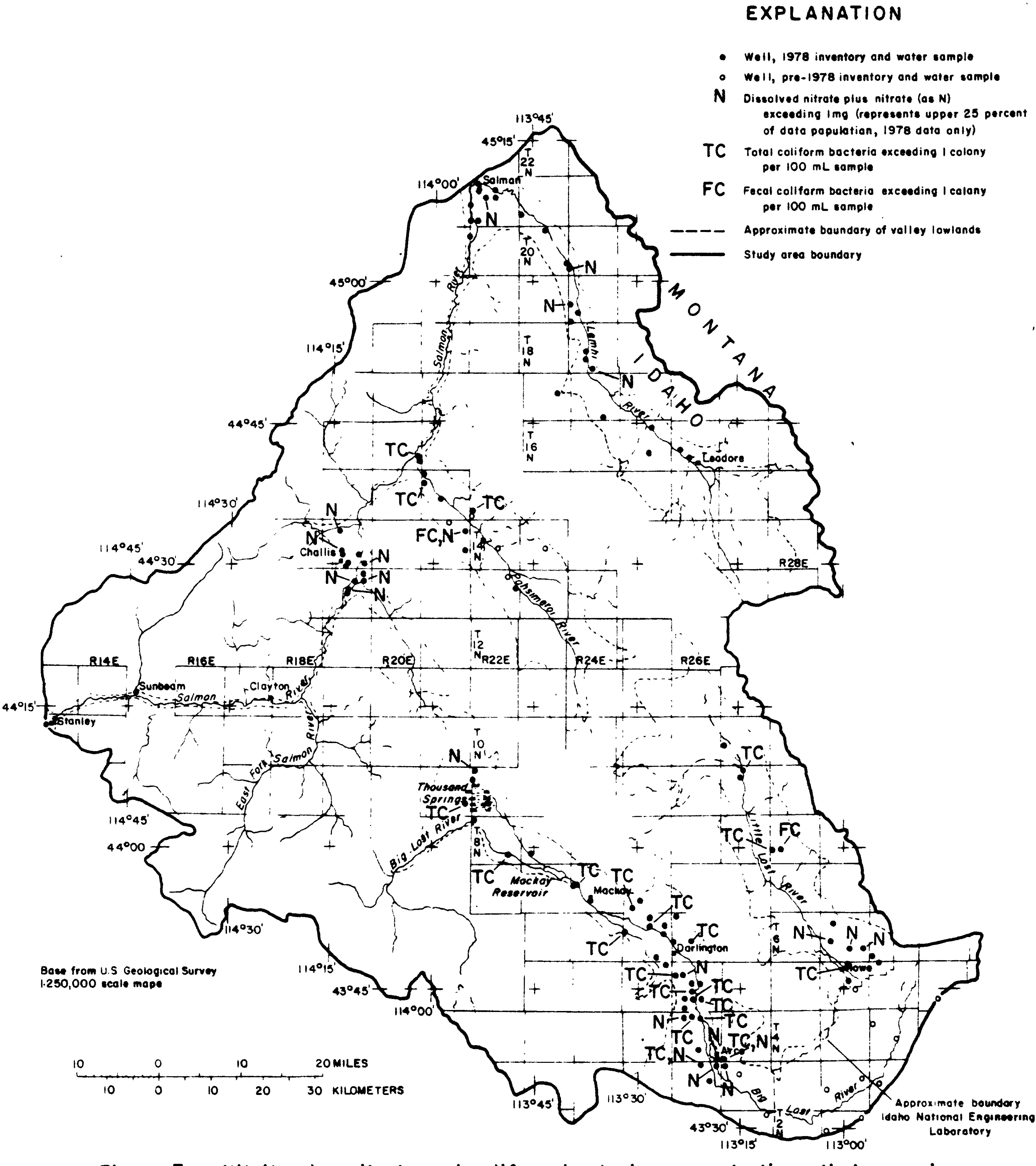


Figure 7.-- Nitrite plus nitrate and coliform bacteria concentrations that exceed specified levels (1978 data).

calculated as the sum of cations, positively charged ions (calcium, magnesium, sodium, and potassium); and anions, negatively charged ions (alkalinity, sulfate, and chloride), plus silica. High concentrations of DS may show natural variations in aquifer composition or may indicate possible ground-water contamination. Natural sources of DS in ground water include decomposition of organic material or soluble compounds and minerals in soils and rocks. DS concentrations in ground water may be increased by infiltration of irrigation return flow, organic and chemical waste-water disposal, or solid waste-disposal leachates. A high DS value may have an influence on the acceptability of water for use and may be an indication of the presence of excessive concentrations of cations or anions that would be esthetically or otherwise objectionable to the consumer.

Concentrations of DS exceed the maximum EPA recommended public drinking water limit of 500 mg/L in ground-water samples from seven wells in the Lemhi Valley and one well in the Salmon River valley. Lemhi Valley samples with high DS are from wells completed in the sedimentary aquifer, and the Salmon River sample is from a well completed in both sedimentary and undifferentiated volcanic rocks. Concentrations of dissolved sulfate, chloride, fluoride, or iron exceed maximum EPA mandatory or recommended public drinking water limits (see table 4) in samples from wells in all valleys in the study area. Anomalously high concentrations of dissolved calcium, magnesium, sodium, potassium, or bicarbonate are present in a few samples from wells in all valleys. Plate 3 shows locations of all sampling sites in the study area and the distribution of chemical constituents that exceed maximum EPA public drinking water limits for each site. When public drinking water standards are not established for a constituent, sample concentrations plotted represent the upper 25 percent of the data population.

High or anomalous concentrations of constituents in ground water in the study area are probably from natural sources, rather than from man's activities. High DS concentrations in water samples from the Lemhi and Salmon River valleys, for example, are most often associated with aquifers where clay and sand interfinger, and water is yielded from sand and gravel stringers within clays of the flood-plain alluvium and sedimentary aquifers (Hem, 1970, and Fairbridge, 1972). The control over the higher mineral concentration seems to be the presence of the clay, but the mechanism remains unknown.

Quality of Ground Water for Agricultural Use

Major agricultural uses of ground water in the study area are for livestock and irrigation. Concentrations of chemical constituents are within mineralization, salinity, and alkalinity tolerance levels for most livestock uses (Todd, 1970; and National Academy of Sciences, National Academy of Engineering, 1972). In semiarid areas such as the east-central Idaho valleys, irrigation water quality is influenced by total concentration of soluble salts and relative proportion of sodium to other cations.

On the basis of specific conductance and SAR, the U.S. Salinity Laboratory Staff (1954) has developed a general classification to illustrate the salinity and sodium (alkali) hazard of water used for irrigation. Using this general classification, and on the basis of laboratory determinations of specific conductance and SAR, figures 8 and 9 show the suitability of ground water for irrigation in east-central Idaho valleys.

For irrigation, most ground water in the study area has medium salinity hazard and low sodium hazard. Eleven samples from the Lemhi Valley and two samples from the Salmon River valley show high to very high salinity hazard and medium to very high sodium hazard. Use of highly mineralized ground water in these valleys for irrigation may be limited to salt-tolerant plants in areas where alkali soil formation is not a problem. The relative tolerance of selected crop plants to salt is shown in table 6.

CHEMICAL COMPOSITION OF GROUND WATER

Chemical composition of ground water in each of the east-central Idaho valleys studied is depicted in trilinear diagrams (figs. 10-14). In these diagrams, selected cations (calcium, magnesium, and sodium plus potassium) and anions (bicarbonate plus carbonate, sulfate, and chloride) for each ground-water analysis are shown as a percentage of the total cations and anions, in milliequivalents per liter, plotted as a single point on each lower triangle. Cation and anion plots for each sample are then projected into the upper diamond, or quadrilinear, field. General composition of the water is determined by the location of projection intersections in the diamond field.

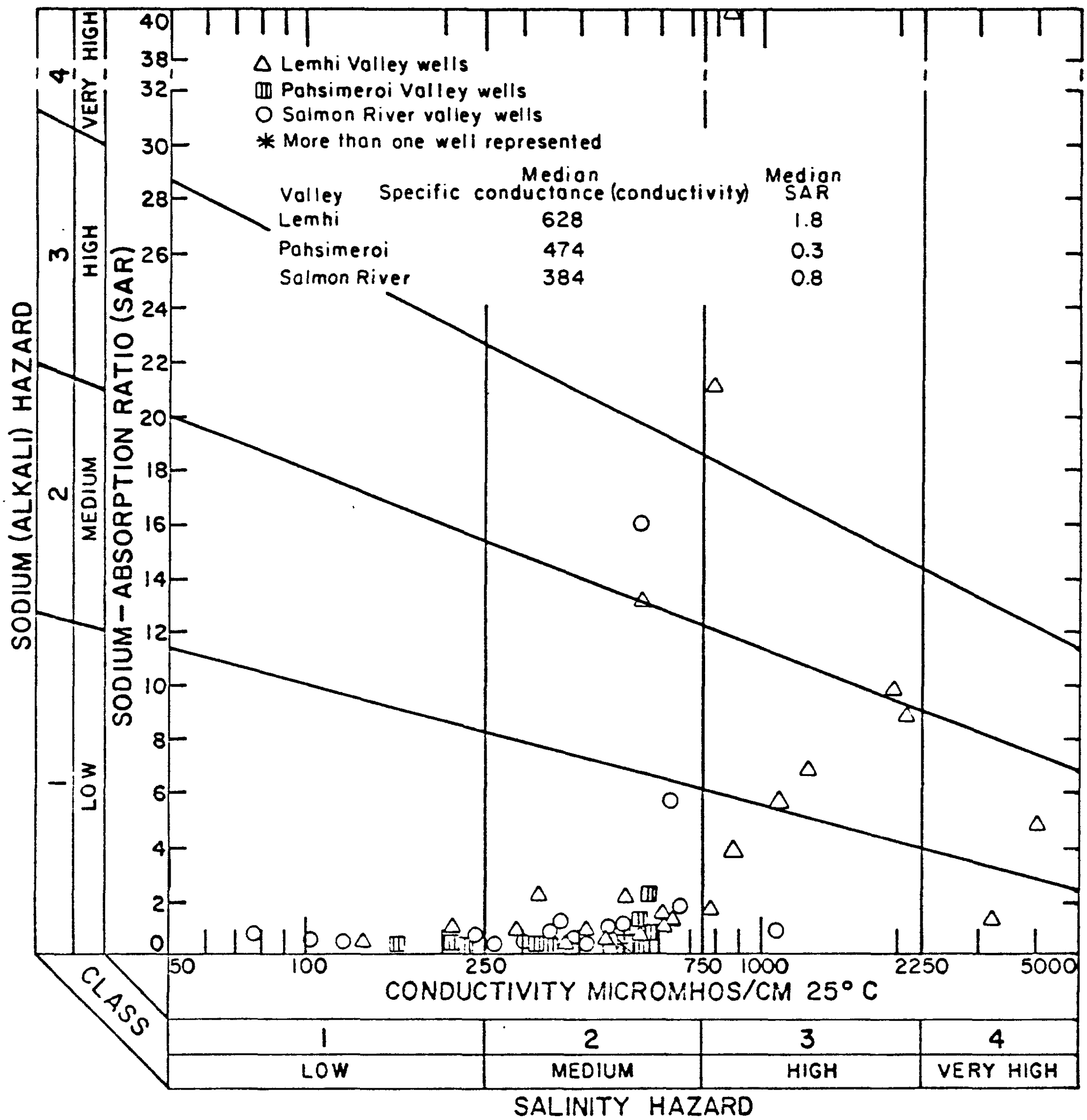


Figure 8.--Salinity and sodium hazards of irrigation water in Lemhi, Pahsimeroi, and Salmon River valleys.

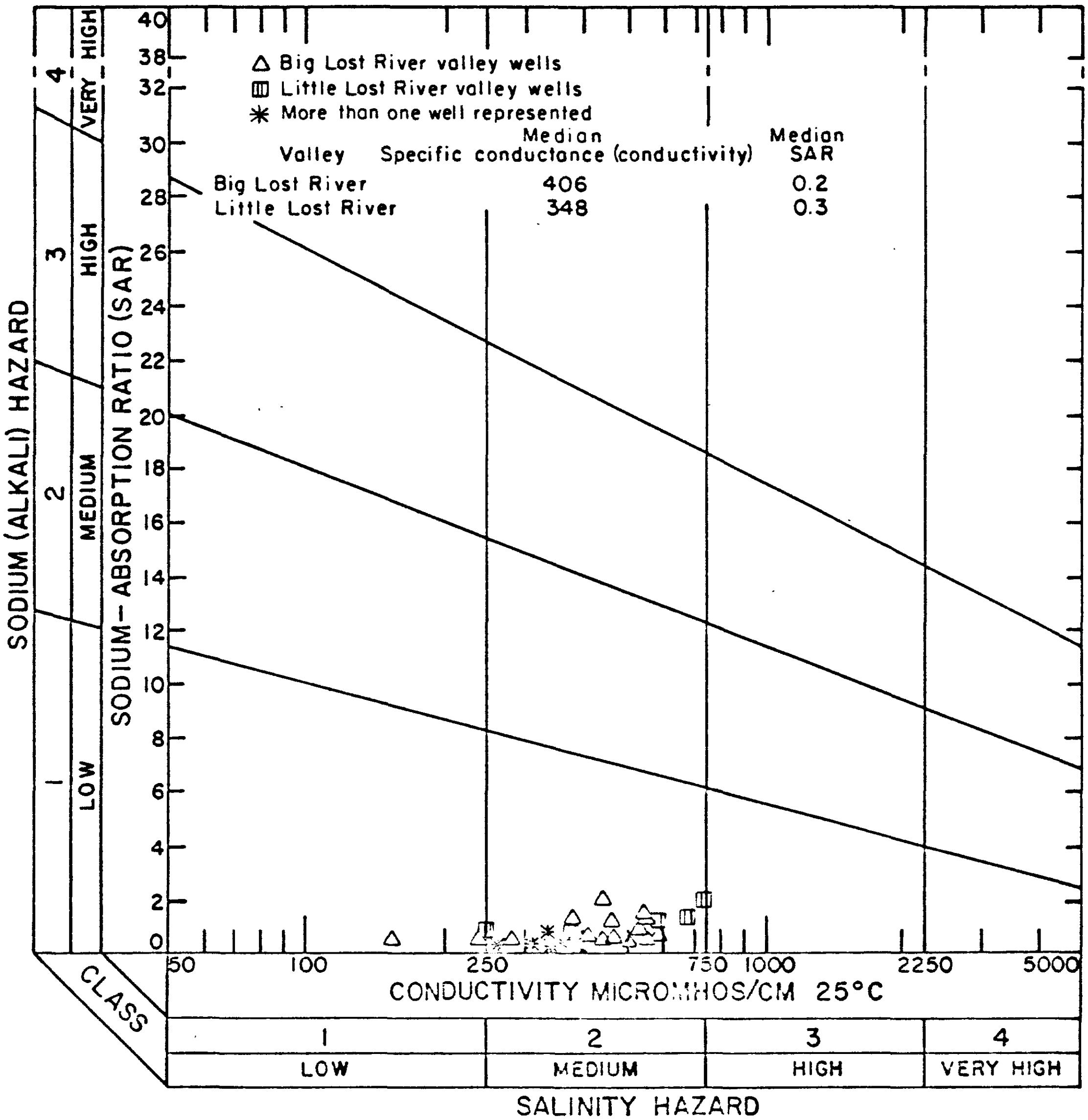


Figure 9.--Salinity and sodium hazards of irrigation water in the Big Lost River and Little Lost River valleys.

Table 6. Relative tolerance of selected crop plants to salt[1]
(Modified from U.S. Salinity Laboratory Staff, 1954)

Fruit crops			Field crops		
High salt tolerance	Medium salt tolerance	Low salt tolerance	High salt tolerance	Medium salt tolerance	Low salt tolerance
	Grape	Pear	Barley	Rye (grain)	Field beans
	Cantaloup	Apple	Sugar beets	Wheat (grain)	
		Plum		Oats (grain)	
		Apricot		Corn (field)	
		Peach		Sunflower	
		Strawberry			
Vegetable Crop			**Forage crops**		
Garden beets	Tomato	Radish	Saltgrass	Sweet clover(s)	White Dutch clover
Asparagus	Broccoli	Celery	Alkaligrass	Perennial ryegrass	Meadow foxtail
Spinach	Cabbage	Green beans	Bermuda grass	Alfalfa	Red clover
	Bell pepper		Rescuegrass	Fescue	
	Cauliflower		Western wheatgrass	Rye (hay)	
	Lettuce		Barley (hay)	Wheat (hay)	
	Sweet corn			Oats (hay)	
	Potatoes			Milkvetch	
	Carrot				
	Onion				
	Peas				
	Squash				
	Cucumber				

[1]Salt tolerance decreases down each list

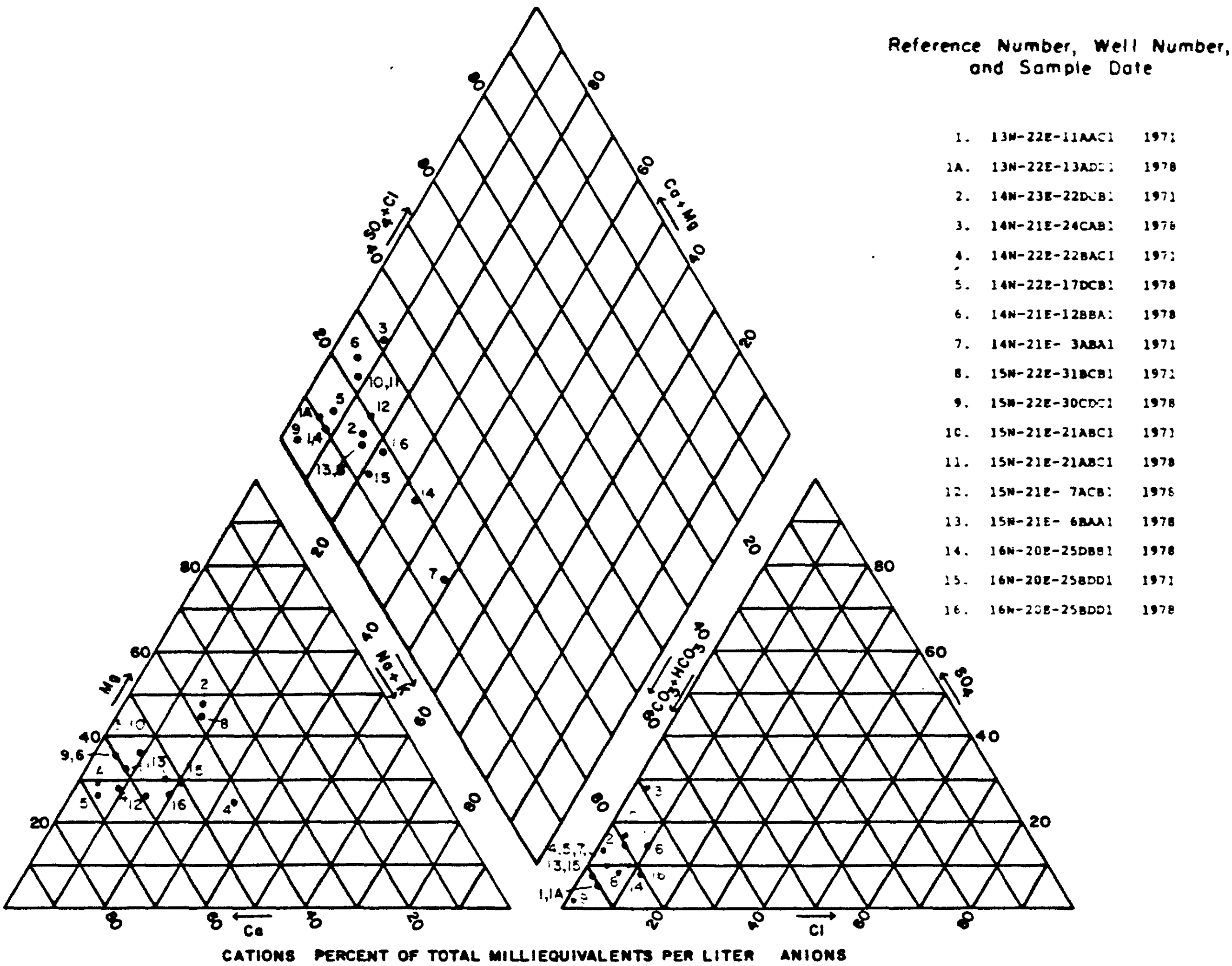
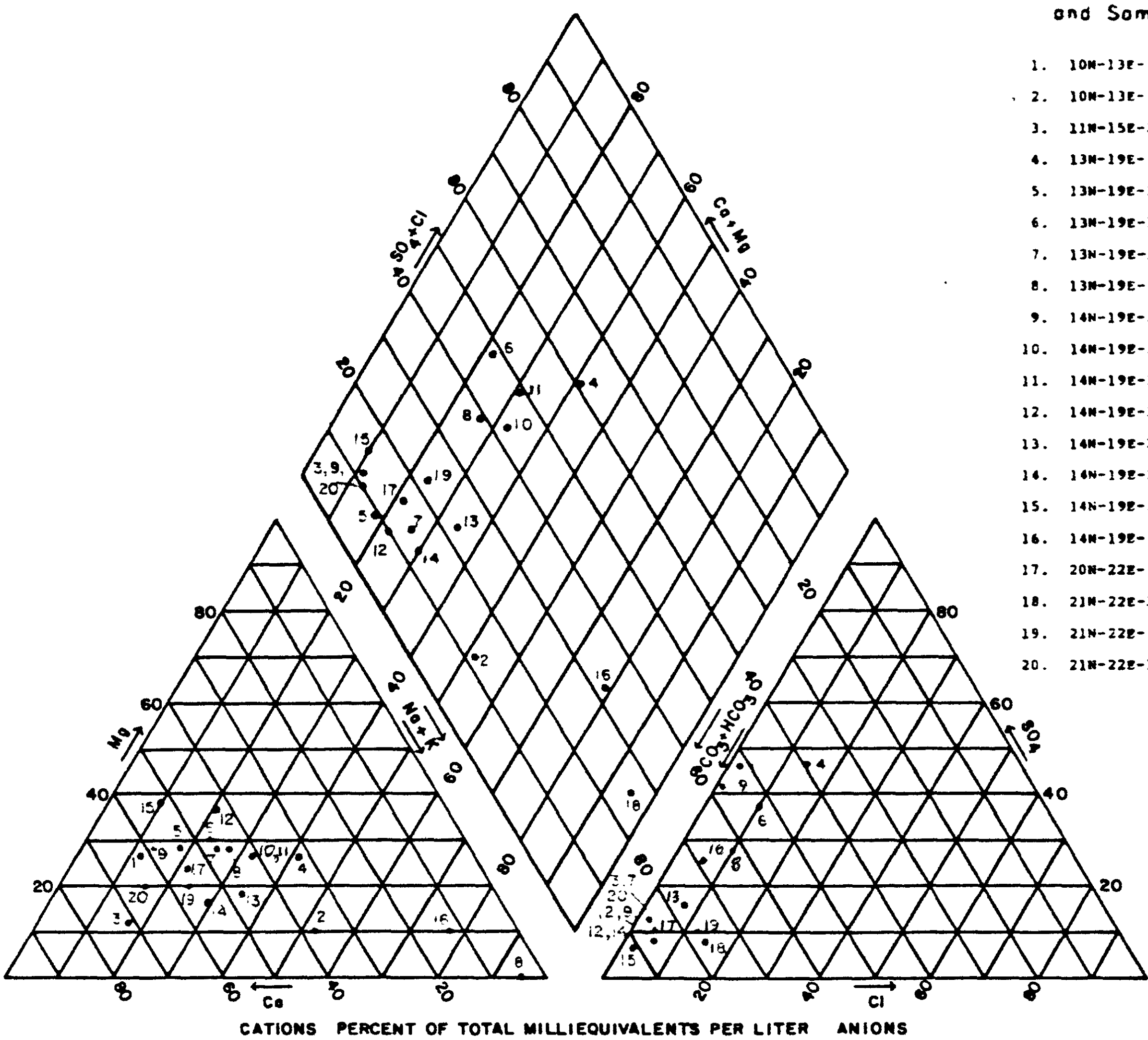


Figure 10.-- Trilinear diagram of chemical analyses of ground water from the Pahsimeroi Valley.



Reference Number, Well Number, and Sample Date

1. 10N-13E- 9AAC1 1978
2. 10N-13E- 3CCB1 1978
3. 11N-15E-20BCB1 1978
4. 13N-19E-15DBC1 1978
5. 13N-19E-15ABB1 1978
6. 13N-19E-12CCC1 1978
7. 13N-19E-11CAA1 1978
8. 13N-19E- 1ADB1 1978
9. 14N-19E-34CAA1 1978
10. 14N-19E-34DAA1 1978
11. 14N-19E-34DAA1 1972
12. 14N-19E-36BDD1 1978
13. 14N-19E-28CCD1 1978
14. 14N-19E-26BCA1 1978
15. 14N-19E-28AAA1 1978
16. 14N-19E- 9ADC1 1978
17. 20N-22E- 7BCD1 1978
18. 21N-22E-32CBB2 1978
19. 21N-22E-31DAA1 1978
20. 21N-22E-19ABB1 1978

Figure 11.—Trilinear diagram of chemical analyses of ground water from the Salmon River valley.

Reference Number, Well Number, and Sample Date

1.	2N-29E-18BDA1	1971	32.	5N-31E-28CCC1	1977
2.	2N-29E-18BDA1	1972	33.	5N-26E-27CCC1	1976
3.	2N-29E-18BDA1	1972	34.	5N-26E-29DBD1	1978
4.	2N-29E-18BDA1	1972	35.	5N-26E-28BBB1	1976
5.	2N-29E-18BDA1	1977	36.	5N-26E-21BBC1	1976
6.	2N-27E- 2DDC1	1965	37.	5N-26E-15CAB1	1978
7.	2N-27E- 2DDC1	1977	38.	5N-26E-16ABB1	1976
8.	2N-29E- 1DBB1	1968	39.	5N-26E- 8CAB1	1976
9.	2N-29E- 1DBB1	1977	40.	5N-26E- 7AAC1	1978
10.	3N-29E-19CBB1	1963	41.	5N-25E- 1ACC1	1978
11.	3N-29E-19CBB1	1965	42.	6N-25E-35DCB1	1978
12.	3N-29E-19CBB1	1977	43.	6N-26E-19CDB1	1978
13.	3N-30E-19BCB1	1977	44.	6N-26E-21DCB1	1978
14.	3N-30E-19BCB1	1977	45.	6N-25E-13CBA1	1978
15.	3N-29E-14DDA1	1977	46.	6N-25E-18ABC1	1978
16.	3N-26E-14DAA1	1978	47.	6N-25E-10BCC1	1978
17.	3N-27E- 9ABB1	1978	48.	6N-25E-12BCB1	1978
18.	3N-26E- 1DAA1	1978	49.	6N-26E- 6CCB1	1978
19.	3N-26E- 3DAA1	1978	50.	6N-25E- 3DAB1	1978
20.	3N-27E- 6ADC1	1978	51.	7N-25E-32BCB1	1978
21.	4N-27E-31DBD1	1978	52.	7N-25E-28ACD1	1978
22.	4N-26E-36ACB1	1978	53.	7N-24E-28BBD1	1978
23.	4N-26E-27ABA1	1978	54.	7N-24E-18AAA1	1978
24.	4N-30E- 7ADB1	1963	55.	7N-24E-18ABB1	1978
25.	4N-30E- 7ADB1	1965	56.	8N-23E-29CAC1	1978
26.	4N-30E- 7ADB1	1977	57.	8N-22E-26CAB1	1978
27.	4N-26E- 5CDC1	1978	58.	8N-22E- 6ABC1	1978
28.	4N-26E- 3ABB1	1978	59.	9N-22E-28CDB1	1978
29.	4N-26E- 4BBA1	1978	60.	9N-21E-25BCC1	1978
30.	5N-31E-28CCC1	1965	61.	9N-22E- 7ABC1	1978
31.	5N-31E-28CCC1	1965	62.	9N-22E- 6CCA1	1978

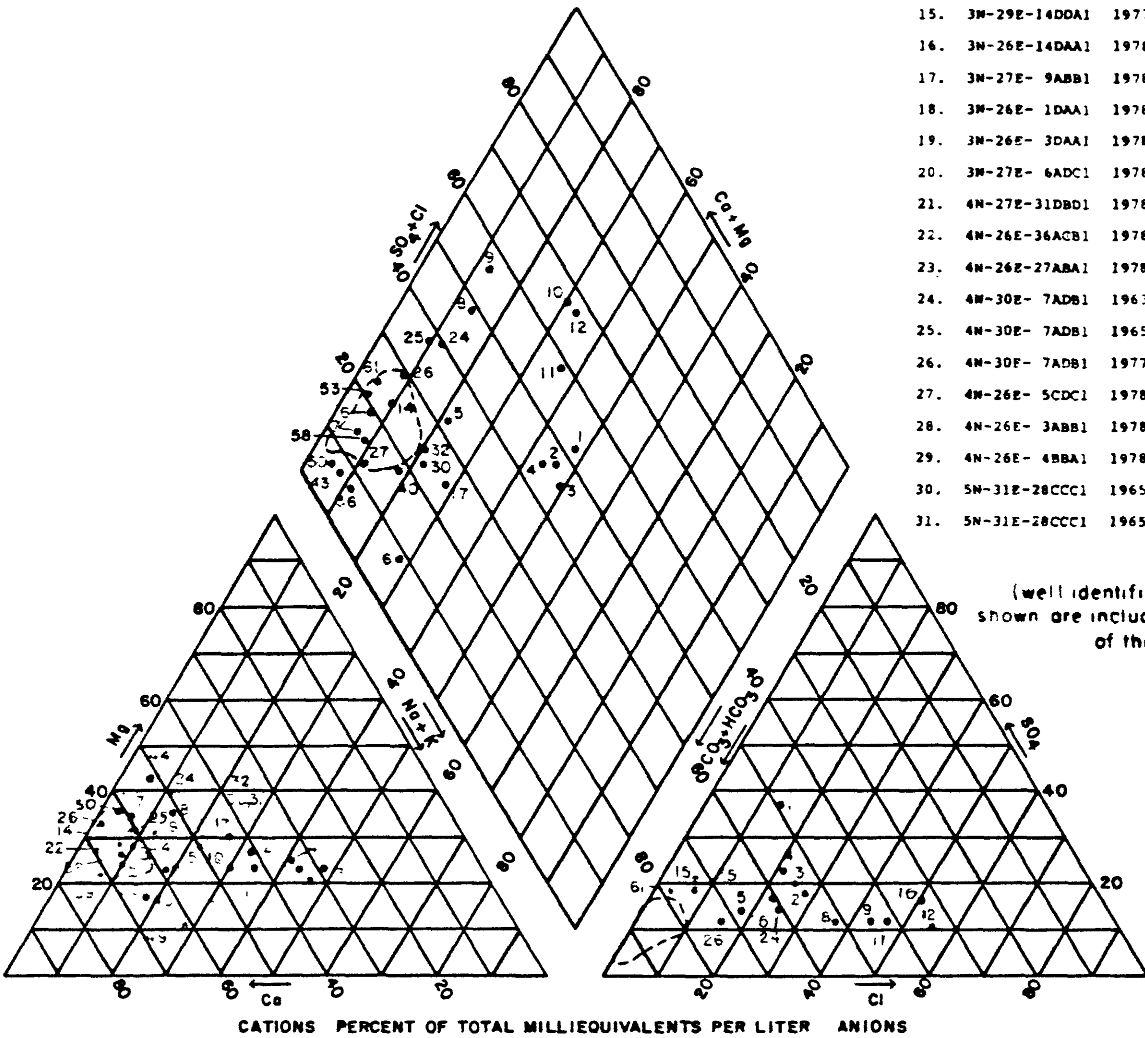


Figure 12 -- Trilinear diagram of chemical analyses of ground water from the Big Lost River valley.

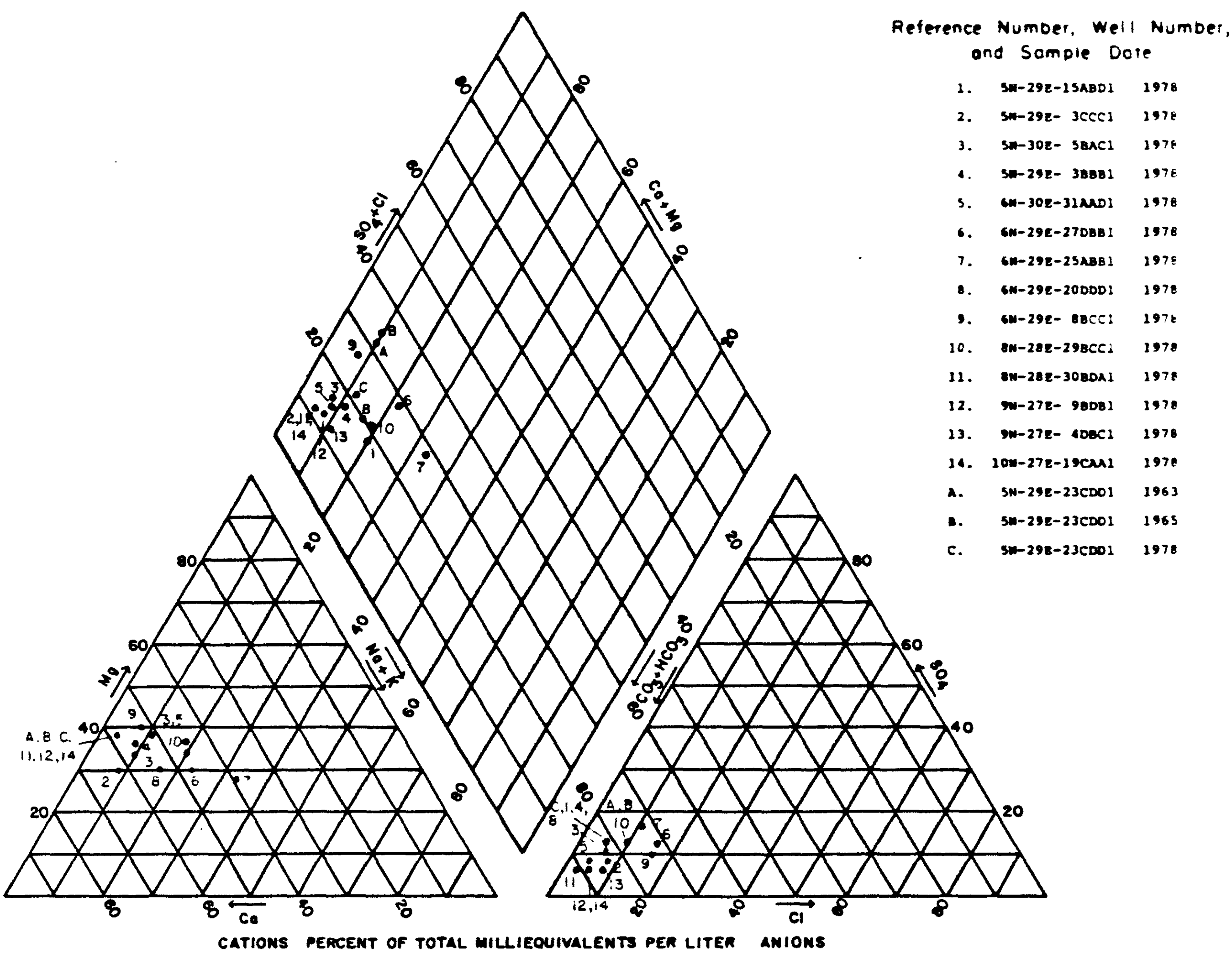
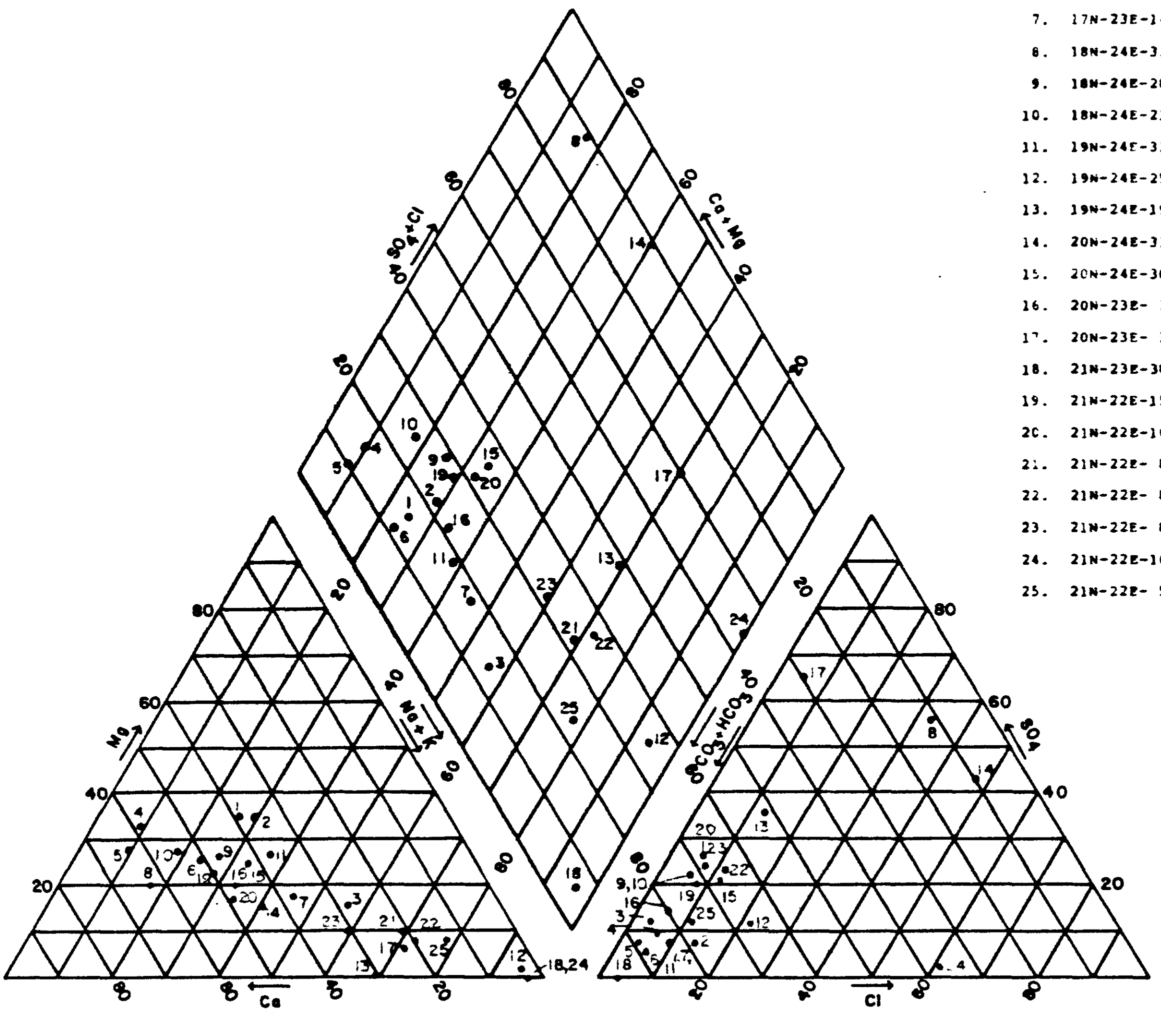


Figure 13.--Trilinear diagram of chemical analyses of ground water from the Little Lost River valley.



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Reference Number, Well Number, and Sample Date

1.	16N-26E-28DCB1	196[illegible]
2.	16N-26E-28DCB1	197[illegible]
3.	16N-25E-22CDA1	1978
4.	16N-26E-20ADB1	1978
5.	16N-25E- 3DAC1	1978
6.	17N-24E-35CBB1	1978
7.	17N-23E-14BAC1	1978
8.	18N-24E-33DBA1	1978
9.	18N-24E-28BBA1	1978
10.	18N-24E-21BCD1	1978
11.	19N-24E-31CAB1	1978
12.	19N-24E-29ACA1	1978
13.	19N-24E-19DDD1	1978
14.	20N-24E-31ADD1	1978
15.	20N-24E-30CCC1	1978
16.	20N-23E- 3CBB1	1978
17.	20N-23E- 3AAB1	1978
18.	21N-23E-30DDB1	1978
19.	21N-22E-15BAC1	1978
20.	21N-22E-16AAD1	1978
21.	21N-22E- 8CBC1	1978
22.	21N-22E- 8CBC1	1978
23.	21N-22E- 8CBC2	1978
24.	21N-22E-10ACC1	1978
25.	21N-22E- 5CCB1	1978

Figure 14.-- Trilinear diagram of chemical analyses of ground water from the Lemhi Valley.

Areal variations in water composition within valley aquifers may be due to the chemical influence of water from different sources of recharge or from different aquifers, relative proximity of the sampling site to the source of recharge, or by man-caused contamination.

When both historic (pre-1978) and recent (1978) data are available for a well in the study area and plots are made on a trilinear diagram for each set of data for that well, variations in chemical composition of ground water for the well may indicate local contamination or merely reflect analytical vagaries or seasonal changes affected by recharge. If only two analyses are available for comparison, or where three or more analyses exist with no apparent trend, no conclusions concerning contamination can be drawn. Where three or more analyses are available for a well and a definite trend in the relative chemical proportions is apparent on a trilinear diagram, some change in the ground-water chemistry is indicated, and monitoring in the vicinity of the well may need to be continued.

Well identification numbers shown in figures 10-14 are computer generated and are based on latitude-longitude numerical order for well sites, rather than township-range-section order. In Lemhi, Pahsimeroi, and Salmon River valleys, well identification numbers are progressively larger downstream, generally from southeast to northwest. In Big Lost River and Little Lost River valleys, well identification numbers are progressively larger upstream, generally southeast to northwest.

Chemical composition of ground water in Pahsimeroi, Salmon River, Big Lost River, and Little Lost River valleys is similar, and these valleys are discussed as a group in the beginning of the following section. The greatest diversity in chemical composition of ground water occurs in the Lemhi Valley, which is discussed separately.

Pahsimeroi, Salmon River, Big Lost River, and Little Lost River Valleys

Trilinear diagrams of 17 chemical analyses from the Pahsimeroi Valley (fig. 10), 20 chemical analyses from Salmon River valley (fig. 11), 62 chemical analyses from the Big Lost River valley (fig. 12), and 17 chemical analyses from the Little Lost River valley (fig. 13), show that the chemical composition of ground water in these valleys is generally characterized by calcium, magnesium, and bicarbonate plus carbonate ions. Several analyses of ground water from the Pahsimeroi and Salmon River valleys show sodium plus potassium as the principal cation, rather than calcium and magnesium. Several analyses of ground water from Salmon River and Big Lost River valleys show nearly equal percentages of sulfate and bicarbonate plus carbonate anions. Variations in the composition of ground water in the Pahsimeroi, Salmon River, Big Lost River, and Little Lost River valleys are probably related to different mineral composition of the aquifers and proximity to source(s) of ground-water recharge.

Significant changes in ground-water composition with time are not evident for wells that have current and historical data in Pahsimeroi or Salmon River valleys.

In the Big Lost River valley, some change in chemical composition is apparent in three wells for which analyses were obtained in the 1960's and 1977. Well 2N-29E-1DBB1 (reference numbers 8 and 9 in fig. 12) shows a trend toward an increasing percentage of chloride from 1968-77. Only two analyses are available, however, and no conclusions concerning cause of variation can be drawn. Well 3N-29E-19CBB1 (reference numbers 10, 11, and 12 in fig. 12) shows a trend toward an increasing percentage of bicarbonate plus carbonate between 1963 and 1965. Analysis of water obtained from the well in 1977, however, is similar to analysis of the water in 1963. As no continuing trend is indicated, the difference in the 1965 water is probably due to natural chemical variations in the ground water created by mixing with different proportions of ground-water recharge to the aquifer. Water composition for well 4N-30E-7ADB1 (reference numbers 24, 25, and 26 in fig. 12) shows little change between 1963 and 1965, but a slight increase in bicarbonate plus carbonate is indicated in 1977. The change does not represent a trend for that well, however, and no contamination is implied from the data.

In the Little Lost River valley, chemical composition of water from well 5N-29E-23CDD1 (reference letters A, B, and C in fig. 13) did not vary significantly from 1963-65. Between 1965 and 1978, however, a trend of increasing percentage of bicarbonate plus carbonate ions and decreasing percentage of magnesium ion is indicated. Additional sampling of water from this well may determine whether chemical composition trends are due to local conditions or to natural variations in the aquifer.

Lemhi Valley

Chemical analyses of 25 ground-water samples from the Lemhi Valley are plotted on a trilinear diagram (fig. 14) and show a large diversity in the chemical composition of the ground water. As in other east-central Idaho valleys, ground water in the Lemhi Valley is generally characterized by calcium, magnesium, and bicarbonate plus carbonate ions. Unlike other valleys, however, nearly half the analyses from Lemhi Valley show a high percentage composition of sodium plus potassium or sulfate ions.

Polygonal pattern diagrams (Stiff, 1951) were constructed for the ground waters of Lemhi Valley (fig. 15) and more graphically depict the areal trends in chemical character than trilinear diagrams. These pattern diagrams show total ion concentration and proportion of cations and anions for each sample. Nearly half the pattern diagrams for the Lemhi Valley show unusual ion proportion patterns when compared to a diagram of median constituent values, shown in the explanation for figure 15. Comparatively high concentrations of constituents, indicated by long polygon patterns in figure 15, are most noticeable for wells 20N-22E-5CCB1, 20N-23E-3AAB1, 20N-24E-31ADD1, and 18N-24E-33DBA1. Comparatively low concentrations of constituents, indicated by very short polygon patterns in figure 15, are particularly noticeable for wells 20N-23E-3CBB1, 19N-24E-31CAB1, and 17N-24E-35CBB1. Variations in concentrations of constituents are primarily due to lithology of the aquifers and proximity of the well site to source(s) of aquifer recharge, rather than man-caused contamination.

Polygon patterns were constructed for current and historic data for well 16N-26E-28DCB1 (fig. 15). Change in chemical constituent concentrations for ground water at this site is probably not significant.

Ground water in Lemhi Valley becomes progressively more mineralized (polygon patterns become longer) from Leadore to Salmon and from the west to east side of the valley lowlands. Highly mineralized water samples are from wells more than 50 ft deep, completed in, or perforated through, clay

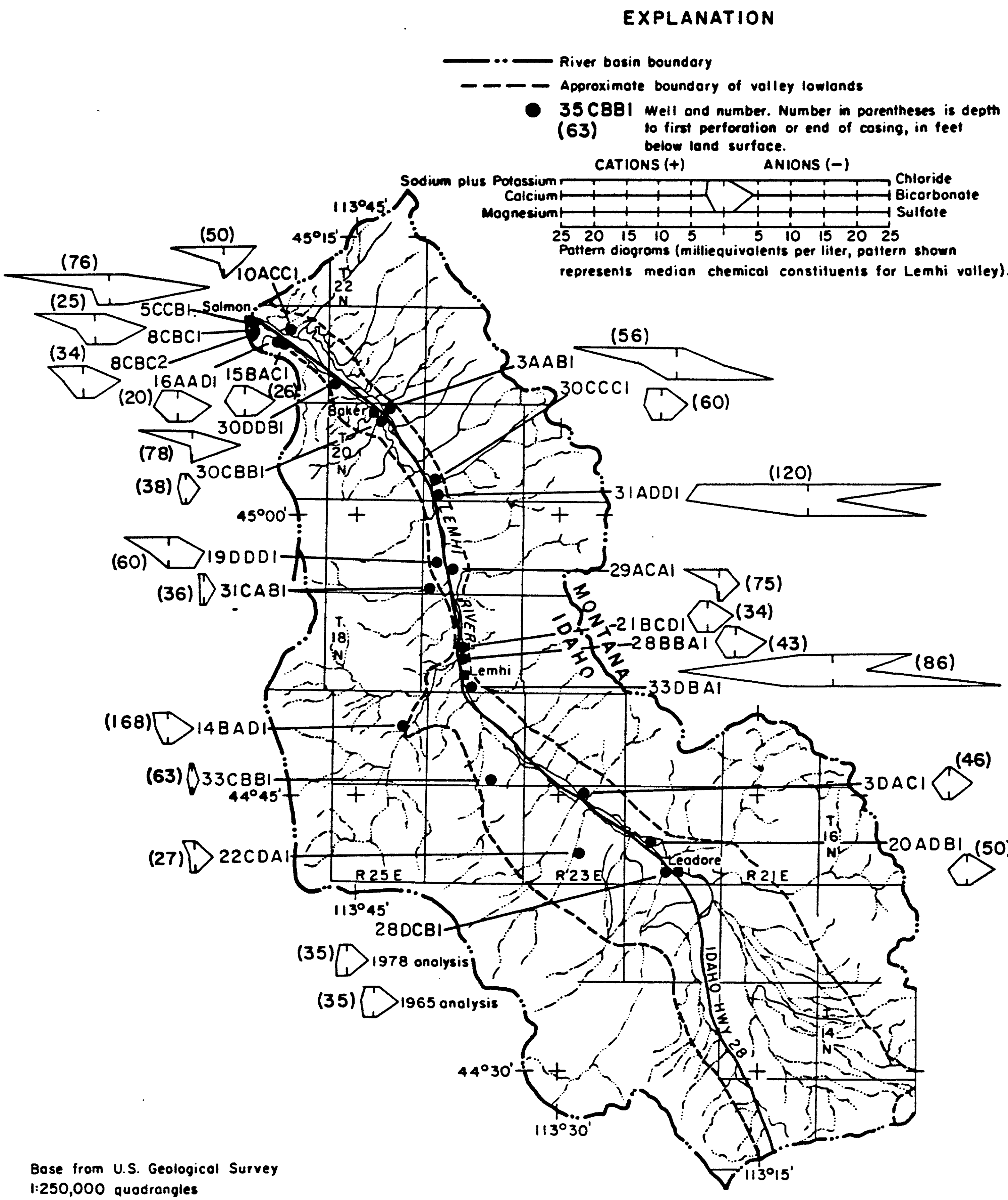

Figure 15.-- Chemical character of Lemhi Valley ground water.

beds of the sedimentary aquifer. In this aquifer, thin stringers of sand and gravel are interbedded with clays. Clay beds are thickest on the east-northeast side of the Lemhi Valley and probably originate from reworked alluvial terrace materials. Variations in mineral composition of the clay are due to differences in geologic origins of alluvial terrace materials and mode of deposition (Anderson, 1956, 1957, 1961).

Less mineralized water, depicted by short polygon patterns in figure 15, most commonly occurs in wells less than 50 ft deep completed in flood-plain alluvium. The low dissolved mineral composition of ground water may be due to limited contact time of water with minerals in the aquifer and a close proximity of the sampled well to source of recharge. Waters of low mineralization are most common on the west side of the Lemhi Valley.

SUMMARY

From May through November 1978, water quality, geologic, and hydrologic data were collected for 108 wells in the Lemhi, Pahsimeroi, Salmon River (Stanley to Salmon), Big Lost River, and Little Lost River valleys in east-central Idaho.

Quaternary flood-plain alluvium, Quaternary and Tertiary sedimentary and volcanic rocks, Tertiary and Cretaceous granitic rocks, and Paleozoic marine sedimentary rocks and Precambrian undifferentiated rocks (basement complex) are major rock units in the study area. Flood-plain alluvium and sedimentary and volcanic rocks are penetrated by the greatest number of wells and yield the greatest amount of water to wells.

Aquifers in the study area are recharged primarily by infiltration of precipitation in mountains and foothills, and by losses from streams. Ground water-surface water relations are complex in the valley lowlands, primarily due to intermittent ground-water recharge to or discharge from flood-plain alluvium and sedimentary aquifers. Additional recharge occurs primarily as seepage losses from surface-water sources and infiltration of applied irrigation water. Ground water in the Lemhi, Pahsimeroi, and Salmon River basins flows generally northwestward. Ground water in the Big Lost River and Little Lost River basins flows generally southeastward.

Yields from wells range from 1 to about 4,000 gal/min. Highest yields are from wells completed in flood-plain alluvium, sedimentary rocks, and well-jointed basalts. Lowest yields are from wells completed in consolidated sedimentary rocks, nonjointed volcanic rocks, granitic rocks, or rocks of the basement complex. Well yields are adequate for most uses in the study area but may be increased in some wells by pump system or well design improvements.

Ground-water quality is generally acceptable for most uses. Concentrations of hardness, nitrate, coliform bacteria, dissolved solids, dissolved sulfate, chloride, fluoride, iron, calcium, magnesium, sodium, potassium, or bicarbonate exceed maximum EPA public drinking water limits or were anomalously high in some water samples. Concentrations of total coliform bacteria that exceeded EPA public drinking water limits were present in some older wells in heavily irrigated or densely populated areas of the valleys. Fecal coliform bacteria were not a widespread ground-water contamination problem in 1978. Highly mineralized water in the study area is probably due to increased abundance of soluble minerals in the aquifer, rather than an indication of contamination from man's activities.

Major agricultural uses of ground water in the study area are for livestock and irrigation. Concentrations of chemical constituents generally were within tolerance levels for most livestock. Most ground water has a medium salinity hazard and a low sodium hazard for irrigation use. Some highly mineralized water may limit irrigation use for crops with low salt tolerance in areas where alkali soil formation is not a problem.

Chemical composition of ground water in all valleys is generally characterized by calcium, magnesium, and bicarbonate plus carbonate ions. Variations in composition are primarily due to aquifer lithology and proximity of sampling site to source of recharge.

In the Lemhi Valley, nearly half the analyses show high percentages of sodium plus potassium or sulfate, or both. Areally, ground water becomes progressively more mineralized downstream from Leadore. Sand and gravel stringers in organic-rich clay beds of the sedimentary aquifer yield the most highly mineralized ground water. The least mineralized water is obtained from flood-plain alluvium, where ground water has a limited contact time with aquifer materials, and sample location is close to aquifer recharge source.

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CONVERSION FACTORS

Multiply inch-pound unit	By	To obtain SI unit
	Length	
inch (in.)	25.40	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
acre	4047	square meter
square mile (mi^2)	2.590	square kilometer
	Flow	
gallon per minute (gal/min)	0.06309	liter per second

Temperature

Conversion of °C to °F is based on the equation, °F=(1.8)(°C)+32.