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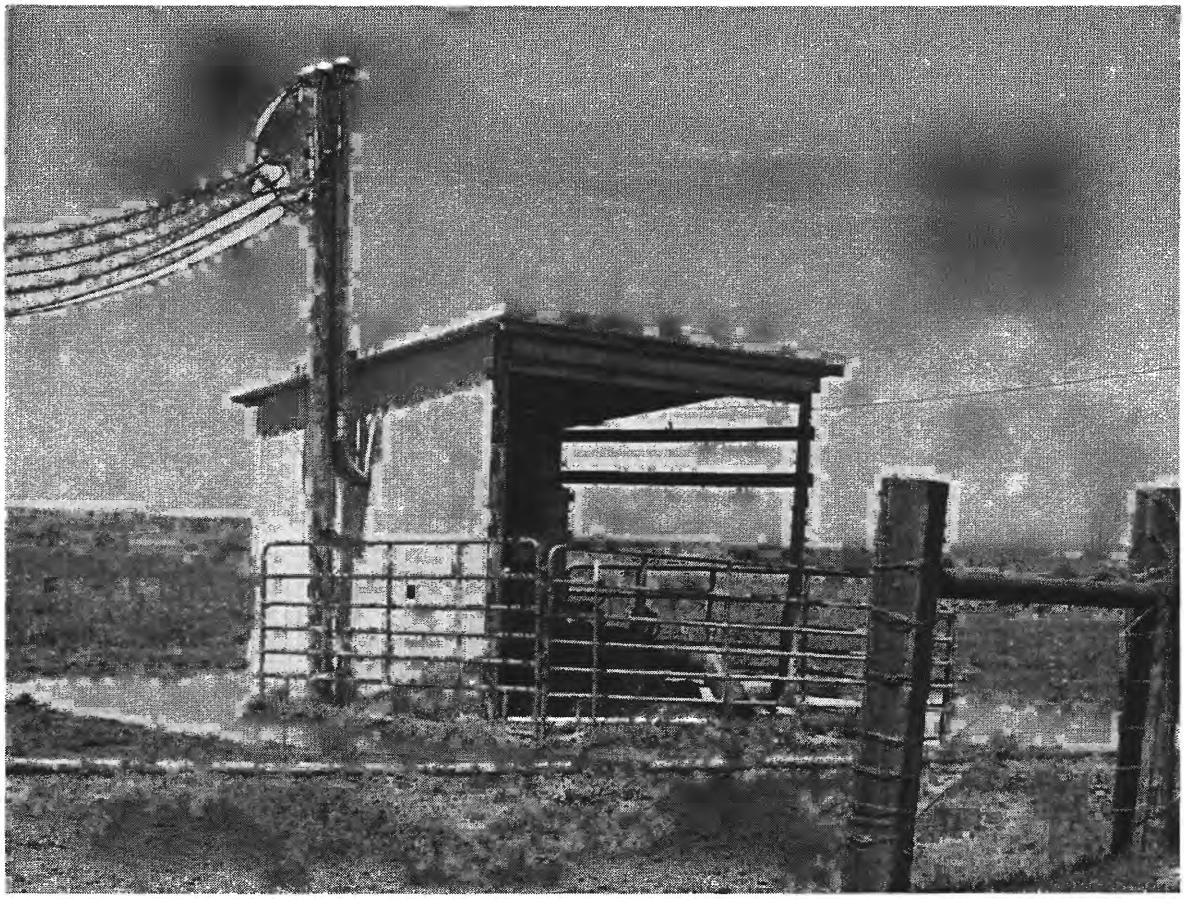
RADIOCHEMICAL AND CHEMICAL CONSTITUENTS IN WATER FROM SELECTED WELLS AND SPRINGS FROM THE SOUTHERN BOUNDARY OF THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY TO THE HAGERMAN AREA, IDAHO, 2001

U.S. GEOLOGICAL SURVEY
Open-File Report 03-168



Prepared in cooperation with the

U.S. DEPARTMENT OF ENERGY and IDAHO DEPARTMENT OF WATER RESOURCES

USGS

Radiochemical and Chemical Constituents in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman Area, Idaho, 2001

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Idaho Falls, Idaho
April 2003

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
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CONTENTS

FIGURES

TABLES

CONVERSION FACTORS AND ABBREVIATED UNITS

Multiply	By	To Obtain
foot (ft)	0.3048	meter
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: mL (milliliter); L (liter); µg/L (microgram per liter); mg/L (milligram per liter); µm (micrometer); and µS/cm (microsiemens per centimeter) at 25 degrees Celsius.

Radiochemical and Chemical Constituents in Water from Selected Wells and Springs from the Southern Boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman Area, Idaho, 2001

By **Brian V. Twining and Gordon Rattray, U.S. Geological Survey,** ***and*** **Linford J. Campbell, Idaho Department of Water Resources**

Abstract

The U.S. Geological Survey and the Idaho Department of Water Resources, in cooperation with the U.S. Department of Energy, sampled water from 16 of 18 sites as part of the fifth round of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman area. The samples were collected from eight irrigation wells, four domestic wells, two stock wells, one spring, and one public supply well and analyzed for selected radiochemical and chemical constituents. Two sites were not sampled because one was decommissioned and the other was discontinued due to a change in the well owner. Two quality-assurance replicate samples also were collected and analyzed. Tritium analyses from 19 spring samples collected along the Snake River in the Twin Falls-Hagerman area also are presented within this report along with two replicate quality assurance samples.

None of the reported radiochemical or chemical constituent concentrations exceeded the established maximum contaminant levels for drinking water. Many of the radionuclide- and inorganic-constituent concentrations were greater than the respective minimum reporting levels. Most of the organic-constituent concentrations were less than the minimum reporting levels.

INTRODUCTION

For several years, the public has expressed concern about waste-disposal practices at the Idaho National Engineering and Environmental Laboratory (INEEL) and the effect these practices might have on the water quality of the Snake River Plain aquifer. In the late 1980's, the U.S. Department of Energy (DOE) requested that the U.S. Geological Survey (USGS) conduct studies to respond to the public's concern and to gain a greater understanding of the radiochemical and chemical quality of water in the aquifer. One study described a one-time sampling effort in the eastern part of the A & B Irrigation District in Minidoka County (Mann and Knobel, 1990). A second study, an ongoing annual sampling effort in the area between the southern boundary of the INEEL and Hagerman (fig. 1), is being conducted with the Idaho Department of Water Resources (IDWR) in cooperation with the DOE. A third study, discontinued after 2001, involved sampling for tritium from 19 springs on the north side of the Snake River in the Twin Falls-Hagerman area (Mann, 1989; Mann and Low, 1994; Twining, 2002).

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). Subsequent rounds of sampling involve analyzing water samples annually from about one-third of the 55 sites so that all 55 sites are sampled every 3 years. Data for a variety of radiochemical and chemical constituents from the subsequent rounds have been

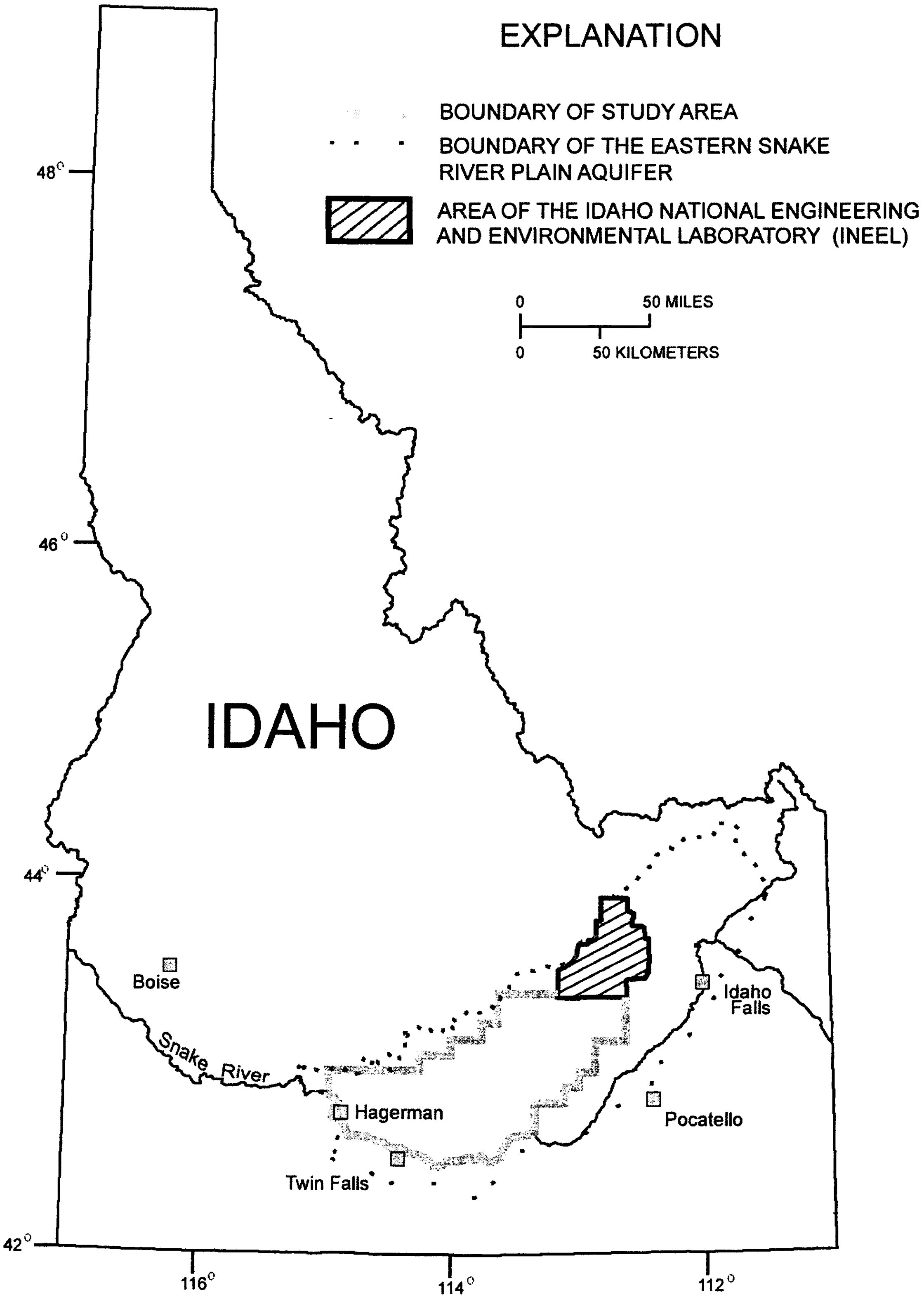

Figure 1. Location of the study area, between the Idaho National Engineering and Environmental Laboratory and Hagerman, Idaho.

published in reports by Bartholomay, Edwards, and Campbell (1992, 1993, 1994a, 1994b); Bartholomay, Williams, and Campbell (1995, 1996, 1997b, 1998); and Bartholomay, Twining, and Campbell (1999, 2000, 2001). Bartholomay, Williams, and Campbell (1997a) evaluated the data collected during the first 4 years of the study. This report summarizes the results of analyses of water samples collected from 16 of the initial 55 sites in 2001 as part of the third year of the fifth round of sampling. Results from the 19 selected springs analyzed for tritium in 2001 also are presented.

The INEEL 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). In the past, wastewater containing radiochemical and chemical wastes generated at the INEEL was discharged mostly to ponds and wells. After 1984, most aqueous wastes have been discharged to infiltration ponds. Many of the constituents in the wastewater enter the aquifer indirectly by percolation through the unsaturated zone (Pittman and others, 1988).

Chemical and radioactive wastes have been detected 13 mi southwest of the disposal areas at the INEEL (Bartholomay and others, 2000). Tritium was detected intermittently at concentrations up to 3,400±200 pCi/L in water from three wells along the southern boundary of the INEEL between 1983 and 1985 (Pittman and others, 1988). From April 1985 to October 1995, tritium concentrations in water from wells near the southern boundary of the INEEL were less than the reporting level (Bartholomay and others, 1997, p. 27); however in 1998, due to lower laboratory detection limits used, tritium was detected at concentrations greater than the reporting level in one well at the boundary and one well south of the boundary (Bartholomay and others, 2000).

Water samples collected from the 16 sites (fig. 2) were analyzed by the USGS National Water Quality Laboratory (NWQL) at Denver, Colorado, for selected radionuclides, trace elements, common ions, nutrients, purgeable organic compounds, carbamate insecticides, organophosphorus insecticides, gross polychlorinated biphenyls (PCBs), gross polychlorinated naphthalenes (PCNs), chlorophenoxy-acid herbicides, and other herbicides. Samples also were collected at the same sites for selected radionuclide analyses by the Idaho State University Environmental Monitoring Laboratory (ISU-EML) at Pocatello, Idaho. Two replicate water samples also were collected and analyzed as a measure of quality assurance. Water samples from the 19 selected springs (fig. 3) were sampled and analyzed for tritium by the NWQL in addition to two replicate quality assurance samples.

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 rocks 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 INEEL 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 of 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

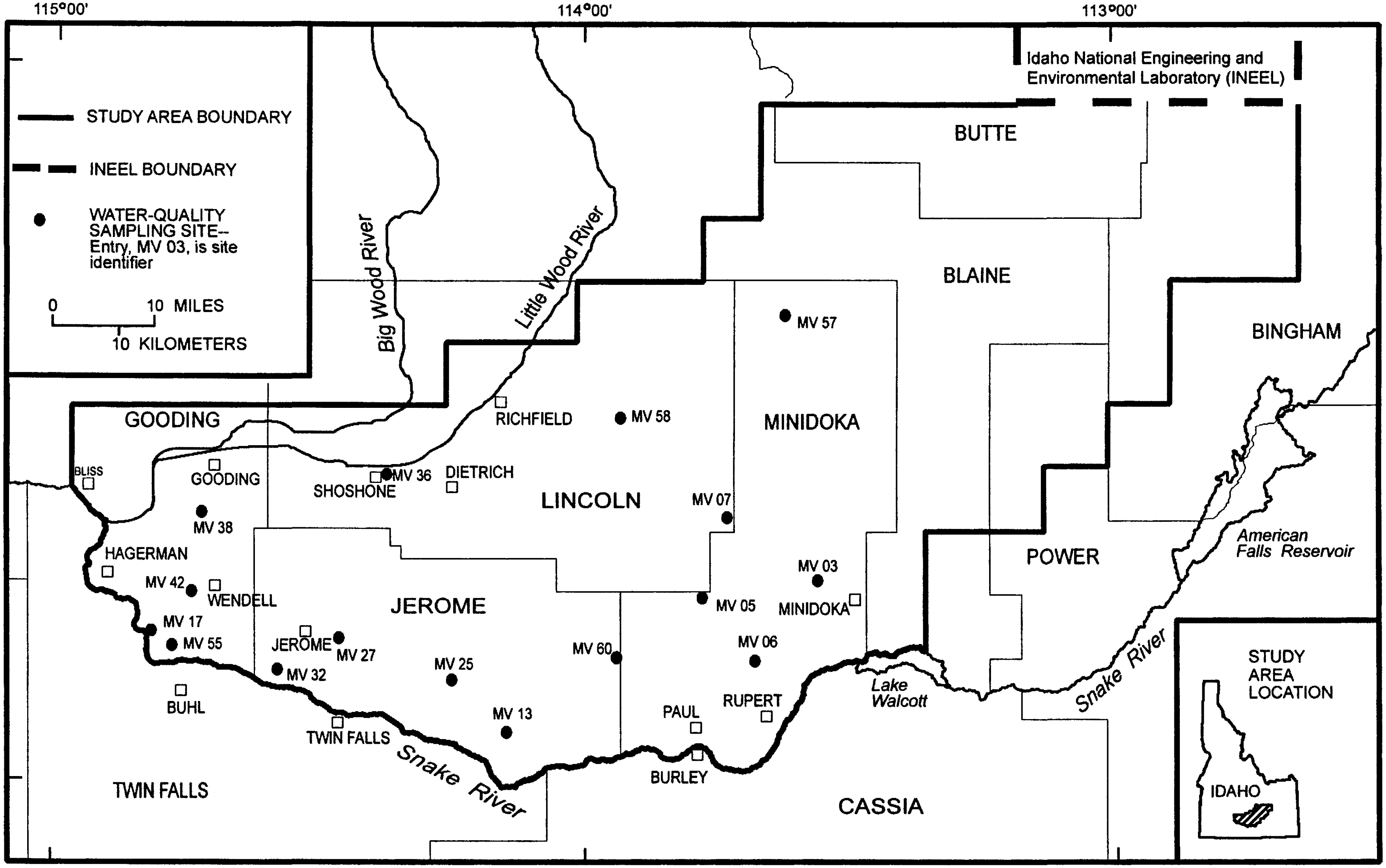

Figure 2. Location of selected water-quality sampling sites on the eastern Snake River Plain.

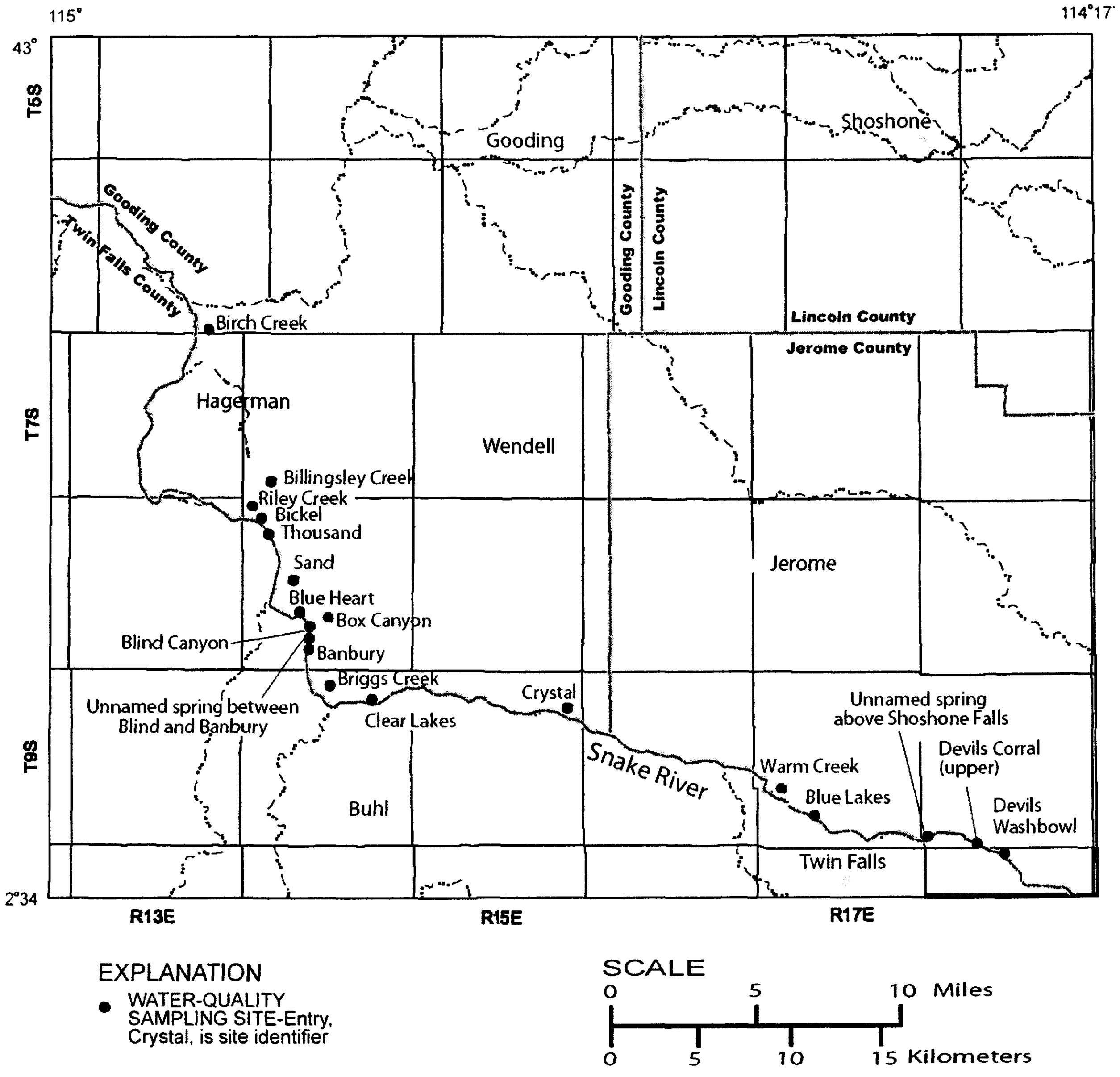

Figure 3. Location of springs at which water samples were collected for tritium analyses, Twin Falls-Hagerman area, Idaho.

pumpage for irrigation and spring flow to the Snake River (Mann and Knobel, 1990). Discharge from springs in the eastern Snake River Plain has fluctuated during the nearly 100 years of flow monitoring as a result of changes in water use, irrigation practices, and precipitation (Kjelstrom, 1992, p. 2).

Acknowledgments

The authors gratefully acknowledge the well owners for granting permission to collect the water samples and extend special thanks to Downey Stode of the Tikura Cattlemen's Association for his help in pumping one of the wells for sample collection. The authors are grateful for technical review of the manuscript by Flint Hall of the Idaho Department of Water Resources and Steven R. Anderson of the USGS.

METHODS AND QUALITY ASSURANCE

The methods used in sampling and analyzing 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; Fishman and Friedman, 1989; Faires, 1992; Fishman, 1993; and Wilde and others, 1998). The methods used in the field and quality-assurance practices are described in the following sections.

Site Selection

Water samples were collected at 16 sites (fig. 2), including 8 irrigation wells, 4 domestic wells, 2 stock wells, 1 spring, and 1 public supply well, and 2 replicate water samples also were collected for quality-assurance purposes. The irrigation wells and public supply well were equipped with turbine pumps. The domestic and stock wells were equipped with submersible pumps. Spring samples were collected as close as reasonably possible to the spring orifices. Samples were collected from the 19 selected springs for tritium analysis as described by Twining (2002). 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 the NWQL were collected and preserved in accordance with laboratory requirements specified by Timme (1995). Water samples analyzed by ISU-EML were collected in accordance with State of Idaho INEEL Oversight Program sample collection procedures. Containers and preservatives were supplied by the respective laboratories. Containers and preservatives used for this study are listed on table 1.

Sample Collection

Most irrigation wells were sampled from spigots in discharge lines, but some were sampled from a 6-inch opening off the irrigation pipe or from stilling ponds at the pump discharge point. Domestic, stock, and the public supply wells were sampled from spigots closest to pumps. All the wells either were pumping on arrival of the sampling team or were started on arrival and pumped long enough to ensure that pressure tanks and pumping systems had been thoroughly flushed as evidenced by stable pH, specific conductance, and water-temperature measurements. The springs were sampled as near the source as possible by collecting a grab sample from an area of moving water.

Chemical and physical characteristics monitored at the water-sampling sites included pH, specific conductance, and water temperature. 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 characteristics indicated probable hydrologic and chemical stability. After collection, sample containers were sealed with laboratory film, labeled, and packed into ice chests (if necessary) for shipment to the NWQL. The samples collected for ISU-EML were stored until they were hand-delivered to the laboratory.

Field measurements of pH, specific conductance, and water temperature for selected wells and springs are shown on tables 2 and 4.

These measurements ranged from 7.3 to 8.7 for pH, from 257 to 863 µS/cm for specific conductance, and from 10.8 to 16.3°C for water temperature.

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 INEEL Project Office. Records for samples analyzed by ISU-EML are maintained at the laboratory.

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), Jones (1987), and Pritt and Raese (1995). Water samples analyzed by the NWQL were collected in accordance with a quality-assurance plan for quality-of-water activities conducted by personnel at the INEEL Project Office. The plan was finalized in June 1989, revised in March 1992 and in 1996 (Mann, 1996), and is available for inspection at the USGS INEEL Project Office. Water samples analyzed by ISU-EML were collected in accordance with procedures described by B. Graham (ISU, written commun., 1991). Williams and others (1998) evaluated the quality-assurance/quality control data collected for this study from 1989 through 1995. About 10 percent of the water samples were quality-assurance samples. Sample MV-53 is a replicate of sample MV-60. Sample MV-44 is a replicate of MV-3. Two quality-assurance replicates also were collected as part of the tritium spring sampling study.

RADIOCHEMICAL CONSTITUENTS

Water samples were analyzed for strontium-90, tritium, gross alpha- and gross beta-particle radioactivity, and gamma-emitting radionuclides. The samples were analyzed using methods described by Thatcher and others (1977). Maximum contaminant levels for selected radionuclides and for the types of radioactivity are listed on table 3.

An analytical uncertainty, **s**, is calculated for each radionuclide concentration or radioactivity measurement. This report presents the analytical uncertainty as 2**s**. 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 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 of 1.6**s** to make the qualitative decision whether the radionuclide or radioactivity was detected. At 1.6**s**, 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 1.6**s**, 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 1.6**s** has been defined, the minimum detectable concentration can be established. Concentrations that equal 3**s** represent a measurement at the minimum detectable concentration. For true concentrations of 3**s** 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 true concentrations greater than or equal to 3**s**, 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.

Many analytical results of environmental radioactivity measurements are at or near zero. If the true concentration for a given radionuclide is zero, a given set of analytical results for that radionuclide should be distributed about zero, with an equal number of negative and positive measurements. Negative analytical results occur if the radioactivity of a water sample is less than the background radioactivity or the radioactivity of the prepared blank sample in the laboratory (American Society for Testing and Materials, 1992, p. 126; Knobel and others, 1992, p. 51).

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 labs located at the NWQL and the ISU-EML. The NWQL uses an electrolytic enrichment and liquid scintillation technique to analyze tritium. The ISU-EML uses two analytical techniques: a standard liquid-scintillation technique and an enrichment and liquid-scintillation technique. The analytical method detection limits for low-level tritium between the laboratories differed. Those for the ISU-EML were 150 and less than 25 pCi/L for ten 20-minute counting periods, and those for the NWQL were 1 pCi/L for a 1,000-minute counting period and 0.3 pCi/L for a 360- to 1,200-minute counting period.

The concentrations of tritium in the water samples are shown on tables 4 and 5. Concentrations of tritium in all of the water samples analyzed by the NWQL were greater than the reporting level and ranged from 4.2±1.0 to 44.5±3.2 pCi/L for the 19 spring sites (table 4) and from 0.3±1.0 to 43.2±3.2 pCi/L for the other 16 sites (table 5). Concentrations of tritium in 16 of the 18 water samples analyzed by the ISU-EML using the enrichment technique were greater than the reporting level and ranged from 10±6 to 49±7 pCi/L (table 5). Samples submitted to ISU-EML for tritium analysis were delayed because they had to be reanalyzed due to possible laboratory contamination. The cause of the contamination was traced to two possible sources: insufficient cleaning of laboratory glassware between samples, and/or a strong tritium source from a nearby facility at ISU-EML causing higher than expected measurements. After glassware cleaning procedures were reviewed, all tritium samples were reprepared and reanalyzed and the initial analysis were rejected. Tritium analyses using the enrichment method were analyzed after the laboratory equipment was moved to a new facility away from the tritium source. For comparison, background concentrations of tritium in ground water in Idaho generally range from 0 to

40 pCi/L (Knobel and others, 1992). The maximum contaminant level for tritium in public drinking-water supplies is 20,000 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. Because strontium-90 tends to sorb onto sediment material in the aquifer, it is not expected to move past its current location at the INEEL (Bartholomay, 1998). All concentrations of dissolved strontium-90 were less than the reporting level for the water samples analyzed (table 5).

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 as dissolved thorium-230 in picocuries per liter by the NWQL and as total thorium-230 in picocuries per liter by the ISU-EML.

The concentration of gross alpha-particle radioactivity reported as dissolved thorium-230 in two of the water samples (MV-27 and MV-57) analyzed by the NWQL were greater than the reporting level (table 6). Concentrations of gross alpha-particle radioactivity reported as total thorium-230 in two water samples (MV-5 and MV-13) analyzed by ISU-EML were greater than the reporting level (table 6).

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; however, laboratories normally report the radioactivity as if it were all given off by one radionuclide. In this report, concentrations are reported as dissolved cesium-137 in picocuries per liter by the NWQL and as total cesium-137 in picocuries per liter by the ISU-EML. The average annual concentrations of strontium-90 and tritium in public drinking-water supplies that produce a 4-mrem/yr dose are 8 and 20,000 pCi/L, respectively (table 3). Gross beta-particle radioactivity measurements should not be compared directly with these concentrations.

Concentrations of gross beta-particle radioactivity reported as dissolved cesium-137 in 16 of the water samples analyzed by the NWQL were greater than the reporting level (table 6) and ranged from 2.47±1.02 to 11.0±2.98 pCi/L. Concentrations of gross beta-particle radioactivity reported as total cesium-137 in 17 of the 18 water samples analyzed by ISU-EML were greater than the reporting level (table 6) and ranged from 1.5±0.9 to 6.2±1.2 pCi/L.

Cesium-137 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. When no specific gamma-emitting radionuclides are identified, the concentrations are reported by ISU-EML as total cesium-137 and total potassium-40. Cesium-137 is a fission product of uranium-235, uranium-233, or plutonium-239. 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). Concentrations of cesium-137 in all samples were less than the reporting level (table 7). The concentrations of potassium-40 in all but one sample were less than the reporting level (table 7). Concentrations in MV-13 slightly exceeded the reporting level with reported concentration of 73±44 pCi/L.

CHEMICAL CONSTITUENTS

Water samples were analyzed for selected chemical constituents. These constituents included trace elements, common ions, nutrients, purgeable organic compounds, insecticides, polychlorinated compounds, and herbicides. In this report, minimum reporting levels and method detection limits established for these constituents are not to be confused with reporting levels and analytical method detection limits for selected radionuclides. The minimum reporting level for inorganic and organic constituents is the smallest measured concentration of a constituent that may be reliably reported using a given analytical method (Timme, 1995, p. 92). The method detection limit is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99-percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (Timme, 1995, p. 92).

Trace Elements

Water samples were analyzed for selected dissolved trace elements including arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, vanadium, and zinc. The maximum or secondary maximum contaminant levels and minimum reporting levels of selected trace elements are shown on table 8. The concentrations of dissolved trace elements are shown on table 9.

Arsenic.—Concentrations of arsenic in all samples were greater than the minimum reporting level and ranged from an estimated 2 to 6 µg/L. The maximum contaminant level is 10 µg/L.

Barium.—Concentrations of barium in all samples were greater than the minimum reporting level and ranged from 5 to 106 µg/L. The maximum contaminant level is 2,000 µg/L.

Beryllium.—Concentrations of beryllium in all samples were less than the minimum reporting level of 1 µg/L. The maximum contaminant level is 4 µg/L.

Cadmium.—Concentrations of cadmium in all samples were less than the minimum reporting level of 8 µg/L. The maximum contaminant level is 5 µg/L.

Chromium.—The concentration of chromium in four samples ranged from an estimated 7 to 10 µg/L; concentrations in all other samples were less than the minimum reporting level of 10 µg/L. The maximum contaminant level is 100 µg/L.

Cobalt.—Concentrations of cobalt in all samples were less than the minimum reporting level of 13 µg/L. The maximum contaminant level for cobalt has not been established.

Copper.—Concentrations of copper in two samples ranged from an estimated 3 to 5 µg/L; concentrations in all other samples were less than the minimum reporting level of 5.8 µg/L. The secondary maximum contaminant level is 1,000 µg/L.

Iron.—Concentrations of iron in all samples were less than the minimum reporting level of 10 µg/L. The secondary maximum contaminant level is 300 µg/L.

Lead.—Concentrations of lead in 15 of 18 samples ranged from an estimated 0.04 to 1.1 µg/L, the rest were less than the minimum reporting level of 0.8 µg/L. Lead has an action level of 15 µg/L.

Lithium.—Concentrations of lithium in 18 samples ranged from an estimated 3 to 53 µg/L. The maximum contaminant level for lithium has not been established.

Manganese.—The concentration of manganese in one sample, MV-25, was an estimated 0.2 µg/L. Concentrations in all other samples were less than the minimum reporting level of 3 µg/L. The secondary maximum contaminant level is 50 µg/L.

Mercury.—The concentrations of mercury in two samples, MV-57 and MV-58, were an estimated 0.001 and 0.004 µg/L, respectively; concentrations in all other samples were less than the minimum reporting level of 0.01 µg/L. The maximum contaminant level is 2 µg/L.

Molybdenum.—Concentrations of molybdenum in all samples were less than the minimum reporting level of 50 µg/L. The maximum contaminant level for molybdenum has not been established.

Nickel.—Concentrations of nickel in all samples were less than the minimum reporting level of 50 µg/L. The maximum contaminant level is 100 µg/L.

Selenium.—The concentration of selenium in three samples ranged from an estimated 1 to 1.6 µg/L; concentrations in the other samples were reported as less than the minimum reporting level of 2 µg/L. The maximum contaminant level is 50 µg/L.

Silver.—Concentrations of silver in all samples were less than the minimum reporting level of 5 µg/L. The secondary maximum contaminant level is 100 µg/L.

Strontium.—Concentrations of strontium in all samples were greater than the minimum reporting level of 0.6 µg/L and ranged from 105 to 455 µg/L. The maximum contaminant level for strontium has not been established.

Vanadium.—Concentrations of vanadium in 16 samples ranged from an estimated 5 to 13 µg/L. The minimum reporting level for vanadium is 8 µg/L.

Zinc.—Concentrations of zinc in five samples ranged from an estimated 16 to 181 µg/L. Zinc has a minimum reporting level of 20 µg/L.

Common Ions

Water samples were analyzed for dissolved common ions including calcium, magnesium, silica, and sodium. The minimum reporting levels of these ions are shown on table 10. Maximum contaminant levels have not been established for any of these common ions. The concentrations of dissolved common ions are shown on table 11.

Calcium.—Concentrations of calcium in all samples were greater than the minimum reporting level of 0.012 mg/L and ranged from 23 to 71 mg/L.

Magnesium.—Concentrations of magnesium in all samples were greater than the minimum reporting level of 0.008 mg/L and ranged from 11 to 29 mg/L.

Silica.—Concentrations of silica in all samples were greater than the minimum reporting level of 0.13 mg/L and ranged from 28 to 42 mg/L.

Sodium.—Concentrations of sodium in all samples were greater than the minimum reporting level of 0.09 mg/L and ranged from 12 to 61 mg/L.

Nutrients

Water samples were analyzed for dissolved ammonia (as nitrogen), nitrite (as nitrogen), nitrite plus nitrate (as nitrogen), and orthophosphate (as phosphorus). The maximum contaminant levels and the minimum reporting levels are shown on table 10. A maximum contaminant level has not been established or proposed for ammonia or orthophosphate. Concentrations of nutrients are shown on table 11.

Ammonia (as nitrogen).—Concentrations of ammonia (as nitrogen) in all samples analyzed were less than the minimum reporting level of 0.041 mg/L.

Nitrite (as nitrogen).—Concentrations of nitrite (as nitrogen) in all samples were less than the minimum reporting level of 0.006 mg/L. The maximum contaminant level is 1 mg/L.

Nitrite plus nitrate (as nitrogen).—Concentrations of nitrite plus nitrate (as nitrogen) in 17 of 18 samples were greater than the minimum reporting level of 0.047 mg/L and ranged from 0.4 to 5.3 mg/L. The maximum contaminant level is 10 mg/L.

Orthophosphate (as phosphorus).—Concentrations of orthophosphate (as phosphorus) in eight of the samples ranged from an estimated 0.01 to 0.06 mg/L. The maximum reporting level for orthophosphate is 0.018 mg/L.

Purgeable Organic Compounds

Water samples were analyzed for 61 purgeable organic compounds. The maximum contaminant levels and minimum reporting levels of these compounds are shown on table 12. Concentrations of xylene in two samples were an estimated 0.1487 and 0.1221 µg/L in MV-7 and MV-55, respectively. The minimum reporting level for xylene is 0.2 µg/L. Concentrations of purgeable organic compounds in all other samples were less than the respective minimum reporting levels.

Insecticides and Gross Polychlorinated Compounds

Water samples were analyzed for concentrations of 10 carbamate insecticides, 11 organophosphate insecticides, 15 organochlorine insecticides, gross PCBs, and gross PCNs (table 13). The minimum reporting levels ranged from 0.0025 to 1.0 µg/L. Water samples also were analyzed for an additional group of 23 insecticides that included 11 of the carbamate, organophosphate, and organochlorine insecticides mentioned above; therefore, 11 insecticides are listed twice and minimum reporting levels may be different due to laboratory methods used. The maximum contaminant levels and minimum reporting levels for these compounds are shown on table 13. Concentrations of insecticides and polychlorinated compounds in all samples were less than the respective minimum reporting levels or method detection limits.

Herbicides

Water samples were analyzed for concentrations of 5 chlorophenoxy-acid herbicides and 47 other herbicides. Maximum contaminant levels and minimum reporting levels for these compounds are shown on table 14. Because laboratory schedules with different method detection limits and minimum reporting levels than past schedules were used, concentrations of some herbicides in several samples exceeded the method detection limits or minimum reporting levels (table 15). Concentrations in some of the samples listed in table 15 exceeded the method detection limits but were less than the minimum reporting levels. The estimated concentrations in table 15 need to be evaluated carefully because of variable performance (Zaugg and others, 1995). Concentrations of alachlor in one sample (MV-17) was 0.003 µg/L. Estimated and reported concentrations of atrazine in eight samples ranged from an estimated 0.001 to 0.017 µg/L. Estimated concentrations of desethyl atrazine in four samples ranged from an estimated 0.004 to 0.008 µg/L. The analyses for desethyl atrazine demonstrated low recovery because of poor retention on the solid-phase extraction column (Zaugg and others, 1995). The concentration of EPTC in one sample (MV-38) was 0.008 µg/L. The estimated concentrations of metolachlor in two samples, MV-7 and its replicate MV-13, were an estimated 0.001 and 0.002 µg/L, respectively. Concentrations of simazine in MV-6 were 0.0225 µg/L. Concentrations of herbicides in all the samples not listed in table 15 were less than the minimum reporting levels and method detection limits.

SUMMARY

The USGS and the IDWR, in cooperation with the DOE, sampled water from 16 of 18 previously sampled sites as part of the fifth round of a long-term project to monitor water quality of the Snake River Plain aquifer from the southern boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman area. Two sites were not sampled because one site was decommissioned and the other was discontinued due to a change in the new well owner. Water samples were collected and analyzed for selected radiochemical and chemical constituents. The samples were collected from eight irrigation wells, four domestic wells, two stock wells, one spring, and one public supply well. Two quality-assurance samples also were collected and analyzed. Nineteen spring samples were collected and analyzed for tritium along with two replicate quality assurance samples.

Concentrations of tritium in samples from the 19 springs and 14 sites analyzed by the NWQL and in 16 of the samples analyzed by ISU using an enrichment technique were greater than the reporting level, but none exceeded the maximum contaminant level for drinking water. The concentrations of gross alpha-particle radioactivity reported as dissolved thorium-230 in two samples analyzed by the NWQL and in two samples analyzed by ISU-EML were greater than the reporting level. Concentrations of gross beta-particle radioactivity reported as dissolved cesium-137 in 16 samples analyzed by the NWQL were greater than the reporting level. Concentrations of gross beta-particle radioactivity reported as total cesium-137 in 17 of the 18 samples analyzed by ISU-EML were greater than the reporting level. Concentrations of total cesium-137 were analyzed by using gamma spectrometry, and concentrations

in all the samples were less than the reporting level. Concentrations of total potassium-40, also analyzed by using gamma spectrometry, were less than the reporting level except in one sample.

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

Concentrations of ammonia (as nitrogen) and nitrite (as nitrogen) in all samples were less than the minimum reporting levels. Concentrations of nitrite plus nitrate (as nitrogen) in all but one water sample were greater than the minimum reporting level. Concentrations of orthophosphate (as phosphorus) in five water samples analyzed by the NWQL were greater than the minimum reporting level. No nutrient concentration exceeded an established maximum contaminant level.

Concentrations of most purgeable organic compounds, carbamate insecticides, gross PCBs, and gross PCNs in all samples were less than the respective minimum reporting levels. Estimated concentration of xylene in two samples were 0.1487 and 0.1221 µg/L in MV-7 and MV-55, respectively, but did not exceed the respective minimum reporting level of 0.2 µg/L. Concentrations of some herbicides were greater than the method detection limits or minimum reporting levels, but none exceeded established maximum contaminant levels.

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

[Abbreviations: L, liter; mL, milliliter; µm, micrometer; °C, degrees Celsius. Chemical formulas: HNO_3, nitric acid; HCl, hydrocloric acid. Chilled samples were shipped by overnight-delivery mail. Analyzing laboratory: NWQL, U.S. Geological Survey National Water Quality Laboratory; ISU-EML, Idaho State University Environmental Monitoring Laboratory]

Constituent or type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Size		
Strontium-90	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	0.45-µm filter	NWQL
Tritium	Polyethylene	1 L	None	None	None	NWQL
	Polyethylene	1 L	None	None	None	ISU-EML
Other radionuclides	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	.45-µm filter	NWQL
	Polyethylene	2 L	None	None	None	ISU-EML
Trace elements and common ions	Polyethylene, acid rinsed	250 mL	Ultrex, HNO_3	2 mL	.45-µm filter	NWQL
	Polyethylene	125 mL	None	None	None	NWQL
Mercury	Glass, acid rinsed	250 mL	Ultrapure HCl	2 mL	.45-µm filter	NWQL
Nutrients	Polyethylene, brown	125 mL	None	None	.45-µm filter, chill 4°C	NWQL
Purgeable organic compounds	Glass, baked	40 mL	None	None	Chill 4°C	NWQL
Pesticides	Glass, baked	1 L	None	None	Chill 4°C	NWQL

Table 2. Results of field measurements of water for pH, specific conductance, and temperature from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Site type: H, domestic; I, irrigation; Sp, spring; QA, quality assurance (MV-44* is a replicate of MV-3; *MV-53 is a replicate of MV-50); P, public supply; S, stock. Date sampled: month/day/year. Units: 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]

Site identifier	Site type	Date sampled	pH	Specific conductance	Temperature
MV-3	I	7/24/01	7.9	451	12.8
MV-5	I	7/24/01	7.9	712	12.1
MV-6	I	7/24/01	7.7	605	14.5
MV-7	I	6/26/01	8.0	361	13.1
MV-13	I	7/24/01	7.9	598	15.2
MV-17	Sp	7/25/01	8.1	380	14.4
MV-25	H	7/26/01	7.3	686	14.1
MV-27	I	7/26/01	7.7	660	14.2
MV-32	H	7/25/01	7.8	676	15.0
MV-36	P	7/24/01	7.6	384	13.7
MV-38	I	7/25/01	8.0	346	14.1
MV-42	H	7/25/01	7.8	410	15.3
MV-44*	QA	7/24/01	7.9	451	12.8
MV-53*	H	7/24/01	7.8	863	16.3
MV-55	I	7/26/01	7.8	409	14.4
MV-57	S	6/5/01	8.1	257	12.1
MV-58	S	6/5/01	7.4	274	10.8
MV-60*	QA	7/24/01	7.8	863	16.3

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

[The maximum contaminant levels were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 344) for community water systems and are included for comparison purposes only. Maximum contaminant levels given for strontium-90 and tritium are average annual concentrations assumed to produce a total body or organ dose of 4 millirem per year (mrem/yr) of beta-particle radiation. 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 and gamma radioactivity excludes radioactivity from natural sources and is included for comparison purposes only. Abbreviation: pCi/L, picocurie per liter]

Radionuclide or type of radioactivity	Maximum contaminant level
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L
Gross alpha-particle radioactivity	15 pCi/L
Gross beta-particle and gamma radioactivity	4 mrem/yr

Table 4. Physical and chemical characterisitcs of and tritium concentrations in water from selected springs in the Twin Falls-Hagerman area, Idaho

[See figure 3 for location of springs. Analyses performed by the U.S. Geological Survey National Water Quality Laboratory. Analytical results and uncertainties—for example,4.2±0.5—in picocures per liter. Analytical uncertainties reported as 2**s**. Concentrations that exceed the reporting level of 3 times 1**s** are shown in boldface type. Date sampled: month/day/year. Units: pH, negative base-10 logarithm of the hydrogen-ion activity in moles per liter; specific conductance, microsiemens per centimeter at 25 °C (degrees celsius); temperature, °C. Remarks: replicate indicates a second sample was submitted for analysis with a different identifier]

Name of spring(s)	Date sampled	Temperature (°C)	pH	Specific conductance	Tritium	Remarks
Banbury	3/5/01	13.5	8.5	422	**4.2±1.0**	
Bickel	3/5/01	15.4	8.3	324	**6.7±1.0**	
Billingsley Creek	3/5/01	15.2	7.7	343	**8.6±1.0**	
Birch Creek	3/5/01	14.5	8.4	422	**18.9±1.6**	
Blind Canyon	3/5/01	13.7	8.7	585	**8.0±1.0**	
QA-1	3/5/01	13.7	8.7	585	**9.0±1.0**	Replicate
Blue Heart	3/5/01	14.5	7.6	388	**5.8±1.0**	
Blue Lakes	3/6/01	15.7	7.8	604	**37.4±2.6**	
Box Canyon	3/7/01	14.3	8.1	409	**7.0±1.0**	
Briggs Creek	3/7/01	14.2	7.7	478	**7.7±1.0**	
Clear Lakes	3/7/01	14.2	7.9	467	**7.0±1.0**	
Crystal	3/7/01	14.6	8.1	673	**30.7±1.6**	
Devils Corral (upper)	3/6/01	14.6	7.9	622	**29.8±1.6**	
Devils Washbowl	3/6/01	13.6	8.4	634	**35.5±1.9**	
Riley Creek	3/5/01	15.2	8.0	326	**6.4±1.0**	
Sand	3/7/01	14.2	7.8	388	**5.4±1.0**	
QA-2	3/7/01	14.2	7.8	388	**5.8±1.0**	Replicate
Thousand	3/5/01	14.6	8.3	352	**6.1±1.0**	
Unnamed springs between Blind Canyon and Banbury	3/5/01	13.8	8.4	422	**5.8±1.0**	
Unnamed spring #2 above Shoshone Falls Power Plant	3/7/01	14.8	8.2	602	**44.5±3.2**	
Warm Creek	3/7/01	15.5	7.8	614	**37.4±2.6**	

Table 5. Concentrations of tritium and strontium-90 inn water from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory (NWQL) and Idaho State University Environmental Monitoring Laboratory (ISU-EML) using the following methods: strontium-90 by chemical separation and precipitation; tritium by enrichment and liquid scintillation at the NWQL and by standard liquid scintillation and enrichment and liquid scintillation at ISU-EML. Analytical results and uncertainties—for example 0.108±0.094—in picocuries per liter. Analytical uncertainties are reported as **2s.** Concentrations that exceed the reporting level of 3 times **1s** are shown in boldface type. Symbol: *, quality-assurance sample (MV-53 is a replicate of MV-60; MV-44 is a replicate of MV-03); U, non-detect; J, estimate]

Site identifier	Tritium, NWQL	Tritium, ISU-EML	Tritium, ISU-EML (Enrichment)	Strontium-90, NWQL
MV-3	1.3±1.0	85±90 U, J	**15±7**	0.108±0.194
MV-5	**7.0±1.0**	40±90 U, J	**16±6**	.046±0.079
MV-6	**40.3±2.6**	25±90 U	**44±8**	.187±0.242
MV-7	.3±1.0	29±90 U	**27±8**	.125±0.163
MV-13	**41±2.6**	27±90 U	**32±10**	.042±0.214
MV-17	**6.7±1.0**	85±90 U, J	**17±6**	.0113±0.242
MV-25	**36.8±2.6**	70±90 U, J	**38±6**	.102±0.192
MV-27	**31.0±1.9**	-15±90 U, J	**32±9**	.216±0.208
MV-32	**27.2±1.9**	20±90 U	**37±6**	-.035±0.22
MV-36	**35.8±2.6**	27±90 U	**29±8**	.097±0.2
MV-38	**30.1±1.9**	40±90 U, J	**36±6**	.203±0.201
MV-42	**12.2±1.0**	77±90 U, J	**18±5**	.069±0.185
MV-44*	**1.9±1.0**	65±90 U	2±8	.0272±0.2
MV-53*	**42.2±2.6**	62±90 U, J	**46±6**	.122±0.249
MV-55	NA	5±90 U, J	8±7	.088±0.213
MV-57	.3±1.0	48±90 U	**10±6**	.078±0.156
MV-58	**27.5±1.9**	55±90 U, J	**35±8**	.004±0.142
MV-60	**43.2±3.2**	65±90 U, J	**49±7**	-.0379±0.238

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

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory (NWQL) and the Idaho State University Environmental Monitoring Laboratory (ISU-EML) using a residue procedure. Analytical results and uncertainties—for example .48±0.96—in picocuries per liter. Analytical uncertainties are reported as 2**s**. Concentrations that equal or exceed the reporting level of 3 times 1**s** are shown in boldface type. Symbol: *, quality-assurance sample (MV-53 is a replicate of MV-60; MV-44 is a replicate of MV-3). Samples from MV-3, MV-6 and MV-38 for ISU gross alpha and gross beta analyses represent laboratory averages of split samples or lab recounts or reevaporations]

Site identifier	Gross alpha, as dissolved thorium-230, NWQL	Gross alpha, as total thorium-230, ISU-EML	Gross beta, as dissolved cesium-137, NWQL	Gross beta, as total cesium-137, ISU-EML
MV-3	1.61±2.07	1.15±1.5	**6.15±1.70**	**2.05±0.85**
MV-5	3.80±3.48	**4.9±2.3**	**9.28±2.55**	**3.9±1.0**
MV-6	2.80±2.39	1.9±2.15	**8.52±2.18**	**3.35±1.0**
MV-7	.48±0.96	1.1±1.4	3.20±2.16	**1.8±0.8**
MV-13	1.35±2.09	**3.7±1.8**	**9.00±2.17**	**5.0±1.0**
MV-17	0.69±1.56	0.3±1.4	**5.91±1.23**	**1.8±0.8**
MV-25	4.42±3.21	0.5±2.9	**8.66±2.97**	**6.2±1.2**
MV-27	**5.12±3.37**	0.8±1.8	**7.61±2.51**	**3.5±1.1**
MV-32	3.34±3.13	1.6±2.2	**8.28±2.63**	**4.7±1.0**
MV-36	1.17±1.73	2.3±1.7	**4.98±1.59**	**1.5±0.8**
MV-38	1.67±2.35	2.05±1.85	**5.27±1.26**	**1.6±0.85**
MV-42	2.24±2.80	1.4±1.8	**6.97±1.49**	**1.5±0.9**
MV-44*	3.64±2.91	1.5±1.7	**4.52±1.19**	**1.7±0.9**
MV-53*	5.02±3.86	2.2±2.1	**9.24±2.88**	**5.8±1.1**
MV-55	.89±1.10	1.4±1.5	2.78±2.34	**2.9±0.9**
MV-57	**2.20±1.13**	1.1±1.4	**2.47±1.02**	0.8±0.8
MV-58	.63±0.76	1.1±1.2	**3.58±1.51**	**1.6±0.8**
MV-60	4.16±3.78	1.1±2.6	**11.00±2.98**	**5.0±1.1**

Table 7. Concentrations of cesium-137 and potassium-40 in water from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Analyses were performed by the Idaho State University Environmental Monitoring Laboratory using gamma spectrometry. Analytical results and uncertainties—for example 0.05±2.15—are for total concentrations in picocuries per liter. Analytical uncertainties are reported as 2**s**. Concentrations that equal or exceed the reporting level of 3 times 1**s** are shown in bold face type. Symbol: *, quality-assurance sample (MV-53 is a replicate of MV-60, MV-44 is a replicate of MV-3). Results for MV-3, MV-6, and MV-38 are averages of split analyses]

Site identifier	Cesium-137	Potassium-40
MV-3	-0.2±1.6	12±42
MV-5	2.5±1.9	-3±41
MV-6	-0.2±1.5	-8±42
MV-7	1.0±1.9	-7±42
MV-13	-0.8±2.0	**73±44**
MV-17	-0.1±1.5	52±44
MV-25	1.2±1.7	8±42
MV-27	1.9±1.9	39±42
MV-32	0.4±1.8	15±45
MV-36	-0.8±1.7	38±42
MV-38	2.1±1.7	7±42
MV-42	.02±1.3	34±42
MV-44*	1.3±1.6	-13±42
MV-53*	1.9±1.8	-8±41
MV-55	1.1±1.8	0±41
MV-57	0.6±1.3	48±45
MV-58	0.9±1.8	41±42
MV-60	0.2±1.3	10±40

Table 8. Maximum or secondary maximum contaminant levels and minimum 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 (1994; 2000, p. 343, 421) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels—in brackets—are from U.S. Environmental Protection Agency (2000, p. 613). Units are in micrograms per liter (μg/L). Symbols: ••, maximum contaminant level has not been established; *, lead has an action level of 15 μg/L]

Trace element	Maximum or secondary maximum contaminant level	Minimum reporting level
Arsenic	10	1.8
Barium	2,000	0.9
Beryllium	4	1
Cadmium	5	8
Chromium	100	10
Cobalt	••	13
Copper	[1,000]	5
Iron	[300]	10
Lead	*	.08
Lithium	••	3.9
Manganese	[50]	3
Mercury	2	.011
Molybdenum	••	50
Nickel	100	50
Selenium	50	2.0
Silver	[100]	5
Strontium	••	.6
Vanadium	••	8
Zinc	[5,000]	20

Table 9. Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory. Analytical results in micrograms per liter. Symbols: --, results not available; <, concentration is less than the respective minimum reporting level; *, quality-assurance sample (MV-53 is a replicate of MV-60; MV-44 is a replicate of MV-3); E, estimated result]

Site identifier	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Lithium
MV-3	3	25	<1	<8	10	<13	5E	<10	.14	26
MV-5	3	58	<1	<8	<10	<13	<.8	<10	<.08	36
MV-6	4	82	<1	<8	<10	<13	<.8	<10	<.08	30
MV-7	2	22	<1	<8	<10	<13	<.8	<10	1.1	27
MV-13	6	77	<1	<8	<10	<13	<5	<10	.04E	25
MV-17	3	23	<1	<8	<10	<13	<5	<10	<.08	26
MV-25	3	56	<1	<8	<10	<13	<5	<10	.22	24
MV-27	2	58	<1	<8	<10	<13	<5	<10	.08	34
MV-32	3	85	<1	<8	<10	<13	<5	<10	.21	36
MV-36	2	40	<1	<8	<10	<13	<5	<10	.08E	5
MV-38	2	28	<1	<8	7E	<13	<5	<10	.08	7
MV-42	3	--	<1	<8	<10	<13	<5	<10	.18	18
MV-44*	2	25	<1	<8	<10	<13	<5	<10	.13	27
MV-53*	3	106	<1	<8	8E	<13	<5	<10	.38	53
MV-55	2	23	<1	<8	<10	<13	<5	<10	.04E	29
MV-57	2	5	<1	<8	<10	<13	<5	<10	.06E	4
MV-58	3	18	<1	<8	<10	<13	<5	<10	.28	3E
MV-60	3	106	<1	<8	9E	<13	3E	<10	.37	42

Table 9. Concentrations of dissolved trace elements in water from selected wells and springs, eastern Snake River Plain—Continued

Site identifier	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Vanadium	Zinc
MV-3	<3	<.01	<50	<50	<2	<5	219	8	<20
MV-5	<3	<.01	<50	<50	<2	<5	350	7E	<20
MV-6	<3	<.01	<50	<50	<2	<5	384	<8	<20
MV-7	<3	<.01	<50	<50	<2	<5	198	9	<20
MV-13	<3	<.01	<50	<50	<2	<5	256	13	<20
MV-17	<3	<.01	<50	<50	<2	<5	200	10	<20
MV-25	2E	<.01	<50	<50	1.4E	<5	283	13	181
MV-27	<3	<.01	<50	<50	<2	<5	349	6E	<20
MV-32	<3	<.01	<50	<50	1.6E	<5	360	7E	<20
MV-36	<3	<.01	<50	<50	<2	<5	186	<8	<20
MV-38	<3	<.01	<50	<50	<2	<5	163	8E	<20
MV-42	<3	<.01	<50	<50	<2	<5	204	11	16E
MV-44*	<3	<.01	<50	<50	<2	<5	216	8	<20
MV-53*	<3	<.01	<50	<50	<2	<5	454	5E	66
MV-55	<3	<.01	<50	<50	<2	<5	203	11	<20
MV-57	<3	.000E	<50	<50	<2	<5	139	8	<20
MV-58	<3	.004E	<50	<50	<2	<5	105	11	30
MV-60	<3	<.01	<50	<50	1E	<5	455	7E	70

Table 10. Maximum contaminant levels and minimum reporting levels of selected common ions and nutrients 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 (2000, p. 421) for community water systems and are for comparison purposes only. Minimum reporting levels are from Timme (1995). Units are in milligrams per liter (mg/L). Symbol: ••, maximum contaminant level has not been established]

Constituent	Maximum contaminant level	Minimum reporting level
Calcium	••	0.012
Magnesium	••	.008
Silica	••	.13
Sodium[1]	••	.09
Ammonia (as nitrogen)	••	.041
Nitrite (as nitrogen)	1	.008
Nitrite plus nitrate (as nitrogen)	10	.047
Orthophosphate (as phosphorus)	••	.018

[1] Idaho Department of Health and Welfare (1989) recommends an optimum concentration of 20 mg/L for public drinking-water supplies.

Table 11. Concentrations of dissolved common ions and nutrients in water from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory. Analytical results in milligrams per liter. Symbols: <, concentration is less than the respective minimum reporting level; *, quality-assurance sample (MV-53 is a replicate of MV-60; MV-44 is a replicate of MV-3; E, estimated result)]

Site identifier	Calcium	Magnesium	Silica	Sodium	Ammonia (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Orthophosphate (as phosphorus)
MV-3	41	17	33	26	<0.041	<0.006	1.6	<0.018
MV-5	56	25	33	51	<.041	<.006	2.6	.01E
MV-6	68	20	30	20	<.041	<.006	5.3	.01E
MV-7	34	14	32	15	<.041	<.006	.43	<.018
MV-13	48	21	42	44	<.041	<.006	1.6	<.018
MV-17	36	16	33	19	<.041	<.006	.93	<.018
MV-25	58	24	35	44	<.041	<.006	2.6	.06
MV-27	61	24	35	36	<.041	<.006	1.8	<.02
MV-32	63	26	41	39	<.041	<.006	4.3	.01E
MV-36	45	15	31	17	<.041	<.006	1.3	.03
MV-38	38	14	31	14	<.041	<.006	1.1	.03
MV-42	37	19	35	20	<.041	<.006	1.4	.02
MV-44*	40	17	33	27	<.041	<.006	<.047	<.018
MV-53*	70	29	36	61	<.041	<.006	4.5	<.018
MV-55	37	16	33	20	<.041	<.006	.8	<.018
MV-57	23	11	29	12	<.041	<.006	.4	<.018
MV-58	24	11	28	15	<.041	<.006	1.5	.018
MV-60	71	29	35	58	<.041	<.006	4.4	<.018

Table 12. Maximum contaminant levels and minimum reporting levels of selected purgeable organic compounds in drinking water

[Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory using an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994; 2000, p. 419) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). Units are in micrograms per liter. Symbols: ••, MCL has not been established or proposed; *, total trihalomethanes—which include bromoform, chlorodibromomethane, chloroform, and dichlorobromomethane—in community water systems serving 10,000 or more persons cannot exceed 100 µg/L (U.S. Environmental Protection Agency, 2000, p. 343)]

Compound	MCL	MRL	Compound	MCL	MRL
Acrylonitrile	••	2.5	1,3-Dichloropropane	••	0.2
Benzene	5	.1	2,2-Dichloropropane	••	.2
Bromobenzene	••	.2	cis-1,3-Dichloropropene	••	.2
Bromochloromethane	••	.2	trans-1,3-Dichloropropene	••	.2
Bromoform	*	.2	1,1-Dichloropropene	••	.2
Bromomethane	••	.3	Ethylbenzene	700	.1
n-Butylbenzene	••	.2	Hexachlorobutadiene	••	.2
sec-Butylbenzene	••	.2	Isopropylbenzene	••	.2
tert-Butylbenzene	••	.2	p-Isopropyltoluene	••	.2
Carbon tetrachloride	5	.2	Methylene chloride	5	.2
Chlorobenzene	100	.1	Methyl tert-butylether	••	.2
Chlorodibromomethane	*	.2	Naphthalene	••	.5
Chloroethane	••	.2	n-Propylbenzene	••	.2
Chloroform	*	.1	Styrene	100	.1
Chloromethane	••	.2	1,1,1,2-Tetrachloroethane	••	.2
2-Chlorotoluene	••	.2	1,1,2,2-Tetrachloroethane	••	.2
4-Chlorotoluene	••	.2	Tetrachloroethylene	5	.1
1,2-Dibromo-3-chloropropane	.2	1	Toluene	1,000	.1
1,2-Dibromoethane	.05	.2	1,2,3-Trichlorobenzene	••	.2
Dibromomethane	••	.2	1,2,4-Trichlorobenzene	70	.2
1,2-Dichlorobenzene	600	.1	1,1,1-Trichloroethane	200	.1
1,3-Dichlorobenzene	600	.2	1,1,2-Trichloroethane	5	.2
1,4-Dichlorobenzene	75	.1	Trichloroethene	5	.1
Dichlorobromomethane	*	.2	Trichlorofluoromethane	••	.2
Dichlorodifluoromethane	••	.2	1,2,3-Trichloropropane	••	.2
1,1-Dichloroethane	••	.1	1,1,2-Trichloro 1,2,2-trifluoroethane	••	.1
1,2-Dichloroethane	5	.1	1,2,4-Trimethylbenzene	••	.2
cis-1,2-Dichloroethene	70	.2	1,3,5-Trimethylbenzene	••	.2
1,1-Dichloroethene	7	.2	Vinyl chloride	2	.2
trans-1,2-dichloroethene	100	.2	Xylenes, total ortho, meta, and para	10,000	.2
1,2-Dichloropropane	5	.2			

Table 13. Maximum contaminant levels and minimum reporting levels of selected insecticides and gross polychlorinated compounds in drinking water

[Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory. Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level; MDL, method detection limit; LRL, lower reporting limit. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 420-421) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). MDLs are from Zaugg and others (1995). Units are in micrograms per liter. Symbols: ••, MCL has not been established or proposed; *, samples analyzed using two different laboratory schedules resulting in different method MRLs; **, chlorthalonil is a fungicide, DNOC is considered an insecticide and herbicide]

Carbamate insecticides

Insecticide	MCL	MRL	Insecticide	MCL	MRL
Aldicarb	3	0.21	Methiocarb	••	0.07
Aldicarb sulfone	2	.20	Methomyl	••	.017
Aldicarb sulfoxide	4	.02	Oxamyl	200	.018
*Carbaryl (Sevin)	••	.024	Propham	••	.09
*Carbofuran	40	.20	Propoxur	••	.12

Organophosphate insecticides

Insecticide	MCL	MRL	Insecticide	MCL	MRL
*Chlorpyrifos; Dursban	••	0.01	*Malathion	••	0.027
DEF	••	.01	Methylparathion	••	.01
*Diazinon	••	.005	Parathion	••	.007
*Di-Syston (Disulfoton)	••	.01	*Phorate	••	.011
Ethion	••	.013	Trithion	••	.01
*Fonofos	••	.012			

Organochlorine insecticides

Insecticide	MCL	MRL	Insecticide	MCL	MRL
Aldrin	••	0.013	Heptachlor	0.4	0.014
Chlordane, technical	2	.1	Heptachlor epoxide	.2	.009
DDD, p,p'-	••	.01	*Lindane	.2	.004
*DDE, p,p'-	••	.0025	Methoxychlor, p,p'-	40	.01
DDT, p,p'-	••	.01	Mirex	••	.006
*Dieldrin	••	.0048	Perthane	••	.1
Endosulfan I	••	.01	Toxaphene	3	1.0
Endrin	2	.014			

Gross polychlorinated compounds

Compound	MCL	MRL
Gross polychlorinated biphenyls (PCBs)	0.5	0.1
Gross polychlorinated naphthalenes (PCNs)	••	.1

Table 13. Maximum contaminant levels and minimum reporting levels of selected insecticides and gross polychlorinated compounds in drinking water—Continued

Additional insecticides

Insecticide	MCL	MRL	MDL	Insecticide	MCL	MRL	MDL
Azinphos methyl-	••	0.038	0.001	*Fonofos	••	0.012	0.003
*Carbaryl (Sevin)	••	.041	.003	HCH, alpha-	••	.007	.002
*Carbofuran	40	.20	.003	*HCH, gamma- (Lindane)	.2	.011	.004
*Chlorpyrifos	••	.005	.004	Hydroxycarbofuran, 3-	••	.011	.014
**Chlorthalonil	••	.13	.035	*Malathion	••	.1	.005
*DDE, p,p'-	••	.0025	.006	Parathion, ethyl-	••	.022	.004
*Diazinon	••	.005	.002	Parathion, methyl-	••	.015	.006
*Dieldrin	••	.006	.001	Permethrine, cis-	••	.019	.005
Dinoseb	••	.09	.035	*Phorate	••	.019	.002
*Disulfoton	••	.021	.017	Propargite I & II	••	.006	.013
**DNOC	••	.25	.035	Terbufos	••	.017	.013
Ethoprop	••	.005	.003				

Table 14. Maximum contaminant levels and minimum reporting levels of chlorophenoxy-acid herbicides and other herbicides in drinking water

[Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory. Abbreviations: MCL, maximum contaminant level; MRL, minimum reporting level; MDL, method detection limit. MCLs were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 420-421) for community water systems and are included for comparison purposes only. MRLs are from Timme (1995). MDLs are from Zaugg and others (1995). Units are in micrograms per liter. Symbols: ••, MCL has not been established or proposed; *, samples analyzed using two different laboratory schedules resulting in different method MRLs]

Chlorophenoxy-acid herbicides

Herbicide	MCL	MRL	Herbicide	MCL	MRL
*2,4-D	70	0.021	*Silvex	50	0.01
(dissolved)	70	.11	(dissolved)	••	.025
2,4-DB	••	.25	*2,4,5-T	••	.07
2,4-DP	••	.10	(dissolved)	••	.040

Other herbicides

Herbicide	MCL	MRL	MDL	Herbicide	MCL	MRL	MDL
Acetochlor	••	0.006	0.002	*Linuron	••	0.035	0.002
Acifluorfen	••	.05	.035	(dissolved)	••	.018	.018
Alachlor	2	.0045	.002	MCPA	••	.17	.050
Atrazine	3	.007	.001	MCPB	••	.14	.035
Atrazine, desethyl-	••	.006	.002	Metolachlor	••	.013	.002
Benfluralin	••	.010	.002	Metribuzin	••	.006	.004
Bentazon	••	.035	.014	Molinate	••	.0016	.004
Bromacil	••	.09	.035	Napropamide	••	.007	.003
Bromoxynil	••	.07	.035	Neburon	••	.015	.015
Butylate	••	.002	.002	Norflurazon	••	.024	.024
Chloramben	••	.42	.011	Oryzalin	••	.31	.019
Clopyralid	••	.42	.050	Pebulate	••	.0041	.004
Cyanazine	••	.018	.004	Pendimethalin	••	.022	.004
*DCPA (Dacthal)	••	.003	.002	Picloram	500	.045	.050
(dissolved)	••	.017	.017	Prometon	••	.015	.018
Dicamba	••	.043	.035	Pronamide	••	.0041	.003
Dichlobenil	••	.049	.020	Propachlor	••	.010	.007
Dichlorprop	••	.031	.032	Propanil	••	.011	.004
Diethylaniline	••	.006	.003	Simazine	4	.005	.005
Diuron	••	.056	.020	Tebuthiuron	••	.016	.010
EPTC (Eptam)	••	.002	.002	Terbacil	••	.034	.007
Ethalfluralin	••	.009	.004	Thiobencarb	••	.0048	.002
Fenuron	••	.017	.013	Triallate	••	.0023	.001
Fluometuron	••	.035	.035	Triclopyr	••	.25	.050
				Trifluralin	••	.009	.002

Table 15. Concentrations of selected herbicides in water from selected wells and springs, eastern Snake River Plain

[See figure 2 for location of sites. Analyses were performed by the U.S. Geological Survey National Water Quality Laboratory. Units are in micrograms per liter. Symbols: <, concentration is less than the respective minimum reporting level; *, quality-assurance sample (MV-53 is a replicate of MV-60; MV-44 is a replicate of MV-3); E, concentration was estimated and needs to be evaluated carefully because of variable performance. Concentrations of herbicides not listed here but in table 14 were less than the minimum reporting levels and method detection limits in all samples]

Site identifier	Alachlor	Atrazine	Desethyl atrazine	EPTC	Metolachlor	Simazine
MV-3	<0.002	<0.007	<0.006	<0.002	<0.013	<0.005
MV-5	<.002	<.007	<.006	<.002	<.013	<.005
MV-6	<.002	.017	.008E	<.002	<.013	.0225
MV-7	<.002	<.007	<.006	<.002	.001E	<.005
MV-13	<.002	.001E	<.006	<.002	.002E	<.005
MV-17	.003	<.007	<.006	<.002	<.013	<.005
MV-25	<.002	.006E	.004E	<.002	<.013	<.005
MV-27	<.002	<.007	.005E	<.002	<.013	<.005
MV-32	<.002	<.007	<.006	<.002	<.013	<.005
MV-36	<.002	.001E	<.006	<.002	<.013	<.005
MV-38	<.002	.002E	<.006	.008	<.013	<.005
MV-42	<.002	.003E	.005E	<.002	<.013	<.005
MV-44*	<.002	<.007	<.006	<.002	<.013	<.005
MV-53*	<.002	.007E	<.006	<.002	<.013	<.005
MV-55	<.002	<.007	<.006	<.002	<.013	<.005
MV-57	<.002	<.007	<.006	<.002	<.013	<.005
MV-58	<.002	<.007	<.006	<.002	<.013	<.005
MV-60	<.002	.007	<.006	<.002	<.013	<.005