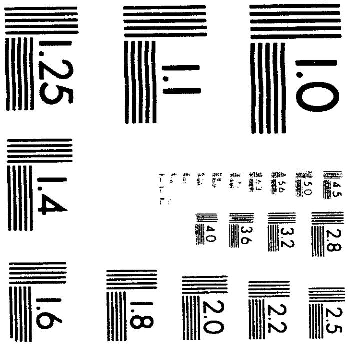
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Radionuclides, Inorganic Constituents, Organic Compounds, and Bacteria in Water From Selected Wells and Springs From the Southern Boundary of the Idaho National Engineering Laboratory to the Hagerman Area, Idaho, 1991

By Roy C. Bartholomay and Daniel D. Edwards, U.S. Geological Survey
and
Linford J. Campbell, Idaho Department of Water Resources

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Idaho Falls, Idaho
1993

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U.S. GEOLOGICAL SURVEY

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FIGURES

1 and 2: Maps showing:

TABLES

CONVERSION FACTORS AND ABBREVIATED UNITS

Multiply	By	To Obtain
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year
foot (ft)	0.3048	meter
gallon (gal)	3.785	liter
mile (mi)	1.609	kilometer
millirem per year (mrem/yr)	0.010	millisievert per year
picocurie per liter (pCi/L)	0.037	becquerel per liter
square mile (mi^2)	2.590	square kilometer

Temperature can be converted from degrees Celsius (°C) to degrees Fahrenheit (°F) by the equation: °F = (°C × 1.8) + 32

Abbreviated units used in report: gram (g); milliliter (mL); liter (L); microgram per liter (µg/L); milligram per liter (mg/L); micrometer (µm); and microsiemens per centimeter at 25 degrees celsius (µS/cm).

Radionuclides, Inorganic Constituents, Organic Compounds, and Bacteria in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering Laboratory to the Hagerman Area, Idaho, 1991

by **Roy C. Bartholomay** *and* **Daniel D. Edwards, U.S. Geological Survey**

Linford J. Campbell, Idaho Department of Water Resources

Abstract

The U.S. Geological Survey and the Idaho Department of Water Resources, in response to a request from the U.S. Department of Energy, sampled 18 sites as part of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering Laboratory to the Hagerman area. Water samples were collected and analyzed for manmade pollutants and naturally occurring constituents. The samples were collected from six irrigation wells, seven domestic wells, two springs, one stock well, one dairy well, and one observation well. Quality assurance samples also were collected and analyzed. The water samples were analyzed for selected radionuclides, inorganic constituents, organic compounds, and bacteria.

None of the samples analyzed for radionuclides, inorganic constituents, or organic compounds exceeded the established maximum contaminant levels for drinking water. Most of the radionuclide and inorganic constituent concentrations exceeded their respective reporting levels. All the samples analyzed for dissolved organic carbon had concentrations that exceeded their reporting level. Concentrations of 1,1,1-trichloroethane exceeded the reporting level in two water samples. Two samples and a quality assurance replicate contained reportable concentrations of 2, 4-D. One sample contained fecal coliform bacteria counts that exceeded established maximum contaminant levels for drinking water.

INTRODUCTION

Recently, the public has expressed much concern about waste disposal practices at the Idaho National Engineering Laboratory (INEL) and the impact these practices might have had on the water quality of the Snake River Plain aquifer. The U.S. Department of Energy requested that the U.S. Geological Survey (USGS) conduct two studies to respond to the public's concern and to gain a greater understanding of the chemical quality of water in the aquifer. The first study described a one-time sampling effort during May 1989 in the eastern part of the A & B Irrigation District in Minidoka County (Mann and Knobel, 1990). The second study, an ongoing annual sampling effort in the area between the southern boundary of the INEL and

Hagerman (fig. 1), is being conducted in cooperation with the Idaho Department of Water Resources. The initial round of sampling for the second study involved analyzing water samples collected from 55 sites during August and September 1989 (Wegner and Campbell, 1991). Water samples from 19 of the initial 55 sites were collected and analyzed during 1990 (Bartholomay and others, 1992). This report summarizes the analyses of water samples collected during August 1991 from 18 more of the initial 55 sites.

The INEL includes about 890 mi^2 of the northeastern part of the eastern Snake River Plain and is about 110 mi northeast of the Hagerman area (fig. 1). Wastewater containing chemical and radiochemical wastes generated at the INEL was discharged mostly to ponds and wells in the past. Since 1983, most aqueous wastes have been discharged to infiltration ponds. Many of the constituents in the wastewater enter the aquifer indirectly following percolation through the unsaturated zone (Pittman and others, 1988).

Chemical and radioactive wastes have migrated from less than 1 to about 9 mi southwest of the disposal areas at the INEL (Pittman and others, 1988). Tritium was detected at concentrations of less than the reporting level to 3,400±200 pCi/L in water from three wells along the southern boundary of the INEL between 1983 and 1985. Since April 1986, tritium concentrations in water from wells near the southern boundary of the INEL have been less than the Radiological and Environmental Sciences Laboratory (RESL) analytical method detection limit of 500 pCi/L (Mann and Cecil, 1990).

Water samples from 18 sites (fig. 2) were analyzed for selected radionuclides, trace elements, common ions, purgeable organic compounds, carbamate and organophosphorus insecticides, organochlorine insecticides, gross polychlorinated biphenyls (PCB's), gross polychlorinated naphthalenes (PCN's), triazine and chlorophenoxy-acid herbicides, surfactants, DOC (dissolved organic carbon), cyanide, and fecal coliform bacteria. In addition, one site sampled in 1990 was resampled for analysis of selected radionuclides by the USGS National Water Quality Laboratory (NWQL) at Arvada, Colo. The same site also was sampled for analysis of selected radionuclides and inorganic constituents by the Idaho State University (ISU) Environmental Monitoring Laboratory at Pocatello, Idaho, and the Idaho Department of Health and Welfare Laboratory (IDHWL) at Twin Falls and Boise, Idaho. Two replicate water samples and one equipment blank also were collected and analyzed as a measure of quality assurance.

Geohydrologic Setting

The eastern Snake River Plain is a northeast-trending structural basin about 200 mi long and 50 to 70 mi wide. The basin, bounded by faults on the northwest and downwarping and faulting on the southeast, has been filled with basaltic lava flows interbedded with terrestrial sediments (Whitehead, 1986). Individual basalt flows average 20 to 25 ft in thickness with an aggregate thickness of several thousand feet in places. Alluvial fan deposits are composed primarily of sand and gravel, whereas in areas where streams were dammed by basalt flows, the sediments are predominantly silt and clay (Garabedian, 1986). Rhyolitic lava flows and tuffs are exposed locally at the surface and may exist at depth under most of the eastern plain. A 10,365-ft-deep test hole at the INEL penetrated about 2,160 ft of basalt and sediment and 8,205 ft of tuffaceous and rhyolitic volcanic rocks (Mann, 1986).

Movement of water in the aquifer generally is from the northeast to the southwest. Water moves horizontally through basalt interflow zones and vertically through joints and interfingering edges of the interflow zones. Infiltration of surface water, heavy pumpage, geologic conditions, and seasonal fluxes in recharge and discharge locally affect the movement of ground water (Garabedian, 1986).

The Snake River Plain aquifer is recharged by seepage from the upper reaches of the Snake River, tributaries and canals, infiltration from irrigation and precipitation, and underflow from tributary valleys on the perimeter of the plain. Discharge from the aquifer primarily is by pumpage for irrigation and spring flow to the Snake River (Mann and Knobel, 1990). Between 1902 and 1980, spring flow to the Snake River

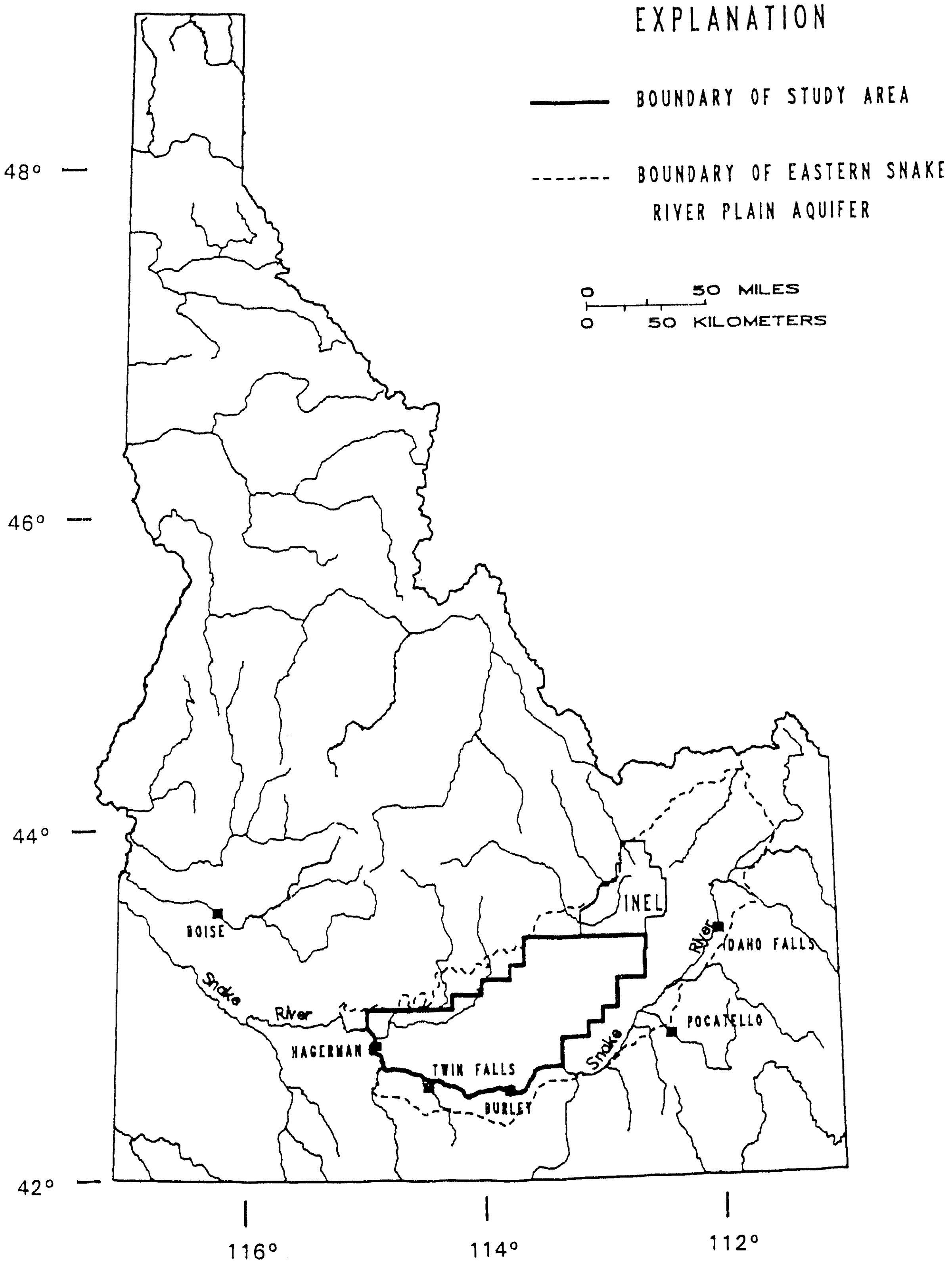

Figure 1.—Location of the study area between the Idaho National Engineering Laboratory and Hagerman, Idaho.

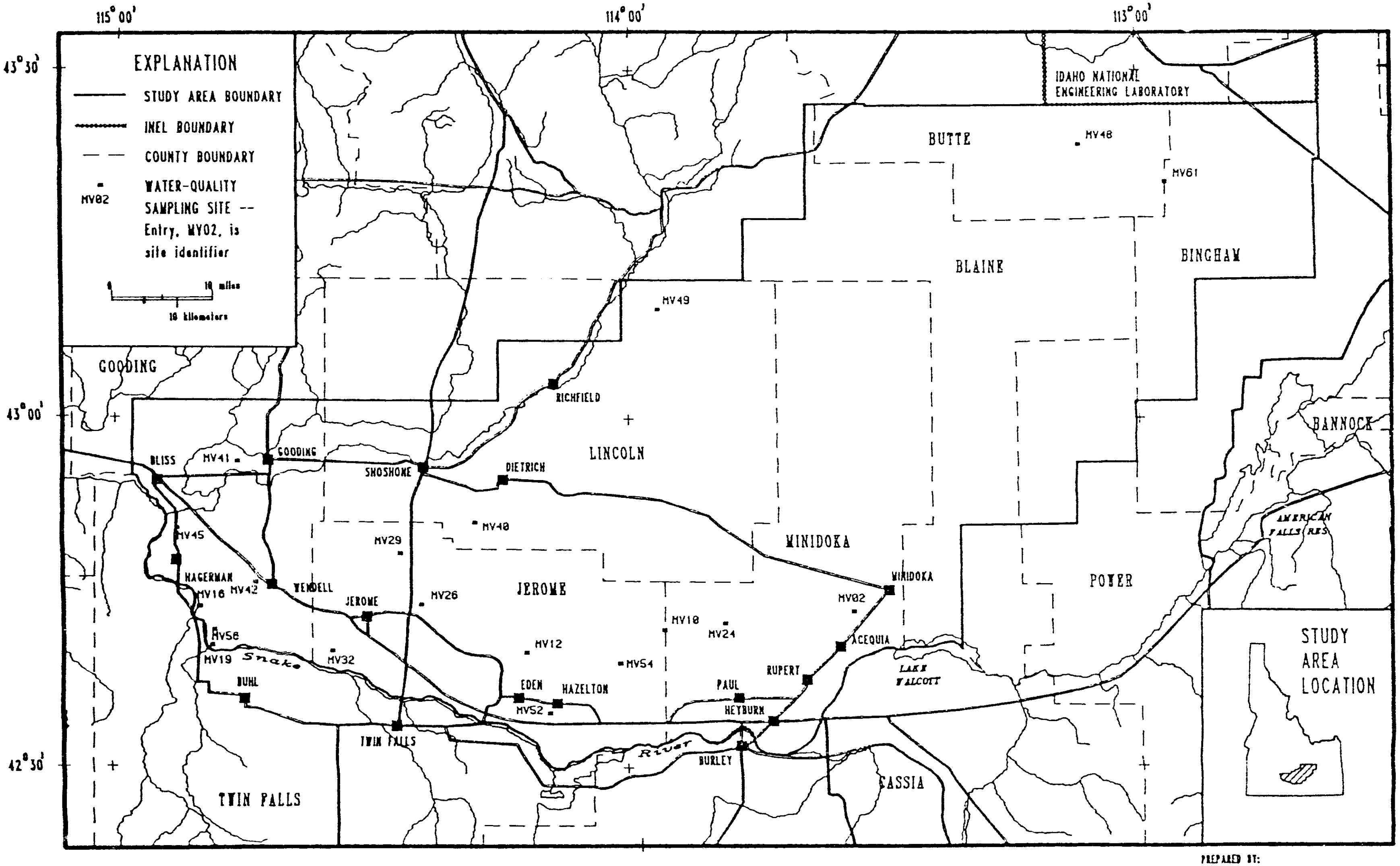

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Figure 2.—Location of selected water-quality sampling sites on the eastern Snake River Plain.

increased about 1.2 million acre-ft/yr, largely as a result of increased recharge from infiltration of irrigation water (Mann, 1989, p. 5).

Acknowledgments

The authors gratefully acknowledge the well owners for granting permission to collect the water samples and extend special thanks to Downy Strode of the Tikura Cattlemen's Association for his help in locating and pumping one of the wells for sample collection. Thanks are extended to the Idaho Image Analysis Facility, located at the Idaho Department of Water Resources, for assistance in preparing maps in this report. The authors are grateful for technical review of the manuscript by Robert Bobo of the Idaho Department of Health and Welfare, and Linda C. Davis of the USGS.

METHODS AND QUALITY ASSURANCE

The methodology used in sampling for selected chemicals generally followed the guidelines established by the USGS (Goerlitz and Brown, 1972; Stevens and others, 1975; Wood, 1981; Claassen, 1982; W.L. Bradford, USGS, written commun., 1985; Wershaw and others, 1987; and Fishman and Friedman, 1989). The methods used in the field and quality assurance practices are outlined in following sections.

Site Selection

Water samples were collected at 18 locations (fig. 2), including 6 irrigation wells, 7 domestic wells, 2 springs, 1 stock well, 1 dairy well, and 1 observation well. In addition, one observation well (MV-61) sampled in 1990 was resampled. Two replicate water samples and one equipment blank also were collected. The irrigation wells were equipped with turbine pumps. The domestic, stock, dairy, and observation wells were equipped with submersible pumps. Criteria for site selection were geographic location, ease of sample collection, and long-term access.

Sample Containers and Preservatives

Sample containers and preservatives differ depending on the constituent(s) for which analyses are requested. Samples analyzed by NWQL were collected and preserved in accordance with laboratory requirements specified by Pritt and Jones (1989). Water samples analyzed by ISU were collected in accordance with laboratory requirements specified by the director of the Environmental Monitoring Program at ISU. Water samples analyzed by IDHWL were collected in accordance with laboratory requirements specified by the director of the Bureau of Laboratories at IDHWL. Containers and preservatives were supplied by the respective laboratories. Containers and preservatives used for this study are listed on table 1.

Sample Collection

Irrigation wells were sampled from spigots in discharge lines near pumps; domestic, stock, and dairy wells were sampled from the closest available spigots to pumps; and observation wells were sampled at the well head. All the wells either were pumping on arrival of the sampling team or were started on arrival and, when possible, pumped long enough to ensure that pressure tanks and pumping systems had been thoroughly flushed as evidenced by stable pH, specific conductance, and temperature measurements. The two springs were sampled as near the source as possible by collecting a grab sample from an area of moving water.

Table 1.—*Containers and preservatives used for water-sample collection*

[Abbreviations: gal, gallon; g, gram; L, liter; mL, milliliter; µm, micrometer; °C, degrees Celsius; $HgCl_2$, mercuric chloride; NaCl, sodium chloride; HNO_3, nitric acid; $K_2Cr_2O_7$, potassium dichromate; NaOH, sodium hydroxide. Chilled samples were shipped by overnight-delivery mail. Analyzing laboratory: NWQL--U.S. Geological Survey's National Water Quality Laboratory; IDHWL—Idaho Department of Health and Welfare Laboratory; ISU—Idaho State University's Environmental Monitoring Laboratory]

Type of constituent	Container		Preservative		Other treatment	Laboratory providing analyses
	Type	Size	Type	Size		
Pesticides	Glass, baked	1 L	None	None	Chill 4°C	NWQL
Nutrients	Polyethylene, brown	250 mL	$HgCl_2$/ NaCl	1 mL	0.45 µm filter, chill 4°C	NWQL
Purgeable organic compounds	Glass, baked	40 mL	None	None	Chill 4°C	NWQL
	Glass, baked	40 mL	Ascorbic acid	0.05 g	Chill 4°C	IDHWL
Trace elements	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	0.45 µm filter	NWQL
	Polyethylene, acid-rinsed	1 L	HNO_3	5 mL	0.45 µm filter	IDHWL
	Polyethylene, acid-rinsed	1 L	HNO_3	5 mL	None	IDHWL
Mercury	Glass, acid-rinsed	250 mL	$K_2Cr_2O_7$/ HNO_3	10 mL	0.45 µm filter	NWQL
Tritium	Glass, baked	1 L	None	None	None	NWQL
	Polyethylene	500 mL	None	None	None	ISU
Radium	Polyethylene, acid-rinsed	1 L	HNO_3	4 mL	0.45 µm filter	NWQL
Radon-222	Glass vials	20 mL	Scintillation cocktail	10 mL	None	NWQL

Table 1.—*Containers and preservatives used for water-sample collection*--Continued

Type of constituent	Container		Preservative		Other treatment	Laboratory providing analyses
	Type	Size	Type	Size		
Strontium-90	Polyethylene, acid-rinsed	1 L	HNO_3	4 mL	0.45 µm filter	NWQL
	Polyethylene	1 gal	None	None	None	ISU
Uranium	Polyethylene, acid-rinsed	1 L	HNO_3	4 mL	0.45 µm filter	NWQL
Other radionuclides	Polyethylene, acid-rinsed	1 L	None	None	None	NWQL
	Polyethylene	1 gal	None	None	None	ISU
Bacteria	Polyethylene, autoclaved	250 mL	None	None	Chill 4°C	IDHWL
Dissolved organic carbon	Glass, baked	125 mL	None	None	Silver filter, chill 4°C	NWQL
Surfactants	Polyethylene	250 mL	None	None	Chill 4°C	NWQL
Cyanide	Polyethylene	250 mL	NaOH	5 mL	Chill 4°C	NWQL
Common ions	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	0.45 µm filter	NWQL
	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	None	NWQL
	Polyethylene	250 mL	None	None	0.45 µm filter	NWQL
	Polyethylene	250 mL	None	None	None	NWQL
	Polyethylene, acid-rinsed	1L	None	None	Chill 4°C	IDHWL

Chemical and physical characteristics monitored at the water-sampling sites included pH, specific conductance, temperature, alkalinity, and concentrations of dissolved oxygen. These characteristics were monitored during pumping using methods described by Wood (1981) and Hardy and others (1989). A water sample was collected when measurements of these properties indicated probable hydraulic and chemical stability. After collection, sample containers were sealed with laboratory film, labeled, and packed into ice chests for shipment by overnight-delivery mail to the NWQL. The samples collected for the IDHWL and ISU were stored in coolers until they were hand-delivered to the respective laboratories.

Measurements of pH, specific conductance, water temperature, alkalinity, and concentrations of dissolved oxygen are shown on table 2. Measured pH of water from sampling sites ranged from 7.5 to 8.1, which is within the U.S. Environmental Protection Agency's (1989) recommended range of 6.5 to 8.5 for community water systems. Specific conductance measurements ranged from 340 to 1,080 µS/cm. Measurements of temperature ranged from 11.5 to 16.5°C. The Idaho Department of Health and Welfare (IDHW, 1989) has established a secondary maximum contaminant level of 26.6°C for temperature. All the temperature measurements were below this level. Alkalinity as calcium carbonate ranged from 126 to 286 mg/L. Concentrations of dissolved oxygen ranged from 6.8 to 9.8 mg/L.

Conditions at the sampling site during sample collection were recorded in a field logbook; a chain-of-custody record was used to track the samples from the time of collection until delivery to the analyzing laboratory. These records are available for inspection at the USGS Project Office at the INEL.

Quality Assurance

Detailed descriptions of internal quality control and overall quality assurance practices used by the NWQL are provided in reports by Friedman and Erdmann (1982) and Jones (1987). Water samples analyzed by NWQL were collected in accordance with a quality assurance plan for quality of water activities conducted by personnel assigned to the INEL Project Office; the plan was finalized in June 1989, and is available for inspection at the USGS Project Office at the INEL. Water samples analyzed by IDHWL were collected in accordance with procedures described by W. Baker, J. Dodds, and B. Ellis (IDHW, written communs., 1991). Water samples analyzed by ISU were collected in accordance with procedures described by B. Graham (ISU, written commun., 1991). Ten percent of the water samples were quality assurance samples. Sample MV-28 is a replicate of sample MV-24. Sample MV-34 is a replicate of sample MV-40. Sample MV-61 is a resample for selected radionuclides. Sample MV-62 is an equipment blank analyzed for purgeable organic compounds and selected dissolved trace elements. Sample MV-62 contained 0.22 µg/L of chloroform. Because none of the other samples contained reportable concentrations of chloroform, the blank water may have been contaminated.

RADIONUCLIDES

Water samples were analyzed for radon-222, strontium-90, tritium, gross alpha- and gross beta-particle radioactivity, total uranium, radium-226, and radium-228. In addition, gamma-emitting radionuclides were identified. The samples were analyzed using methods described by Thatcher and others (1977) and U.S. Environmental Protection Agency (1987). Maximum contaminant levels for the types of radioactivity and for selected radionuclides are listed on table 3.

An analytical uncertainty, s, is calculated for each radionuclide concentration. This report presents the analytical uncertainty as 2s. Guidelines for interpreting analytical results are based on an extension of the method described by Currie (1984). In radiochemical analyses, laboratory measurements are made on a target sample and a prepared blank. Instrument signals for the sample and blank vary randomly. Therefore, it is

Table 2.—*Results of field measurements of water for pH, specific conductance, temperature, alkalinity, and concentrations of dissolved oxygen from selected wells and springs, eastern Snake River Plain*

[Site identifier: see figure 2 for location of sites. Site use: H--domestic; I--irrigation; D--dairy; Sp--spring; QA--quality assurance (see Quality Assurance section in text for explanation); O--observation; S--stock. Date sampled: month/day/year. pH: negative base-10 logarithm of hydrogen ion activity, in moles per liter. Specific conductance: microsiemens per centimeter at 25°C (degrees Celsius). Temperature: °C. Alkalinity: mg/L as calcium carbonate. Dissolved oxygen: mg/L using Azide modification of Winkler method (American Public Health Association and Water Pollution Control Federation, 1985). -- indicates no analysis was performed]

Site identifier	Site use	Date sampled	pH	Specific conductance	Temperature	Alkalinity	Dissolved oxygen
MV-02	H	08/12/91	7.9	580	14.5	171	6.8
MV-10	I	08/12/91	7.8	800	14.0	200	8.1
MV-12	D	08/14/91	7.9	715	15.0	181	9.0
MV-16	Sp	08/13/91	7.9	410	15.0	148	8.6
MV-19	Sp	08/15/91	8.0	498	15.0	157	9.0
MV-24	H	08/12/91	7.7	1,080	15.0	271	7.6
MV-26	I	08/16/91	8.0	466	14.0	142	9.1
MV-28	QA	08/12/91	7.7	1,080	15.0	271	7.6
MV-29	I	08/14/91	8.1	345	14.5	126	8.8
MV-32	H	08/15/91	7.8	720	15.5	230	7.9
MV-34	QA	08/15/91	8.0	340	14.5	136	8.2
MV-40	I	08/15/91	8.0	340	14.5	136	8.2
MV-41	I	08/13/91	7.5	780	14.5	286	7.9
MV-42	H	08/13/91	7.8	465	16.5	175	8.3
MV-45	I	08/13/91	8.0	380	16.0	154	8.2
MV-48	O	08/21/91	8.1	365	13.0	146	8.0
MV-49	S	08/21/91	7.6	388	11.5	185	9.8
MV-52	H	08/14/91	7.8	630	16.5	220	8.7
MV-54	H	08/14/91	7.8	842	15.0	226	9.0
MV-56	H	08/16/91	7.9	414	15.0	140	8.3
MV-61	O	08/21/91	8.1	384	15.5	--	--

Table 3.—*Maximum contaminant levels for types of radioactivity and selected radionuclides in drinking water*

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989, p. 550) for community water systems and are for comparison purposes only. The proposed maximum contaminant level—in parentheses—are from U.S. Environmental Protection Agency (1991). The maximum contaminant level given for gross alpha-particle radioactivity includes radium-226 but excludes radon and uranium. The maximum contaminant level given for gross beta-particle radioactivity excludes radioactivity from natural sources and is included for comparison purposes only. Maximum contaminant level values listed for strontium-90 and tritium are average annual concentrations assumed to produce a total body or organ dose of 4 mrem/yr (millirem per year) of beta-particle radiation. Abbreviations: pCi/L--picocurie per liter, µg/L--microgram per liter]

Type of radioactivity or radionuclide	Maximum contaminant level
Gross alpha-particle radioactivity	15 pCi/L
Gross beta-particle and gamma radioactivity	4 mrem/yr
Radium-226 plus radium-228	5 pCi/L
Radium-226	(20 pCi/L)
Radium-228	(20 pCi/L)
Radon-222	(300 pCi/L)
Strontium-90	8 pCi/L
Total uranium	(20 µg/L)
Tritium	20,000 pCi/L

essential to distinguish between two key aspects of the problem of detection: (1) The instrument signal for the sample must be greater than the signal for the blank to make the decision that there was detection; and (2) an estimation must be made of the minimum concentration that will yield a sufficiently large signal to make the correct decision for detection or nondetection most of the time. The first aspect of the problem is a qualitative decision based on signals and a definite criterion for detection. The second aspect of the problem is an estimation of the detection capabilities of a complete measurement process that includes hypothesis testing.

In the laboratory, instrument signals must exceed a critical level to make the qualitative decision whether the radionuclide or radioactivity was detected. Concentrations that equal 1.6s meet this criterion; at 1.6s, there is about a 95-percent probability that the correct decision—not detected—will be made. Given a large number of samples, as many as 5 percent of the samples with measured concentrations greater than or equal to 1.6s, which were concluded as being detected, might not contain the radioactive constituent. These measurements are referred to as false positives and are errors of the first kind in hypothesis testing.

Once the critical level of 1.6s has been defined, the minimum detectable concentration can be established. Concentrations that equal 3s represent a measurement at the minimum detectable concentration. For true concentrations of 3s or greater, there is a 95-percent-or-more probability of correctly concluding that the radioactive constituent was detected in a sample. Given a large number of samples, as many as 5 percent of the samples with measured concentrations greater than or equal to 3s, which were concluded as being not detected, could contain the radioactive constituent at the minimum detectable concentration. These measurements are referred to as false negatives and are errors of the second kind in hypothesis testing.

True radionuclide concentrations between 1.6s and 3s have larger errors of the second kind. That is, there is a greater-than-5-percent probability of false negative results for samples with true concentrations between 1.6s and 3s, and although the radionuclide or radioactivity might have been detected, such detection may not be considered reliable; at 1.6s, the probability of a false negative is about 50 percent.

These guidelines are based on counting statistics alone and do not include systematic or random errors inherent in laboratory procedures. The values 1.6s and 3s vary slightly with background or blank counts and with the number of gross counts for individual analyses. The use of the critical level and minimum detectable concentration aids the reader in the interpretation of analytical results and does not represent absolute concentrations of radioactivity that may or may not have been detected. In this report, if the concentration of a selected radionuclide was equal to or greater than 3s, the concentration is considered to be above a "reporting level." The reporting level should not be confused with the analytical method detection limit, which is based on laboratory procedures. At small concentrations, the reporting level approaches the analytical method detection limit; however, at larger concentrations, they may be significantly different.

Radon-222

Radon-222 is a naturally occurring radioactive gas that results from the decay of radium-226. Concentrations of radon-222 in 10 water samples analyzed by NWQL exceeded the reporting level and ranged from 66±29 to 152±34 pCi/L (table 4). Concentrations in all the samples were below the proposed maximum contaminant level of 300 pCi/L (table 3).

Strontium-90

Strontium-90 is a fission product that was widely distributed in the environment during atmospheric weapons tests. Strontium-90 generally is present in ground water as a result of these tests and from nuclear industry waste-disposal practices. All water samples analyzed by NWQL contained dissolved strontium-90

Table 4.—*Concentrations of radon-222, strontium-90, and tritium in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and Idaho State University's (ISU) Environmental Monitoring Laboratory using the following methods: radon-222 by liquid scintillation; tritium by enrichment and gas counting at NWQL and by liquid scintillation at ISU; strontium-90 by chemical separation and precipitation. Analytical results and uncertainties—for example, 79±46—in pCi/L (picocurie per liter). Analytical uncertainties are reported as 2s. Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40); -- indicates no analysis was performed]

Site identifier	Radon-222 NWQL	Strontium-90 NWQL	Strontium-90 ISU	Tritium NWQL	Tritium ISU
MV-02	79±46	0.106±0.217	-3.6±2.0	37.4±2.56	150±220
MV-10	70±31	.090±0.192	-3.4±1.0	48.3±3.20	150±220
MV-12	42±47	.007±0.190	0±0.6	39.7±2.56	70±200
MV-16	106±34	.093±0.220	-.8±0.4	13.6±0.90	60±200
MV-19	45±36	.040±0.207	-3.3±1.0	15.4±0.77	40±200
MV-24	43±31	.055±0.195	0±0.2	82.6±5.76	230±220
MV-26	15±34	.024±0.200	-4.0±1.2	9.5±0.77	10±200
MV-28*	81±32	.210±0.233	-2.7±1.0	90.6±5.76	90±220
MV-29	107±41	.091±0.214	-.3±0.6	3.81±0.58	180±220
MV-32	15±41	.120±0.223	.8±0.6	73.6±5.12	240±220
MV-34*	137±37	.060±0.238	--	14.2±0.96	--
MV-40	56±42	.022±0.196	-.4±0.6	13.7±0.90	80±200
MV-41	26±26	.062±0.213	.5±1.0	70.4±4.48	200±220
MV-42	152±34	.188±0.222	0±0.8	29.8±1.98	120±200
MV-45	124±26	.104±0.200	-.3±0.6	22.6±1.47	100±220
MV-48	138±61	.120±0.363	.1±0.6	29.2±1.92	250±220
MV-49	82±62	-.085±0.199	-4.3±1.4	85.4±5.76	240±220
MV-52	66±29	.052±0.216	-.4±0.6	78.1±5.12	220±220
MV-54	43±31	.155±0.238	-.6±0.8	85.4±5.76	40±200
MV-56	31±35	.162±0.225	1.0±0.8	9.76±0.64	140±220
MV-61	--	.076±0.133	-2.3±0.8	--	140±220

concentrations less than the reporting level (table 4). All the samples analyzed by ISU contained total strontium-90 concentrations less than the reporting level.

In 1989, MV-61 had a strontium-90 concentration (2.93±0.40 pCi/L) greater than the reporting level, whereas a quality assurance replicate sample (MV-60) had a concentration (0.06±0.18 pCi/L) less than the reporting level (Wegner and Campbell, 1991). To clarify these results, MV-61 was sampled in 1990 (Bartholomay and others, 1992) and was resampled in 1991. Both of these later samples contained strontium-90 concentrations less than the reporting level.

Tritium

Tritium, a radioactive isotope of hydrogen, is formed in nature by interactions of cosmic rays with gases in the upper atmosphere. Tritium also is produced in thermonuclear detonations and is a waste product of the nuclear power industry. Samples were submitted to the NWQL and the ISU laboratory. The NWQL used an enrichment and gas-counting technique and the ISU laboratory used a liquid scintillation technique. The analytical method detection limit for the laboratories differed. The analytical method detection limit for the ISU laboratory was 300 pCi/L using a 200-minute counting period, and that for the NWQL was 0.3 pCi/L using a 360- to 1,200-minute counting period.

The concentrations of tritium in the water samples are shown on table 4. All the water samples analyzed by NWQL contained concentrations of tritium larger than the reporting level; concentrations ranged from 3.81±0.58 to 90.6±5.76 pCi/L. Tritium concentrations in all water samples analyzed by the ISU laboratory were below the reporting level. For the purpose of comparison, background concentrations of tritium in ground water in Idaho generally range from 75 to 150 pCi/L (Orr and others, 1991). The maximum contaminant level for tritium in public drinking-water supplies is 20,000 pCi/L (table 3).

Gross Alpha-Particle Radioactivity

Gross alpha-particle radioactivity is a measure of the total radioactivity given off as alpha particles during the radioactive decay process; however, laboratories normally report the radioactivity as if it were all given off by one radionuclide. In this report, concentrations are reported both as natural uranium in micrograms per liter and as thorium-230 in picocuries per liter by the NWQL, and as americium-241 in picocuries per liter by the ISU laboratory.

The gross alpha-particle radioactivity in the dissolved fraction of all the water samples analyzed by NWQL exceeded the reporting level (table 5). The concentrations reported as uranium ranged from 1.70±0.840 to 7.65±1.69 µg/L. The concentrations reported as thorium-230 ranged from 1.19±0.588 to 5.24±1.15 pCi/L. Gross alpha-particle radioactivity in the suspended fraction of all the water samples analyzed by NWQL were less than the reporting level. Gross alpha-particle radioactivity reported as total americium-241 in all the water samples analyzed by ISU were less than the reporting level. Total concentrations of dissolved and suspended fractions of gross alpha-particle radioactivity in all the water samples were less than the maximum contaminant level of 15 pCi/L (table 3).

Gross Beta-Particle Radioactivity

Gross beta-particle radioactivity is a measure of the total radioactivity given off as beta particles during the radioactive decay process. Laboratory instruments for these measurements are calibrated to a single radionuclide, cesium-137, or a chemically similar pair of radionuclides in equilibrium, strontium-90 in equilibrium with yttrium-90. In this report, concentrations are reported as strontium-90 in equilibrium with

Table 5.—*Concentrations of gross alpha-particle radioactivity in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho State University's (ISU) Environmental Monitoring Laboratory using a residue procedure. Analytical results and uncertainties—for example, 1.70±0.840—in indicated units. Analytical uncertainties are reported as 2s. Site identifier: see figure 2 for location of sites. Abbreviations: µg/L--microgram per liter; pCi/L--picocurie per liter. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40). -- indicates no analysis was performed]

Site identifier	Dissolved as uranium NWQL (µg/L)	Dissolved as thorium-230 NWQL (pCi/L)	Suspended as uranium NWQL (µg/L)	Suspended as thorium-230 NWQL (pCi/L)	Total as americium-241 ISU (pCi/L)
MV-02	1.70±0.840	1.19±0.588	-0.291±0.308	-0.162±0.180	-1.5±1.8
MV-10	4.84±1.38	3.35±0.970	-.198±0.362	-.105±0.197	.1±2.8
MV-12	3.29±1.13	2.28±0.790	-.009±0.440	-.005±0.247	.1±2.8
MV-16	2.82±1.04	1.95±0.727	-.025±0.269	-.017±0.184	-1.1±1.4
MV-19	3.39±1.12	2.36±0.776	-.009±0.444	-.005±0.250	-1.4±1.4
MV-24	4.86±1.38	3.53±1.00	-.121±0.235	-.066±0.130	-2.4±3.0
MV-26	2.23±0.914	1.59±0.654	-.109±0.155	-.063±0.093	-1.7±1.4
MV-28*	5.28±1.46	3.69±1.03	-.120±0.232	-.063±0.124	-4.2±3.2
MV-29	2.15±0.913	1.55±0.660	.356±0.608	.207±0.356	-.2±1.6
MV-32	5.30±1.47	3.75±1.05	.358±0.455	.268±0.344	.1±2.8
MV-34*	2.38±0.982	1.66±0.689	-.117±0.228	-.065±0.128	--
MV-40	2.34±0.987	1.63±0.691	-.230±0.281	-.130±0.166	1.4±1.8
MV-41	7.65±1.69	5.24±1.15	.082±0.472	.048±0.273	-.7±2.6
MV-42	4.58±1.32	3.18±0.928	.029±0.514	.015±0.272	1.8±1.4
MV-45	1.87±0.797	1.27±0.541	-.057±0.435	-.030±0.232	-1.1±1.2
MV-48	2.79±1.03	1.95±0.719	-.140±0.340	-.076±0.187	-1.2±1.2
MV-49	2.27±0.911	1.56±0.633	.146±0.367	.101±0.258	0±1.2
MV-52	5.67±1.45	4.00±1.02	-.183±0.307	-.105±0.181	.6±2.4
MV-54	3.39±1.19	2.38±0.835	.062±0.337	.039±0.210	.5±3.2
MV-56	2.12±0.942	1.48±0.658	-.280±0.297	-.156±0.171	-.2±1.6
MV-61	4.15±1.27	2.88±0.890	.084±0.255	.045±0.139	0±1.6

yttrium-90 in picocuries per liter, and as cesium-137 in picocuries per liter. Reporting of the concentrations of gross beta-particle radioactivity in either one of these ways is for reference purposes only and does not imply that the radioactivity is attributed to these specific isotopes. The average annual concentrations of strontium-90 and cesium-137 in public drinking-water supplies that produce a 4-mrem/yr dose are 8 pCi/L and 120 pCi/L, respectively. Gross beta-particle radioactivity measurements should not be compared directly to these concentrations.

Gross beta-particle radioactivity was measured in both the dissolved and suspended fractions of the water samples analyzed by NWQL. Dissolved concentrations of gross beta-particle radioactivity reported as cesium-137 and as strontium-90 in equilibrium with yttrium-90 in 20 of the 21 water samples analyzed by NWQL exceeded the reporting levels (table 6); concentrations ranged from 2.53±0.873 to 11.9±2.86 pCi/L, and 1.93±0.666 to 8.91±2.14 pCi/L, respectively. Suspended concentrations of gross beta-particle radioactivity reported as cesium-137 and as strontium-90 in equilibrium with yttrium-90 in water samples analyzed by NWQL from two sites exceeded the reporting level. Concentrations of cesium-137 and strontium-90 in equilibrium with yttrium-90 were 1.16±0.625 and 1.11±0.597 pCi/L, respectively, for MV-32 and 0.872±0.549 and 0.823±0.518, respectively, for MV-48. Total concentrations of gross beta-particle radioactivity reported as cesium-137 in five water samples analyzed by ISU exceeded the reporting levels (table 6); concentrations ranged from 7.2±4.2 to 10.4±5.0 pCi/L.

Total Uranium

Uranium is a widely distributed element that has three naturally occurring radioactive isotopes: uranium-238, uranium-235, and uranium-234. These isotopes undergo a complex series of radioactive decay that results in their ultimate conversion to stable isotopes of lead (Haglund, 1972). Total uranium is a measurement of the combined concentrations of these three isotopes. Dissolved total uranium concentrations in all water samples analyzed by NWQL exceeded the reporting levels (table 7); concentrations ranged from 1.39±0.209 to 6.37±0.955 µg/L. The proposed maximum contaminant level for total uranium is 20 µg/L (table 3).

Radium

Radium-224 and radium-228 are naturally occurring radioactive decay products of thorium-232; radium-226 is a naturally occurring decay product of uranium-238. Radium-224 was not detected in any of the water samples. Concentrations of radium-226 exceeded the reporting level in all the water samples analyzed by NWQL; concentrations ranged from 0.018±0.011 to 0.062±0.015 pCi/L (table 7). Concentrations of radium-228 in all the water samples analyzed by NWQL were less than the reporting level. The sum of radium-226 and radium-228 concentrations in all the water samples was less than the maximum contaminant level of 5 pCi/L (table 3).

Cesium-137, Lead-212, Lead-214, Bismuth-214, and Potassium-40

Gamma spectrometry involves using a series of detectors to simultaneously determine the concentrations of a variety of radionuclides by the identification of their characteristic gamma emissions. Total and suspended fractions of cesium-137 and suspended fractions of lead-212, lead-214, bismuth-214, and potassium-40 were identified in water samples. The NWQL reported the radionuclides as suspended fractions, whereas ISU reported them as total.

Table 6.—*Concentrations of gross beta-particle radioactivity in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho State University's (ISU) Environmental Monitoring Laboratory using a residue procedure. Analytical results and uncertainties—for example, 7.57±2.01—in picocuries per liter. Analytical uncertainties are reported as 2s. Site identifier: see figure 2 for location of sites. Abbreviations: Sr-90/Y-90--strontium-90 in equilibrium with yttrium-90. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40). -- indicates no analysis was performed]

Site identifier	Dissolved as cesium-137 NWQL	Dissolved as Sr-90/Y-90 NWQL	Suspended as cesium-137 NWQL	Suspended as Sr-90/Y-90 NWQL	Total as cesium-137 ISU
MV-02	7.57±2.01	5.43±1.22	-0.248±0.487	-0.241±0.474	5.8±4.4
MV-10	9.67±2.23	7.25±1.67	.163±0.481	.154±0.454	4.7±4.4
MV-12	7.43±1.78	5.68±1.36	.341±0.476	.321±0.449	8.7±4.6
MV-16	3.99±1.27	2.88±0.793	.375±0.487	.362±0.470	7.2±4.2
MV-19	4.70±1.40	3.41±1.39	.224±0.463	.216±0.448	7.6±4.4
MV-24	10.6±2.59	8.10±1.98	.553±0.508	.529±0.486	10.4±5.0
MV-26	5.40±1.26	4.10±0.958	.136±0.444	.129±0.419	.8±4.2
MV-28*	11.9±2.86	8.91±2.14	.059±0.468	.057±0.456	4.1±5.0
MV-29	3.96±1.20	2.95±1.08	.392±0.483	.370±0.456	-1.2±4.2
MV-32	8.15±1.91	6.10±1.43	1.16±0.625	1.11±0.597	5.1±4.6
MV-34*	4.36±1.25	3.22±0.795	-.182±0.496	-.177±0.482	--
MV-40	4.11±1.19	3.02±0.756	.207±0.460	.200±0.446	-.5±4.0
MV-41	7.33±1.89	5.48±1.41	.507±0.539	.485±0.516	4.5±4.6
MV-42	.710±0.576	.536±0.427	.225±0.500	.216±0.478	1.6±4.2
MV-45	4.45±1.30	3.26±1.26	.147±0.466	.142±0.451	7.7±4.2
MV-48	3.07±0.917	2.39±0.714	.872±0.549	.823±0.518	5.0±4.2
MV-49	2.53±0.873	1.93±0.666	.278±0.492	.270±0.478	4.4±4.2
MV-52	8.93±1.88	6.75±1.42	-.443±0.462	-.431±0.449	4.5±4.4
MV-54	9.19±2.12	6.99±1.62	.375±0.481	.354±0.454	5.7±4.8
MV-56	4.73±1.32	3.40±0.816	.340±0.480	.329±0.465	.3±4.2
MV-61	2.99±0.944	2.29±0.722	.840±0.570	.814±0.552	5.3±4.2

Table 7.--Concentrations of total uranium and selected radium isotopes in water from selected wells and springs, eastern Snake River Plain

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using the following methods: total uranium by extraction and laser-induced phosphorimetry; radium-226 by radon emanation; and radium-228 by separation and beta counting. Analytical results and uncertainties—for example, 1.68±0.252—in indicated units. Analytical uncertainties are reported as 2s. Site identifier: see figure 2 for location of sites. Abbreviations: µg/L--microgram per liter; pCi/L--picocurie per liter. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40)]

Site identifier	Total uranium (µg/L)	Radium-226 (pCi/L)	Radium-228 (pCi/L)
MV-02	1.68±0.252	0.033±0.009	0.153±0.429
MV-10	1.59±0.239	.036±0.011	.211±0.318
MV-12	2.57±0.385	.036±0.014	.424±0.356
MV-16	1.56±0.243	.024±0.008	.118±0.341
MV-19	2.11±0.317	.028±0.008	.173±0.286
MV-24	3.35±0.503	.030±0.009	.600±0.574
MV-26	1.64±0.245	.033±0.010	.208±0.324
MV-28*	3.31±0.497	.032±0.012	.113±0.337
MV-29	1.48±0.222	.028±0.014	.182±0.451
MV-32	3.16±0.473	.021±0.007	.401±0.356
MV-34*	1.59±0.239	.028±0.011	.265±0.304
MV-40	1.48±0.221	.027±0.011	.213±0.312
MV-41	6.37±0.955	.062±0.015	.176±0.345
MV-42	1.39±0.209	.031±0.012	.195±0.348
MV-45	1.67±0.250	.018±0.011	.336±0.377
MV-48	1.66±0.249	.032±0.009	.372±0.347
MV-49	1.68±0.252	.030±0.008	.110±0.366
MV-52	3.41±0.512	.039±0.015	.451±0.401
MV-54	2.85±0.428	.035±0.010	.096±0.396
MV-56	1.55±0.232	.030±0.009	.261±0.305
MV-61	2.11±0.317	.039±0.010	.220±0.326

Cesium-137 is a fission product of uranium-235, uranium-233, or plutonium-239. None of the samples analyzed by NWQL had concentrations of cesium-137 that exceeded the reporting level (table 8). One sample analyzed by ISU had a concentration equal to the reporting level. MV-28, a quality assurance replicate of MV-24, had a concentration of 3±2 pCi/L.

Lead-212 is a decay product of radium-224 in the thorium-232 decay series. Lead-212 was identified in four water samples; three samples had concentrations greater than the reporting levels and ranged from 0.227±0.133 to 0.259±0.1125 pCi/L (table 8).

Lead-214 is an intermediate isotope in the uranium-238 decay series. Lead-214 was identified in one water sample, MV-32, at a concentration less than the reporting level (table 8).

Bismuth-214 is a naturally occurring member of the uranium-238 decay series. Bismuth-214 was identified in the sample from MV-26 at a concentration of 0.461±0.235 pCi/L, which exceeded the reporting level.

Potassium makes up approximately 2.6 percent of the Earth's continental crust, and about 0.0119 percent of all potassium is the naturally occurring radioactive isotope potassium-40 (Kretz, 1972). Potassium-40 was identified in eight water samples; four samples had concentrations greater than the reporting levels and ranged from 5.05±1.45 to 7.382±3.157 pCi/L (table 8).

INORGANIC CONSTITUENTS

Water samples were analyzed for selected inorganic constituents. These constituents included trace elements, common ions, nutrients, and cyanide. In this report, reporting levels established for these constituents are not to be confused with reporting levels and analytical method detection limits for selected radionuclides. The reporting level for inorganic constituents is the lowest measured concentration of a constituent that may be reliably reported using a given analytical method (Pritt and Jones, 1989).

Trace Elements

Water samples were collected and analyzed by NWQL and IDHWL for selected dissolved trace elements including aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, vanadium, and zinc. Water samples also were analyzed for total and hexavalent chromium by NWQL, and total arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, and silver by IDHWL. Maximum contaminant levels and reporting levels for the trace elements are shown on table 9.Concentrations of dissolved trace elements are shown on table 10, and concentrations of total trace elements are shown on table 11.

Aluminum.—Concentrations in 10 samples analyzed by NWQL were equal to or greater than the reporting level and ranged from 10 to 40 µg/L. The proposed secondary maximum contaminant level is 50 µg/L.

Arsenic.—Concentrations of dissolved arsenic in all samples analyzed by NWQL were equal to or greater than the reporting level and ranged from 1 to 5 µg/L. Concentrations of dissolved and total arsenic in all samples analyzed by IDHWL were less than the reporting level of 10 µg/L. The maximum contaminant level is 50 µg/L.

Barium.—Concentrations of dissolved barium in all samples except MV-42 analyzed by NWQL were greater than the reporting level and ranged from 18 to 150 µg/L. Concentrations of dissolved and total barium

Table 8.—*Concentrations of cesium-137, lead-212, lead-214, bismuth-214, and potassium-40 in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho State University's (ISU) Environmental Monitoring Laboratory using gamma spectrometry. Analytical results and uncertainties from NWQL—for example, 0.038±0.101—are for suspended concentrations in pCi/L (picocuries per liter). Analytical results and uncertainties from ISU are for total concentrations in pCi/L. Analytical uncertainties are reported as 2s. Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40); •• indicates that the radionuclide was not detected in that sample; -- indicates no analysis available]

Site identifier	Cesium-137 NWQL	Cesium-137 ISU	Lead-212 NWQL	Lead-214 NWQL	Bismuth-214 NWQL	Potassium-40 NWQL
MV-02	0.038±0.101	1±2	••	••	••	••
MV-10	.065±0.082	0±2	••	••	••	••
MV-12	-.050±0.092	0±2	••	••	••	••
MV-16	-.008±0.089	2±2	0.259±0.1125	••	••	••
MV-19	-.066±0.114	2±2	.257±0.153	••	••	5.721±3.124
MV-24	.057±0.115	1±2	.227±0.133	••	••	••
MV-26	-.027±0.118	1±2	••	••	0.461±0.235	7.291±3.131
MV-28*	-.039±0.096	3±2	••	••	••	••
MV-29	.020±0.114	2±2	.203±0.140	••	••	••
MV-32	.021±0.093	1±2	••	0.300±0.251	••	••
MV-34*	-.063±0.094	--	••	••	••	••
MV-40	.014±0.097	1±2	••	••	••	3.271±2.471
MV-41	.006±0.088	0±2	••	••	••	••
MV-42	-.012±0.092	0±2	••	••	••	3.142±2.514
MV-45	-.121±0.116	1±2	••	••	••	••
MV-48	-.02±0.08	2±2	••	••	••	5.05±1.45
MV-49	-.010±0.085	0±2	••	••	••	••
MV-52	-.021±0.094	2±2	••	••	••	3.715±2.674
MV-54	.050±0.092	1±2	••	••	••	••
MV-56	0±0.115	0±2	••	••	••	7.382±3.157
MV-61	-.036±0.097	1±2	••	••	••	1.28±2.11

Table 9.—*Maximum contaminant levels and reporting levels of selected trace elements in drinking water*

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989, p. 547) for community water systems and are included for comparison purposes only. Proposed maximum contaminant levels—shown in parentheses—are from U.S. Environmental Protection Agency (1990a). Proposed secondary and secondary maximum contaminant levels—shown in brackets—are from U.S. Environmental Protection Agency (1990a). -- indicates that a maximum contaminant level has not been established for that chemical constituent; •• indicates analysis not requested. Units are in µg/L (microgram per liter). Reporting levels for the U.S. Geological Survey's National Water Quality Laboratory (NWQL) are from Pritt and Jones (1989). Reporting levels for the Idaho Department of Health and Welfare Laboratory (IDHWL) are from J. Dodds (written commun., 1991)]

Constituent	Maximum contaminant level	Reporting level NWQL	Reporting level IDHWL
Aluminum	[50]	10	••
Arsenic	50 (30)	1	10
Barium	1,000 (5,000)	2	100
Beryllium	(1)	.5	5
Cadmium	10 (5)	1	1
Chromium, total	50 (100)	1	3
Chromium, dissolved	--	5	3
Chromium, hexavalent	--	1	••
Cobalt	--	3	••
Copper	(1,300)	10	••
Iron	[300] --	3	••
Lead	50 (5)	1	5
Lithium	--	4	••
Manganese	[50] --	1	••
Mercury	2	.1	.5
Molybdenum	--	10	••
Nickel	(100)	10	••
Selenium	10 (50)	1	5
Silver	50 [90]	1	1
Strontium	--	1	••
Vanadium	--	6	••
Zinc	--	3	••

Table 10.—*Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho Department of Health and Welfare Laboratory (IDHWL). Analytical results in µg/L (microgram per liter); < indicates the concentration was less than the respective reporting level. Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40; MV-62 is an equipment blank); -- indicates no analysis was performed]

Site identifier	Aluminum NWQL	Arsenic NWQL	Arsenic IDHWL	Barium NWQL	Barium IDHWL	Beryllium NWQL	Beryllium IDWHL
MV-02	10	3	<10	68	<100	<0.5	<5
MV-10	10	2	<10	85	<100	<.5	<5
MV-12	40	2	<10	56	<100	<.5	<5
MV-16	<10	2	<10	25	<100	.7	<5
MV-19	10	2	<10	30	<100	<.5	<5
MV-24	<10	3	<10	140	130	<.5	<5
MV-26	<10	2	<10	27	<100	<.5	<5
MV-28*	<10	3	<10	150	180	<.5	<5
MV-29	20	2	<10	22	<100	<.5	<5
MV-32	20	2	<10	85	<100	.6	<5
MV-34*	<10	2	--	18	--	<.5	--
MV-40	20	2	<10	18	<100	<.5	<5
MV-41	<10	3	<10	80	<100	<.5	<5
MV-42	<10	3	<10	<2	<100	.9	<5
MV-45	<10	2	<10	25	<100	<.5	<5
MV-48	10	1	<10	50	<100	<.5	<5
MV-49	10	1	<10	54	<100	<.5	<5
MV-52	<10	5	<10	74	<100	<.5	<5
MV-54	10	2	<10	120	110	<.5	<5
MV-56	<10	2	<10	25	<100	.6	<5
MV-61	--	--	<10	--	<100	--	<5
MV-62*	--	--	<10	--	<100	--	<5

Table 10.—*Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain*--Continued

Site identifier	Cadmium NWQL	Cadmium IDHWL	Chromium		
			dissolved NWQL	dissolved IDHWL	hexavalent NWQL
MV-02	<1	<1	<5	<3	<1
MV-10	<1	<1	<5	<3	<1
MV-12	<1	<1	<5	<3	<1
MV-16	<1	<1	<5	<3	<1
MV-19	<1	<1	<5	<3	<1
MV-24	<1	<1	<5	<3	<1
MV-26	<1	<1	<5	<3	<1
MV-28*	<1	<1	<5	<3	<1
MV-29	<1	<1	<5	3	<1
MV-32	<1	<1	<5	<3	<1
MV-34*	<1	<1	<5	--	<1
MV-40	<1	<1	<5	<3	<1
MV-41	<1	<1	<5	<3	<1
MV-42	<1	<1	<5	<3	<1
MV-45	<1	<1	<5	<3	<1
MV-48	2	--	<5	3	1
MV-49	3	<1	<5	<3	1
MV-52	<1	<1	<5	<3	<1
MV-54	1	<1	<5	<3	<1
MV-56	<1	<1	<5	<3	<1
MV-61	--	<1	--	<3	--
MV-62*	--	<1	--	<3	--

Table 10.—*Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain*--Continued

Site identifier	Cobalt NWQL	Copper NWQL	Iron NWQL	Lead NWQL	Lead IDHWL	Lithium NWQL
MV-02	<3	<10	9	<1	<5	43
MV-10	<3	<10	3	<1	<5	48
MV-12	<3	<10	4	<1	<5	43
MV-16	<3	<10	<3	<1	<5	25
MV-19	<3	<10	3	<1	<5	30
MV-24	<3	<10	6	<1	<5	51
MV-26	<3	<10	30	<1	<5	31
MV-28*	<3	<10	5	<1	<5	51
MV-29	<3	<10	140	<1	<5	22
MV-32	<3	<10	31	<1	<5	38
MV-34*	<3	<10	8	2	--	13
MV-40	<3	<10	33	1	<5	13
MV-41	<3	<10	<3	<1	<5	7
MV-42	<3	<10	<3	<1	<5	<4
MV-45	<3	<10	<3	<1	<5	15
MV-48	<3	<10	5	1	<5	<4
MV-49	<3	10	26	<1	<5	5
MV-52	<3	<10	6	<1	<5	24
MV-54	<3	<10	53	<1	<5	55
MV-56	<3	<10	19	<1	<5	27
MV-61	--	--	--	--	<5	--
MV-62*	--	--	--	--	<5	--

Table 10.—*Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain*--Continued

Site identifier	Manganese NWQL	Mercury NWQL	Mercury IDHWL	Molybdenum NWQL	Nickel NWQL	Selenium NWQL	Selenium IDHWL
MV-02	<1	<0.1	<0.5	<10	<10	<1	<5
MV-10	<1	<.1	<.5	<10	<10	1	<5
MV-12	<1	<.1	<.5	<10	<10	1	<5
MV-16	<1	<.1	<.5	<10	<10	<1	<5
MV-19	<1	<.1	<.5	<10	<10	<1	<5
MV-24	<1	<.1	<.5	<10	<10	1	<5
MV-26	<1	<.1	<.5	<10	<10	<1	<5
MV-28*	<1	<.1	<.5	<10	<10	1	<5
MV-29	1	<.1	<.5	<10	<10	<1	<5
MV-32	1	<.1	<.5	<10	<10	<1	<5
MV-34*	<1	<.1	--	<10	<10	<1	--
MV-40	<1	<.1	<.5	<10	<10	<1	<5
MV-41	<1	<.1	<.5	<10	<10	<1	<5
MV-42	<1	<.1	<.5	<10	<10	<1	<5
MV-45	<1	<.1	<.5	<10	<10	<1	<5
MV-48	<1	<.1	<.5	<10	<10	1	<5
MV-49	2	<.1	<.5	<10	<10	<1	<5
MV-52	<1	<.1	<.5	<10	<10	<1	<5
MV-54	3	<.1	<.5	<10	<10	<1	<5
MV-56	1	<.1	<.5	<10	<10	<1	<5
MV-61	--	--	<.5	--	--	--	<5
MV-62*	--	--	<.5	--	--	--	<5

Table 10.—*Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain*--Continued

Site identifier	Silver NWQL	Silver IDHWL	Strontium NWQL	Vanadium NWQL	Zinc NWQL
MV-02	2	<1	340	7	23
MV-10	<1	<1	400	<6	<3
MV-12	<1	<1	360	6	21
MV-16	<1	<1	230	9	3
MV-19	<1	<1	230	8	<3
MV-24	<1	<1	430	6	3
MV-26	<1	<1	220	7	8
MV-28*	<1	<1	440	<6	7
MV-29	<1	<1	180	8	7
MV-32	<1	<1	370	<6	72
MV-34*	<1	--	160	8	7
MV-40	<1	<1	160	8	4
MV-41	<1	<1	370	12	3
MV-42	2	<1	4	12	4
MV-45	1	<1	220	10	<3
MV-48	<1	<1	230	<6	110
MV-49	<1	<1	190	<6	180
MV-52	<1	<1	260	11	45
MV-54	2	<1	480	7	39
MV-56	<1	<1	210	8	43
MV-61	--	<1	--	--	--
MV-62*	--	<1	--	--	--

Table 11.—*Concentrations of total trace elements in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by U.S. Geological Survey's National Water Quality Laboratory (NWQL) and the Idaho Department of Health and Welfare Laboratory (IDHWL). Analytical results in μg/L (microgram per liter); < indicates the concentration was less than the respective reporting level. Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40); --indicates no analysis was performed]

Site identifier	Arsenic IDHWL	Barium IDHWL	Beryllium IDHWL	Cadmium IDHWL	Chromium NWQL	Chromium IDHWL	Lead IDHWL	Mercury IDHWL	Selenium IDHWL	Silver IDHWL
MV-02	<10	<100	<5	<1	2	<3	<5	<0.5	<5	<1.0
MV-10	<10	<100	<5	<1	4	<3	<5	<.5	<5	<1.0
MV-12	<10	<100	<5	<1	1	<3	<5	<.5	<5	<1.0
MV-16	<10	<100	<5	<1	4	<3	<5	<.5	<5	<1.0
MV-19	<10	<100	<5	<1	<1	4	<5	<.5	<5	<1.0
MV-24	<10	120	<5	<1	3	<3	<5	<.5	<5	<1.0
MV-26	<10	<100	<5	<1	<1	<3	<5	<.5	<5	<1.0
MV-28*	<10	150	<5	<1	3	<3	<5	<.5	<5	<1.0
MV-29	<10	<100	<5	<1	4	<3	<5	<.5	<5	<1.0
MV-32	<10	<100	<5	<1	<1	<3	<5	<.5	<5	<1.0
MV-34*	--	--	--	--	2	--	--	--	--	--
MV-40	<10	<100	<5	<1	2	<3	<5	<.5	<5	<1.0
MV-41	<10	<100	<5	<1	2	<3	<5	<.5	<5	<1.0
MV-42	<10	<100	<5	<1	6	<3	<5	<.5	<5	<1.0
MV-45	<10	<100	<5	<1	9	<3	<5	<.5	<5	<1.0
MV-48	<10	<100	<5	<1	2	4	<5	<.5	<5	<1.0
MV-49	<10	<100	<5	<1	1	<3	<5	<.5	<5	<1.0
MV-52	<10	130	<5	<1	1	<3	<5	<.5	<5	<1.0
MV-54	<10	<100	<5	<1	2	<3	<5	<.5	<5	<1.0
MV-56	<10	<100	<5	<1	<1	<3	<5	<.5	<5	<1.0
MV-61	<10	<100	<5	<1	--	5	5	<.5	<5	<1.0

in three samples analyzed by IDHWL were greater than the reporting level and ranged from 110 to 180 µg/L and 120 to 150 µg/L, respectively. The maximum contaminant level is 1,000 µg/L.

Beryllium.—Concentrations of dissolved beryllium in four samples analyzed by NWQL were greater than the reporting level and ranged from 0.6 to 0.9 µg/L. Concentrations of dissolved and total beryllium in all samples analyzed by IDHWL were less than the reporting level of 5 µg/L. The proposed maximum contaminant level is 1 µg/L.

Cadmium.—Concentrations of dissolved cadmium in three samples analyzed by NWQL were equal to or greater than the reporting level and ranged from 1 to 3 µg/L. Concentrations of dissolved and total cadmium in all samples analyzed by IDHWL were less than the reporting level of 1 µg/L. The maximum contaminant level is 10 µg/L.

Chromium.—Chromium analyses included total, dissolved, and hexavalent. Concentrations of total chromium in 16 samples analyzed by NWQL equaled or exceeded the reporting level and ranged from 1 to 9 µg/L; the maximum contaminant level is 50 µg/L. All the samples analyzed by the NWQL had dissolved chromium concentrations less than the reporting level of 5 µg/L. Hexavalent chromium concentrations analyzed by NWQL in samples from MV-48 and MV-49 were equal to the reporting level of 1 µg/L. Concentrations of total chromium in three samples analyzed by IDHWL exceeded the reporting level and ranged from 4 to 5 µg/L. Dissolved chromium concentrations analyzed by IDHWL in samples from MV-29 and MV-48 were equal to the reporting level of 3 µg/L.

Cobalt.—All the samples analyzed by NWQL had dissolved cobalt concentrations less than the reporting level of 3 µg/L.

Copper.—Concentrations of dissolved copper in 19 samples analyzed by NWQL were less than the reporting level of 10 µg/L. One sample (MV-49) had a concentration of 10 µg/L. The proposed maximum contaminant level for copper is 1,300 µg/L.

Iron.—Concentrations of dissolved iron in 16 samples analyzed by NWQL equaled or exceeded the reporting level and ranged from 3 to 140 µg/L; the secondary maximum contaminant level is 300 µg/L.

Lead.—Dissolved lead concentrations in three samples analyzed by NWQL equaled or exceeded the reporting level and ranged from 1 to 2 µg/L. Concentrations of dissolved lead in all samples analyzed by IDHWL were less than the reporting level of 5 µg/L. One sample (MV-61) analyzed by IDHWL had a total lead concentration of 5 µg/L. The maximum contaminant level is 50 µg/L.

Lithium.—Concentrations of dissolved lithium in 18 samples analyzed by NWQL exceeded the reporting level and ranged from 5 to 55 µg/L.

Manganese.—Concentrations of manganese in five samples equaled or exceeded the reporting level and ranged from 1 to 3 µg/L; the secondary maximum contaminant level is 50 µg/L.

Mercury.—All the samples analyzed by NWQL had mercury concentrations less than the reporting level of 0.1 µg/L. All the samples analyzed by IDHWL had mercury concentrations less than the reporting level of 0.5 µg/L. The maximum contaminant level for mercury is 2 µg/L.

Molybdenum.—All the samples analyzed by NWQL had molybdenum concentrations less than the reporting level of 10 µg/L.

Nickel.—All the samples analyzed by NWQL had nickel concentrations less than the reporting level of 10 µg/L. The proposed maximum contaminant level for nickel is 100 µg/L.

Selenium.—Dissolved selenium concentrations in five samples analyzed by NWQL were equal to the reporting level of 1 µg/L. All the samples analyzed by IDHWL had dissolved and total selenium concentrations less than the reporting level of 5 µg/L. The maximum contaminant level is 10 µg/L.

Silver.—Concentrations of dissolved silver in four samples analyzed by NWQL were equal to or greater than the reporting level and ranged from 1 to 2 µg/L. All the samples analyzed by IDHWL had dissolved and total silver concentrations less than the reporting level of 1 µg/L. The maximum contaminant level for silver is 50 µg/L.

Strontium.—Strontium concentrations in all samples analyzed by NWQL exceeded the reporting level and ranged from 4 to 480 µg/L.

Vanadium.—Concentrations of vanadium in 15 samples analyzed by NWQL equaled or exceeded the reporting level and ranged from 6 to 12 µg/L.

Zinc.—Concentrations of zinc in 17 samples analyzed by NWQL equaled or exceeded the reporting level and ranged from 3 to 180 µg/L.

Common Ions

Water samples were analyzed by NWQL for dissolved common ions including bromide, calcium, chloride, fluoride, magnesium, potassium, silica, sodium, and sulfate. Water samples were analyzed by IDHWL for total chloride, fluoride, sodium, and sulfate. Maximum contaminant levels or secondary maximum contaminant levels and reporting levels for these ions are shown on table 12. Concentrations of dissolved common ions are shown on table 13, and concentrations of total common ions are shown on table 14.

Bromide.—Concentrations of dissolved bromide in all samples analyzed by NWQL exceeded the reporting level and ranged from 0.02 to 0.25 mg/L.

Calcium.—Dissolved calcium concentrations in all samples analyzed by NWQL exceeded the reporting level and ranged from 0.68 to 74 mg/L.

Chloride.—Dissolved chloride concentrations in all samples analyzed by NWQL exceeded the reporting level and ranged from 2.4 to 110 mg/L. Total chloride concentrations in all samples analyzed by IDHWL exceeded the reporting level and ranged from 4 to 101 mg/L. The secondary maximum contaminant level is 250 mg/L.

Fluoride.—Concentrations of dissolved fluoride in all samples analyzed by NWQL exceeded the reporting level and ranged from 0.2 to 0.6 mg/L. Concentrations of total fluoride in all samples analyzed by IDHWL exceeded the reporting level and ranged from 0.21 to 0.95 mg/L. The maximum contaminant level is 4 mg/L.

Magnesium.—Dissolved magnesium concentrations in all samples analyzed by NWQL exceeded the reporting level and ranged from 0.26 to 34 mg/L.

Potassium.—Concentrations of dissolved potassium in all samples analyzed by NWQL exceeded the reporting level and ranged from 0.3 to 8.3 mg/L.

Silica.—Dissolved silica concentrations in all samples analyzed by NWQL were greater than the reporting level and ranged from 23 to 40 mg/L.

Sodium.—Concentrations of dissolved sodium in all samples analyzed by NWQL were greater than the reporting level and ranged from 8.6 to 110 mg/L. Concentrations of total sodium in all samples analyzed by

Table 12.—Maximum contaminant levels and reporting levels of selected common ions in drinking water

[The maximum contaminant levels are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989, p. 547) for community water systems and are included for comparison purposes only. Secondary maximum contaminant levels—shown in brackets—are from U.S. Environmental Protection Agency (1989, 1990a); -- indicates that maximum contaminant level has not been established for that chemical constituent; •• indicates analysis not requested. Units are in mg/L (milligram per liter). Reporting levels for the U.S. Geological Survey's National Water Quality Laboratory (NWQL) are from Pritt and Jones (1989). Reporting levels for the Idaho Department of Health and Welfare Laboratory (IDHWL) are from J. Dodds (written commun., 1991)]

Constituent	Maximum contaminant level	Reporting level NWQL	Reporting level IDHWL
Bromide	--	0.01	••
Calcium	--	.02	••
Chloride	[250] --	.1	0 .89
Fluoride	4 [2]	.1	.01
Magnesium	--	.01	••
Potassium	--	.1	••
Silica	--	.01	••
Sodium[1]	--	.2	.1
Sulfate	[250] --	1	5

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[1] Idaho Department of Health and Welfare (1989) recommends an optimum concentration of 20 mg/L.

Table 13.—*Concentrations of dissolved common ions in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results in mg/L (milligram per liter). Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40)]

Site identifier	Bromide	Calcium	Chloride	Fluoride	Magnesium	Potassium	Silica	Sodium	Sulfate
MV-02	0.09	53	50	0.5	21	6.5	37	40	52
MV-10	.18	64	77	.5	26	6.8	34	56	71
MV-12	.17	66	71	.5	23	5.3	33	45	79
MV-16	.04	38	16	.6	18	3.4	35	23	35
MV-19	.07	44	32	.6	18	3.5	33	23	41
MV-24	.25	73	100	.4	34	8.3	34	88	90
MV-26	.08	44	35	.6	17	3.8	31	24	40
MV-28*	.25	74	110	.4	34	8.2	34	89	95
MV-29	.04	32	17	.6	15	3.4	34	18	33
MV-32	.13	66	49	.4	25	5.0	37	42	57
MV-34*	.03	31	13	.4	15	3.2	33	18	27
MV-40	.03	31	13	.5	15	3.3	33	18	26
MV-41	.09	71	33	.5	32	4.6	40	50	71
MV-42	.04	.68	16	.5	.26	.3	35	110	36
MV-45	.03	36	11	.4	18	3.7	34	20	25
MV-48	.04	43	14	.2	14	2.3	23	8.7	23
MV-49	.02	50	2.4	.2	15	2.2	28	8.6	14
MV-52	.08	50	34	.4	20	5.4	40	46	57
MV-54	.19	74	74	.4	29	7.6	36	60	74
MV-56	.05	37	25	.6	17	3.3	33	22	34

Table 14.—*Concentrations of total common ions in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by the Idaho Department of Health and Welfare Laboratory. Analytical results in mg/L (milligram per liter). Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is replicate of MV-24)]

Site identifier	Chloride	Fluoride	Sodium	Sulfate
MV-02	46	0.54	33	48
MV-10	73	.56	52	69
MV-12	63	.51	41	75
MV-16	17	.63	19	35
MV-19	29	.57	22	40
MV-24	101	.41	84	102
MV-26	34	.61	23	47
MV-28*	101	.44	80	102
MV-29	15	.63	16	30
MV-32	46	.45	34	72
MV-40	12	.50	16	24
MV-41	32	.50	42	72
MV-42	18	.53	92	36
MV-45	13	.49	15	29
MV-48	13	.26	7	22
MV-49	4	.21	8	14
MV-52	32	.53	43	65
MV-54	72	.45	50	77
MV-56	21	.61	18	37
MV-61	22	.95	15	19

IDHWL were greater than the reporting level and ranged from 7 to 92 mg/L. IDHW (1989) recommended an optimum level of 20 mg/L sodium for public drinking-water supplies.

Sulfate.—Concentrations of dissolved sulfate in all samples analyzed by NWQL exceeded the reporting level and ranged from 14 to 95 mg/L. Concentrations of total sulfate in all samples analyzed by IDHWL were greater than the reporting level and ranged from 14 to 102 mg/L. The secondary maximum contaminant level for sulfate is 250 mg/L.

Nutrients and Cyanide

Water samples were analyzed by NWQL for dissolved ammonia (as nitrogen), nitrite (as nitrogen), nitrite plus nitrate (as nitrogen), orthophosphate (as phosphorus), and cyanide. The maximum contaminant levels proposed by the U.S. Environmental Protection Agency (1989 and 1990b) and the reporting levels for nitrite, nitrite plus nitrate, and cyanide are shown on table 15. A maximum contaminant level has not been established or proposed for ammonia or orthophosphate.

Concentrations of nutrients are shown on table 16. Ammonia concentrations in two samples (MV-26 and MV-56) equaled or exceeded the reporting level at concentrations of 0.01 and 0.02 mg/L, respectively. Concentrations of nitrite in all samples were less than the reporting level of 0.01 mg/L. Concentrations of nitrite plus nitrate in all samples exceeded the reporting level and ranged from 0.51 to 5.7 mg/L; the maximum contaminant level is 10 mg/L (table 15). Orthophosphate concentrations as phosphorus in 17 samples equaled or exceeded the reporting level and ranged from 0.01 to 0.07 mg/L. Concentrations of cyanide in all samples were less than the reporting level of 0.01 mg/L.

ORGANIC COMPOUNDS

Water samples were analyzed by NWQL for selected organic compounds. These compounds included dissolved organic carbon, surfactants, purgeable organic compounds, insecticides, polychlorinated compounds, and herbicides. Reporting levels established for these constituents (Pritt and Jones, 1989) are not be confused with reporting levels and analytical method detection limits for selected radionuclides.

Dissolved Organic Carbon

Water samples were analyzed for dissolved organic carbon (DOC), and concentrations are shown on table 16. Concentrations of DOC in all samples were greater than the reporting level of 0.1 mg/L, and ranged from 0.4 to 2.4 mg/L; no maximum contaminant level has been established.

Surfactants

Water samples were analyzed for surfactants (table 16). Concentrations of surfactants in 17 samples equaled or exceeded the reporting level and ranged from 0.01 to 0.08 mg/L; the secondary maximum contaminant level is 0.5 mg/L (U.S. Environmental Protection Agency, 1989).

Purgeable Organic Compounds

Samples from all sites were analyzed for 36 purgeable organic compounds. The maximum contaminant levels and reporting levels for these compounds are shown on table 17. Only one of the compounds,

Table 15.—*Maximum contaminant levels and reporting levels for selected nutrients, cyanide, dissolved organic carbon, and surfactants in drinking water*

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989 and 1990a) for community water systems and are included for comparison purposes only. Proposed maximum contaminant levels—shown in parentheses—are from U.S. Environmental Protection Agency (1990a); -- indicates that a maximum contaminant level has not been established or proposed for that constituent. Units are mg/L (milligram per liter). Reporting levels are from Pritt and Jones (1989)]

Constituent	Maximum contaminant level	Reporting level
Ammonia (as nitrogen)	--	0.01
Nitrite (as nitrogen)	(1)	.01
Nitrite plus nitrate (as nitrogen)	10	.10
Orthophosphate (as phosphorus)	--	.01
Cyanide	(.2)	.01
Dissolved organic carbon	--	.1
Surfactants[1]	--	.01

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[1] Secondary maximum contaminant level for surfactants is 0.5 mg/L (U.S. Environmental Protection Agency, 1989, p. 656).

Table 16.—*Concentrations of nutrients, cyanide, dissolved organic carbon, and surfactants in water from selected wells and springs, eastern Snake River Plain*

[Analyses were performed by U.S. Geological Survey's National Water Quality Laboratory. Analytical results in mg/L (milligram per liter); < indicates the concentration was less than the respective reporting level. Site identifier: see figure 2 for location of sites. Symbols: * indicates quality assurance sample (MV-28 is a replicate of MV-24; MV-34 is a replicate of MV-40); LS indicates sample was lost by laboratory]

Site identifier	Ammonia (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Orthophosphate (as phosphorus)	Cyanide	Dissolved organic carbon	Surfactants
MV-02	<0.01	<0.01	1.1	<0.01	<0.01	0.6	0.02
MV-10	<.01	<.01	2.7	<.01	<.01	1.3	.04
MV-12	<.01	<.01	1.7	.02	<.01	1.2	.02
MV-16	<.01	<.01	.95	.02	<.01	.7	.01
MV-19	<.01	<.01	1.9	.02	<.01	.7	.03
MV-24	<.01	<.01	5.7	.02	<.01	2.3	.07
MV-26	.01	<.01	.89	.02	<.01	.6	.02
MV-28*	<.01	<.01	5.7	.02	<.01	2.4	.08
MV-29	<.01	<.01	.51	.01	<.01	.4	<.01
MV-32	<.01	<.01	3.2	.02	<.01	1.1	.04
MV-34*	<.01	<.01	.67	.02	LS	.4	<.01
MV-40	<.01	<.01	.69	.02	<.01	.5	<.01
MV-41	<.01	<.01	2.6	.07	<.01	1.5	.03
MV-42	<.01	<.01	1.3	.04	<.01	.6	.02
MV-45	<.01	<.01	1.0	.01	<.01	.6	.01
MV-48	<.01	<.01	.77	<.01	<.01	.8	.02
MV-49	<.01	<.01	1.7	.02	<.01	.5	.03
MV-52	<.01	<.01	1.8	.02	<.01	1.2	.02
MV-54	<.01	<.01	4.3	.02	<.01	1.4	.05
MV-56	.02	<.01	.93	.02	<.01	.5	.02

Table 17.—*Maximum contaminant levels and reporting levels of selected purgeable organic compounds in drinking water*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) using an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. The reporting level for all compounds is 0.2 micrograms per liter (Pritt and Jones, 1989). Maximum contaminant level: * indicates that total trihalomethanes—which include bromoform, chloroform, dibromochloromethane, and dichlorobromomethane—in community water systems serving 10,000 or more persons cannot exceed 100 micrograms per liter (U.S. Environmental Protection Agency, 1989, p. 548). Proposed maximum contaminant levels—shown in parentheses—are from J. Rodin (U.S. Environmental Protection Agency, written commun., 1989) and U.S. Environmental Protection Agency (1990a, b). -- indicates that a maximum contaminant level has not been established or proposed for that compound. Units are µg/L (microgram per liter)]

Compound	Maximum contaminant level	Compound	Maximum contaminant level
Benzene	5.0	Ethylbenzene	(700)
Bromoform	*	1,3-Dichloropropene	--
Carbon tetrachloride	5.0	Cis-1,3-Dichloropropene	--
Chlorobenzene	(100)	Styrene	(10.0)
Chloroethane	--	Methyl bromide	--
2-Chloroethyl vinyl ether	--	Trans-1,3-Dichloropropene	--
Chloroform	*	Chloromethane	--
Dibromochloromethane	*	Dichlorobromomethane	*
Methylene chloride	--	Toluene	(2,000)
1,1,2,2-Tetrachloroethane	--	Trichlorofluoromethane	--
1,2-Dichloroethane	5.0	Tetrachloroethylene	(5.0)
1,2-Dichlorobenzene	(600)	1,3-Dichlorobenzene	--
1,4-Dichlorobenzene	75	Trichloroethylene	5.0
1,1,1-Trichloroethane	200	1,2-trans-Dichloroethylene	(100)
1,1,2-Trichloroethane	(5)	Dichlorodifluoromethane	--
1,2-Dibromoethane	--	1,2-Dichloropropane	(5.0)
1,1-Dichloroethane	--	Xylenes, mixed	(10,000)
Vinyl chloride	2.0	1,1-Dichloroethylene	7.0

1,1,1 trichloroethane, was detected in two water samples. The 1,1,1-trichloroethane concentrations from MV-29 and MV-45 were 0.2 and 0.3 µg/L, respectively; the maximum contaminant level is 200 µg/L.

Insecticides and Polychlorinated Compounds

Water samples were analyzed for concentrations of 10 carbamate insecticides, 11 organophosphorus insecticides, 15 organochlorine insecticides, gross PCB's, and gross PCN's. The maximum contaminant levels and reporting levels for these compounds are shown on table 18. None of the measured organic compounds exceeded their respective reporting levels. The laboratory had low surrogate recovery on two samples (MV-19 and MV-54) analyzed for organochlorine insecticides; the data should be considered "qualified" and reviewed with caution.

Herbicides

Concentrations of 12 triazine herbicides and 4 chlorophenoxy-acid herbicides were determined by the NWQL. Maximum contaminant levels and reporting levels for these compounds are shown on table 19. Two samples (MV-40 and MV-56) and a quality assurance replicate (MV-34) had concentrations of 2, 4-D equal to the reporting level of 0.01 µg/L. None of the other herbicides exceeded their respective reporting levels.

FECAL COLIFORM BACTERIA

Water samples were analyzed for fecal coliform bacteria by the IDHWL at Twin Falls, Idaho. Coliform-density tests indicated one sample, MV-19, had a count of nine colonies per 100 mL. The other samples had zero counts per 100 mL. The maximum contaminant level for public drinking-water supplies for bacteria is based on the presence or absence of total coliforms (zero colonies per 100 mL) (U.S. Environmental Protection Agency, 1990a). Because fecal coliform is one of the species included in the total coliform test, one sample exceeded the maximum contaminant level for total coliform.

SUMMARY

The USGS and the Idaho Department of Water Resources, in response to a request from the U.S. Department of Energy, sampled 18 sites as part of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering Laboratory to the Hagerman area. Water samples were collected and analyzed for manmade pollutants and naturally occurring constituents. The samples were collected from six irrigation wells, seven domestic wells, two springs, one stock well, one dairy well, and one observation well. Quality assurance samples also were collected and analyzed. The samples were analyzed for selected radionuclides, inorganic constituents, organic compounds, and bacteria.

Radon-222 was detected at concentrations exceeding the reporting level at 10 sites, but none exceeded the proposed maximum contaminant level. Concentrations of strontium-90 in all samples were less than the reporting level. All samples analyzed by NWQL had concentrations of tritium greater than the reporting level, but none exceeded the maximum contaminant level for drinking water. All samples analyzed by ISU had concentrations of tritium less than the reporting level.

Concentrations of dissolved gross alpha-particle radioactivity in all samples exceeded the reporting level; none exceeded the U.S. Environmental Protection Agency maximum contaminant level. Concentrations of

Table 18.—*Maximum contaminant levels and reporting levels of selected insecticides and gross polychlorinated compounds in drinking water*

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989, p. 548) for community water systems and are included for comparison purposes only. Proposed maximum contaminant levels—shown in parentheses—are from U.S. Environmental Protection Agency (1990a). -- indicates that a maximum contaminant level has not been established or proposed for that compound. Units are in µg/L (microgram per liter). Reporting levels are from Pritt and Jones (1989)]

Carbamate insecticides: reporting level is 0.5 µg/L

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Aldicarb	(10)	3-Hydroxycarbofuran	--
Aldicarb sulfone	(40)	Methomyl	--
Aldicarb sulfoxide	(10)	1-Naphthol	--
Carbaryl (Sevin)	--	Oxamyl	(200)
Carbofuran	(40)	Propham	--

Organophosphorus insecticides: reporting level is 0.01 µg/L

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Chlorpyrifos; Dursban	--	Methyl parathion	--
Diazinon	--	Methyl trithion	--
Disulfoton	--	Parathion	--
Ethion	--	Phorate	--
Fonofos	--	Trithion	--
Malathion	--		

Table 18.—*Maximum contaminant levels and reporting levels of selected insecticides and gross polychlorinated compounds in drinking water*--Continued

Organochlorine insecticides: reporting level is 0.01 μg/L except for chlordane and perthane (0.1 μg/L), and toxaphene (1.0 μg/L)

Insecticide	Maximum contaminant level	Insecticide	Maximum contaminant level
Aldrin	--	Heptachlor	(0.4)
Chlordane	(2.0)	Heptachlor epoxide	(.2)
DDD	--	Lindane	4.0
DDE	--		(.2)
DDT	--	Methoxychlor	100
Dieldrin	--		(400)
Endosulfan	--	Mirex	--
Endrin	.2	Perthane	--
		Toxaphene	5.0

Gross polychlorinated compounds: reporting level is 0.1μg/L

Compound	Maximum contaminant level
Gross polychlorinated biphenyls (PCB's)	(0.5)
Gross polychlorinated naphthalenes (PCN's)	--

Table 19.—*Maximum contaminant levels and reporting levels of triazines and chlorophenoxy-acid herbicides in drinking water*

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1989) for community water systems and are included for comparison purposes only. Proposed maximum contaminant levels—shown in parentheses—are from U.S. Environmental Protection Agency (1990a). -- indicates that a maximum contaminant level has not been established or proposed for that compound. Units are in µg/L (microgram per liter) Reporting levels are from Pritt and Jones (1989).]

Triazines and other nitrogen-containing herbicides: reporting level is 0.1 µg/L

Herbicide	Maximum contaminant level	Herbicide	Maximum contaminant level
Alachlor	(2.0)	Prometon	--
Ametryn	--	Prometryn	--
Atrazine	(3.0)	Propazine	--
Cyanazine	--	Simazine	(1.0)
Metolachlor	--	Simetryn	--
Metribuzin	--	Trifluralin	--

Chlorophenoxy-acid herbicides: reporting level is 0.01 µg/L

Herbicide	Maximum contaminant level	Herbicide	Maximum contaminant level
2, 4-D	100, (70)	Silvex	10, (50)
2, 4-DP	--	2,4,5-T	--

dissolved gross beta-particle radioactivity in all but one sample, suspended gross beta-particle radioactivity in two samples, and total gross beta-particle radioactivity in five samples exceeded the reporting level. Total uranium concentrations exceeded the reporting level in all water samples, but none exceeded the proposed maximum contaminant level. Radium-226 concentrations exceeded the reporting level in all samples; radium-228 concentrations were less than the reporting level in all samples; none exceeded the established maximum contaminant levels for radium isotopes. Five radionuclides were identified using gamma spectroscopy. Cesium-137 was identified in all the samples, lead-212 in four samples, lead-214 in one sample, bismuth-214 in one sample, and potassium-40 in eight samples. Concentrations of cesium-137 in one sample, lead-212 in three samples, bismuth-214 in one sample, and potassium-40 in four samples, exceeded the reporting level.

All the samples contained one or more dissolved trace elements and common ions in concentrations greater than the reporting levels. No samples exceeded an established maximum contaminant level.

Concentrations of ammonia (as nitrogen) in water samples from two sites exceeded the reporting level. Concentrations of nitrite plus nitrate (as nitrogen) in all the water samples exceeded the reporting level. Concentrations of orthophosphate (as phosphorus) in 17 of the water samples exceeded the reporting level. Concentrations of nitrite (as nitrogen) and cyanide in all samples were less than the reporting level. Nutrient concentrations did not exceed established maximum contaminant levels.

Concentrations of dissolved organic carbon exceeded the reporting level in all the samples. Surfactants in 17 water samples exceeded the reporting level but did not exceed secondary maximum contaminant levels. Concentrations of 1,1,1-trichloroethane exceeded the reporting level in two water samples. No carbamate insecticides, organophosphorus insecticides, organochlorine insecticides, gross PCB's, or gross PCN's were detected at concentrations exceeding their respective reporting levels. Concentrations of 2, 4-D were equal to the reporting level in two samples and a quality assurance replicate.

A water sample from one site had fecal coliform bacteria counts that exceeded the U.S. Environmental Protection Agency's maximum contaminant level.

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