CHEMICAL CONSTITUENTS IN WATER FROM WELLS IN THE VICINITY OF THE NAVAL REACTORS FACILITY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1990-91

By Roy C. Bartholomay, LeRoy L. Knobel, and Betty J. Tucker

U.S. GEOLOGICAL SURVEY

Open-File Report 93-34

Prepared in cooperation with the
U.S. DEPARTMENT OF ENERGY

Idaho Falls, Idaho
January 1993

U.S. DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., *Secretary*

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, *Director*

For additional information write to:

Project Chief
U.S. Geological Survey
INEL, MS 4148
P.O. Box 2230
Idaho Falls, ID 83403

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Box 25425, Mail Stop 517
Federal Center
Denver, CO 80225-0425

CONTENTS

ILLUSTRATIONS

Page

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To Obtain
acre-foot (acre-ft)	1,233	cubic meter
foot (ft)	0.3048	meter
foot per mile (ft/mi)	0.1646	meter per kilometer
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
picocurie per liter (pCi/L)	0.037	becquerel per liter
square mile (mi^2)	2.590	square kilometer

For temperature, degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) by using the equation: $°F = (1.8)(°C) + 32$.

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviated water-quality units used in report: mg/L (milligram per liter); µg/L (microgram per liter); and µS/cm (microsiemens per centimeter at 25 degrees Celsius).

CHEMICAL CONSTITUENTS IN WATER FROM WELLS IN THE VICINITY OF THE NAVAL REACTORS FACILITY, IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO, 1990-91

By

Roy C. Bartholomay, LeRoy L. Knobel, and Betty J. Tucker

ABSTRACT

The U.S. Geological Survey, in response to a request from the U.S. Department of Energy's Pittsburgh Naval Reactors Office, Idaho Branch Office, sampled 12 wells as part of a long-term project to monitor water quality of the Snake River Plain aquifer in the vicinity of the Naval Reactors Facility, Idaho National Engineering Laboratory, Idaho. Water samples were analyzed for manmade contaminants and naturally occurring constituents. Sixty samples were collected from eight ground-water monitoring wells and four production wells. Ten quality-assurance samples also were collected and analyzed.

Most of the samples contained concentrations of total sodium and dissolved anions that exceeded reporting levels. The predominant category of nitrogen-bearing compounds was nitrite plus nitrate as nitrogen. Concentrations of total organic carbon ranged from less than 0.1 to 2.2 milligrams per liter. Total phenols in 52 of 69 samples ranged from 1 to 8 micrograms per liter. Extractable acid and base/neutral organic compounds were detected in water from 16 of 69 samples.

Concentrations of dissolved gross alpha- and gross beta-particle radioactivity in all samples exceeded the reporting level. Radium-226 concentrations were greater than the reporting level in 63 of 68 samples.

INTRODUCTION

The Idaho National Engineering Laboratory (INEL), encompassing about 890 mi^2 of the eastern Snake River Plain in southeastern Idaho (fig. 1), is operated by the U.S. Department of Energy. INEL facilities are used in the development of peacetime atomic-energy applications, nuclear safety research, defense programs, and advanced energy concepts. Liquid radionuclide and chemical wastes generated at these facilities have been discharged to onsite infiltration ponds and disposal wells since 1952. Liquid-waste disposal has resulted in detectable concentrations of several chemical constituents in water from the Snake River Plain aquifer underlying the INEL (Orr and Cecil, 1991, p. 2).

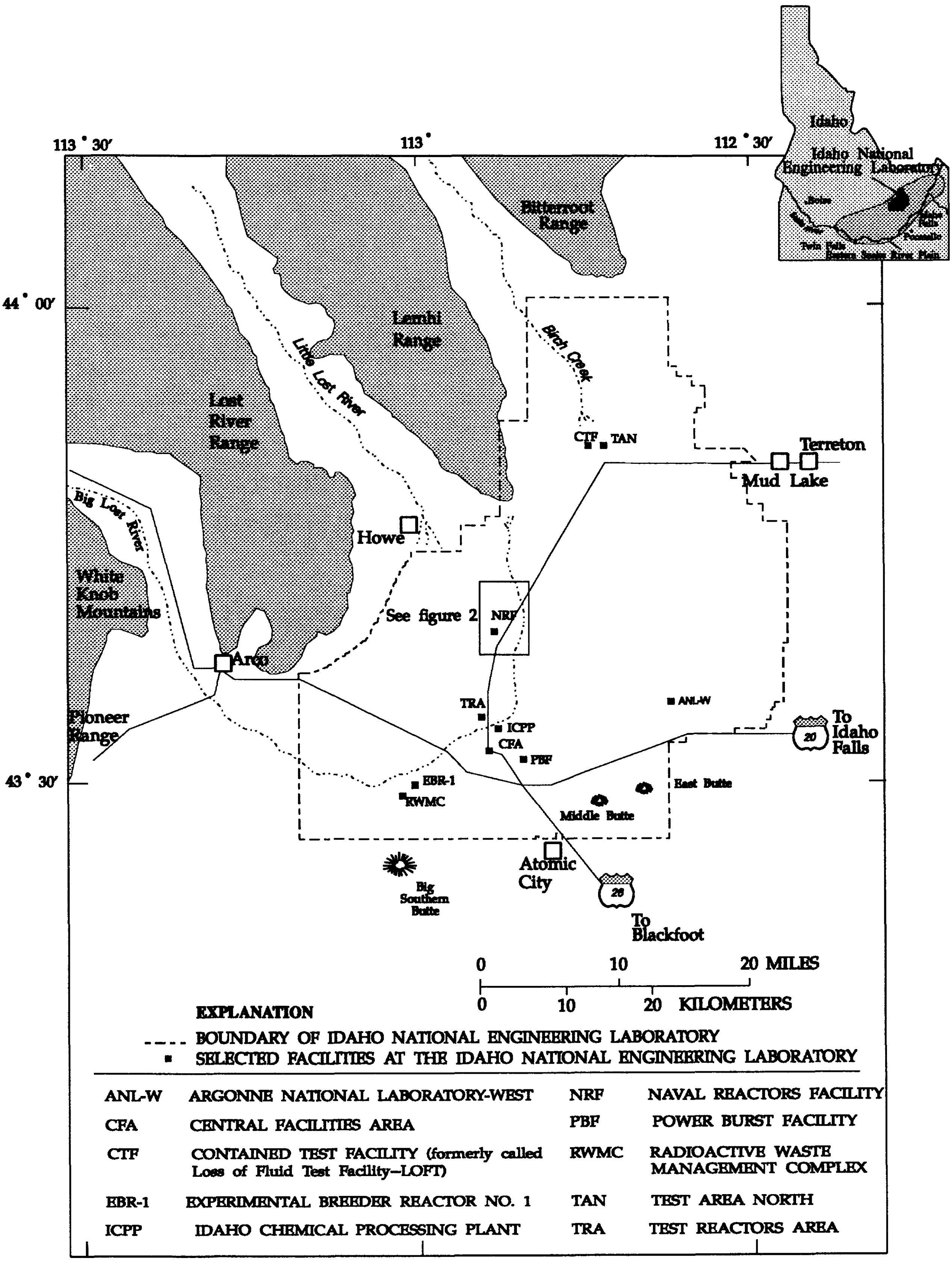

Figure 1.—Location of the Idaho National Engineering Laboratory, Naval Reactors Facility, and other selected facilities.

The U.S. Department of Energy requires information about the mobility of liquid radionuclide- and chemical-waste constituents in the Snake River Plain aquifer. Waste-constituent mobility is, in part, determined by (1) the rate and direction of ground-water flow; (2) the locations, quantities, and methods of waste disposal; (3) waste-constituent chemistry; and (4) the geochemical processes taking place in the aquifer (Orr and Cecil, 1991, p. 2). This study was conducted by the U.S. Geological Survey (USGS) in cooperation with the U.S. Department of Energy's Pittsburgh Naval Reactors Office, Idaho Branch Office.

Purpose and Scope

In 1989, the Idaho Branch Office of the Pittsburgh Naval Reactors Office, U.S. Department of Energy, requested that the USGS initiate a water-quality data-collection program in the vicinity of the Naval Reactors Facility (NRF) at the INEL (fig. 1). The purpose of the data-collection program is to provide the Idaho Branch Office with water-chemistry data to evaluate the impact of NRF activities on the water quality of the Snake River Plain aquifer.

The data-collection program consists of three rounds of sample collection and chemical analyses. Round one was a one-time sampling of each well and an analysis for a comprehensive suite of chemical constituents (Knobel and others, 1992) that approximates those contained in the U.S. Environmental Protection Agency's Ground-Water Monitoring List—Appendix IX (U.S. Environmental Protection Agency, 1989, p. 636-642). Round two consisted of collection of 60 samples and analyses for chemical constituents listed in Appendix III-EPA Interim Primary Drinking Water Standards, the constituents listed as parameters for establishing ground-water quality, and selected measurements used as indicators of ground-water contamination (U.S. Environmental Protection Agency, 1989, p. 660-661, 730). Round-two samples also were analyzed for copper, nickel, zinc, and extractable acid and base/neutral compounds. Round three is ongoing. Samples are collected quarterly from each well and analyzed for chloride, chromium, iron, lead, mercury, nickel, nitrate as nitrogen, silver, sodium, sulfate, and measurements of gross alpha- and gross beta-radioactivity, pH, specific conductance, and total organic carbon. As a result of expanded laboratory procedures, all three rounds of sampling include analyses for constituents in addition to those described above.

The purpose of this report is to present a compilation of round-two water-chemistry data collected during 1990-91. Round-two water-chemistry data from two additional wells will be presented in a subsequent report.

Hydrologic Conditions

The Snake River Plain aquifer is one of the most productive aquifers in the United States (USGS, 1985, p. 193). The aquifer consists of a thick sequence of basalts and sedimentary interbeds filling a large, arcuate, structural basin in southeastern Idaho (fig. 1).

Surface Water.—The Big Lost River drains more than 1,400 mi^2 of mountainous area that includes parts of the Lost River Range and the Pioneer Range west of the INEL (fig. 1). Flow in the Big Lost River infiltrates to the Snake River Plain aquifer along its channel and at sinks and playas at the river's terminus. Since 1958, excess runoff has been diverted to spreading areas in the southwestern part of the INEL where much of the water rapidly infiltrates to the aquifer. Other surface drainages that provide recharge to the Snake River Plain aquifer at the INEL include Birch Creek and the Little Lost River (fig. 1) (Orr and Cecil, 1991, p. 23).

Ground water.—Recharge to the Snake River Plain aquifer is principally from infiltration of applied irrigation water, infiltration of streamflow, and ground-water inflow from adjoining mountain drainage basins. Some recharge may be from direct infiltration of precipitation, although the small amount of annual precipitation on the plain (8 in. at the INEL), evapotranspiration, and the great depth to water (in places exceeding 900 ft) probably minimize this source of recharge (Orr and Cecil, 1991, p. 22-23).

Water in the Snake River Plain aquifer moves principally through fractures and interflow zones in the basalt. A large amount of the ground water in the aquifer moves through the upper 800 ft of saturated rocks (Mann, 1986, p. 21). Hydraulic conductivity of basalt in the upper 800 ft of the aquifer generally is 1 to 100 ft/day. Hydraulic conductivity of underlying rocks is several orders of magnitude smaller. The base of the Snake River Plain aquifer at the INEL probably ranges from about 850 to 1,220 ft below land surface (Orr and Cecil, 1991, p. 25).

Depth to water in wells completed in the Snake River Plain aquifer ranges from about 200 ft in the northern part of the INEL to more than 900 ft in the southeastern part; in the vicinity of the NRF, depth to water is about 375 ft. In July 1988, the altitude of the water table was about 4,590 ft above sea level near the TAN (Test Area North), about 4,420 ft above sea level near the RWMC (Radioactive Waste Management Complex), and about 4,500 ft above sea level near the NRF. Water moved southward and southwestward beneath the INEL at an average hydraulic gradient of about 4 ft/mi. Water generally moved southward beneath the INEL at a hydraulic gradient that ranged from about 1 to 15 ft/mi. From July 1985 to July 1988, water-level changes in INEL wells ranged from a 26.8-ft decline near the RWMC to a 4.3-ft rise north of the TAN; the water-level decline was about 1 to 3 ft near the NRF. Water levels generally declined in the southern two-thirds of the INEL during that time and rose in the northern one-third (Orr and Cecil, 1991, p. 25-27).

Ground water moves southwestward from the INEL and eventually discharges from springs along the Snake River downstream from Twin Falls, about 100 mi southwest of the INEL. Approximately 4.3 million acre-ft of ground water discharged from these springs in 1988 (Mann, 1989, p. 2).

Acknowledgments

The authors are grateful to Steven J. Price, Kelly D. Willie, and Kent R. Shelley of Westinghouse Electric Corporation for providing logistical support during sample collection and to Michael G. Rupert of the USGS and Kelly D. Willie of Westinghouse Electric Corporation for technically reviewing the manuscript.

METHODS AND QUALITY ASSURANCE

The methods used for collecting samples for chemical analyses 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; Hardy and others, 1989). The methods used in the field and the quality assurance practices are described in the following sections.

Sample Containers and Preservatives

Sample containers and preservatives differed depending on the constituent(s) for which analyses were requested. Samples analyzed by the USGS's National Water Quality Laboratory (NWQL) were placed in containers and preserved in accordance with laboratory requirements specified by Pritt and Jones (1989). Containers and preservatives were supplied by the NWQL and had undergone a rigorous quality-control procedure (Pritt, 1989, p. 75) to eliminate sample contamination. The containers and preservatives used for this study are listed in table 1 (all tables located at the end of this report).

Well Locations and Sample Collection

Sixty samples were collected from 12 wells (fig. 2): 8 USGS ground-water monitoring wells (12, 15, 17, 97-99, 102, and Water Supply INEL-1); and 4 production wells (NRF-1, -2, -3, and -4). The ground-water monitoring wells were equipped with dedicated submersible pumps. The production wells were equipped with line-shaft turbine pumps. The production wells are located within the NRF boundary; USGS 102 is located west of the boundary (fig. 2); USGS 12, 15, and 17 are upgradient of the facility; and the remaining monitoring wells are located downgradient (Orr and Cecil, 1991, p. 26).

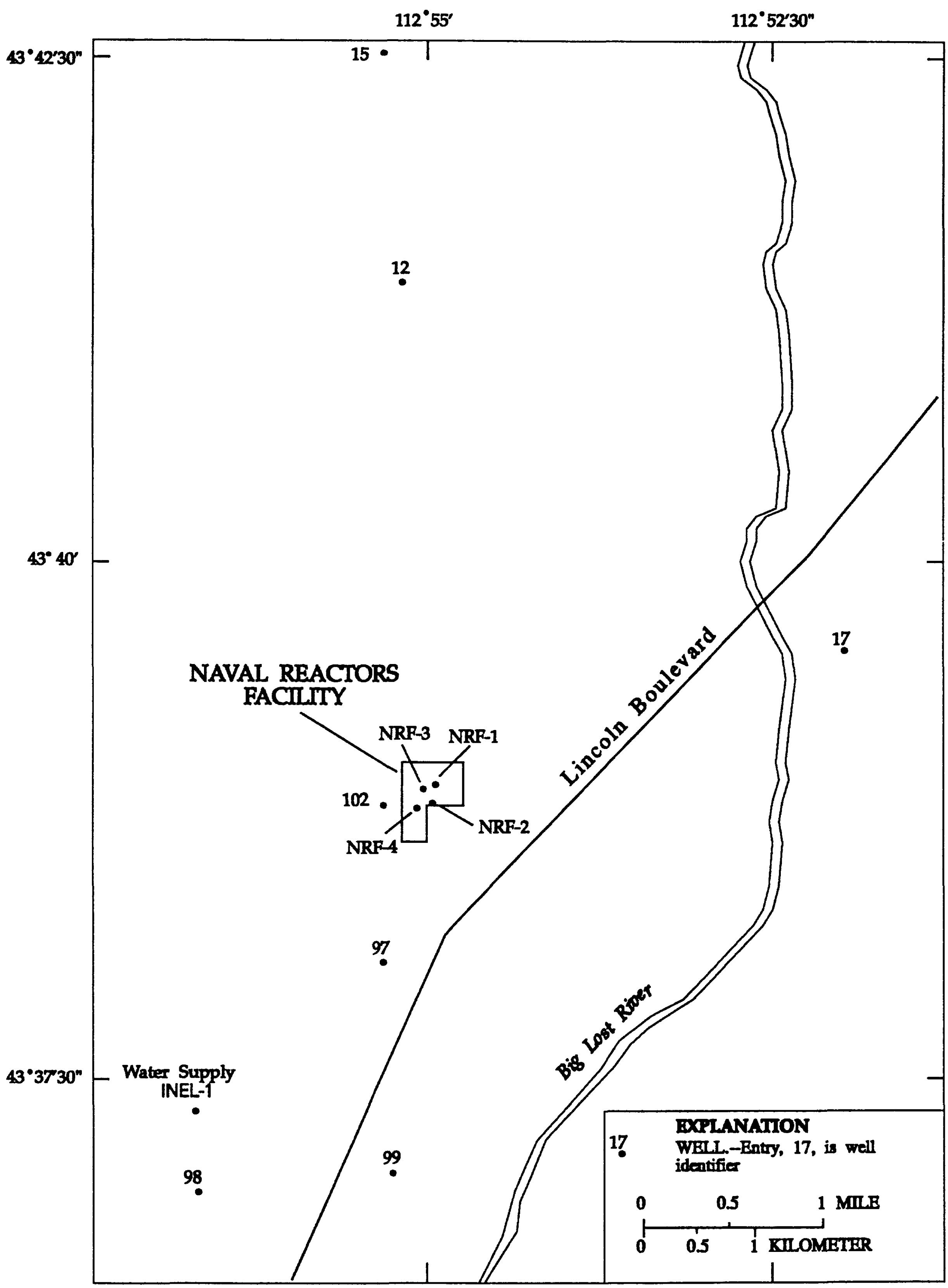

Figure 2. — Location of wells, Naval Reactors Facility and vicinity, Idaho National Engineering Laboratory.

Samples from wells equipped with dedicated submersible pumps were collected from a portable sampling apparatus; samples from wells equipped with turbine pumps were obtained from a stainless-steel port on the pump discharge line. All portable equipment was decontaminated after each sample was collected. After collection, sample containers were sealed with laboratory film, labeled, and stored under secured conditions. Sample containers later were placed in ice chests, sealed, and shipped by overnight-delivery mail to the NWQL.

Conditions at the wells during sample collection were recorded in a field logbook and a chain-of-custody record was used to track samples from the time of collection until delivery to the NWQL. These records are available for inspection at the USGS Project Office at the INEL. The results of field measurements for pH, specific conductance, and water temperature are listed in table 2.

Quality Assurance

A detailed description of internal quality control and the overall quality-assurance practices used by the NWQL is provided in reports by Friedman and Erdmann (1982) and Jones (1987). The water samples were collected in accordance with a quality-assurance plan for quality-of-water activities conducted by personnel at the INEL Project Office; the plan was finalized in June 1989 and is available for inspection at the USGS's Project Office at the INEL. A comparative study to determine agreement between analytical results for water-sample pairs by laboratories involved in the INEL Project Office's quality-assurance program was summarized by Wegner (1989).

Approximately 10 percent of the water samples collected during round-two sampling were quality-assurance samples. Samples QAS-2, 3, 5, 6, 7, 9, 10, 11, and 12 were replicates of samples from NRF-2, USGS 97, USGS 98, USGS 15, USGS 99, Water Supply INEL-1, USGS 97, USGS 102, and NRF-4, respectively. Sample QAS-8 was a blank of deionized water from the Radiological and Environmental Sciences Laboratory (RESL), and will not be included in the discussion of the various constituents measured.

Guidelines for Interpreting Results of Radiochemical Analyses

Concentrations of radionuclides are reported with an estimated sample standard deviation, **s**, that is obtained by propagating sources of analytical uncertainty in measurements. The following guidelines for interpreting analytical results are based on an extension of a method proposed by Currie (1984).

In the analysis for a particular radionuclide, laboratory measurements are made on a target sample and a prepared blank. Instrument signals for the sample and the 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 larger than the signal observed for the blank before the decision can be made that the radionuclide was detected; and (2) an estimation must be made of the minimum radionuclide concentration that will yield a sufficiently large observed signal before the correct decision can be made for detection or nondetection of the radionuclide. The first aspect of the problem is a qualitative decision based on an observed signal and a definite criterion for detection. The second aspect of the problem is an estimation of the detection capabilities of a given measurement process.

In the laboratory, instrument signals must exceed a critical level before the qualitative decision can be made as to whether the radionuclide was detected. Radionuclide concentrations that equal 1.6s meet this criterion; at 1.6s, there is a 95-percent probability that the correct conclusion—not detected—will be made. Given a large number of samples, as many as 5 percent of the samples with measured concentrations larger than or equal to 1.6s which were concluded as being detected, might not contain the radionuclide. 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 may be determined. Radionuclide concentrations that equal 3s represent a measurement at the minimum detectable concentration. For true concentrations of 3s or larger, there is a 95-percent or larger probability that the radionuclide was detected in a sample. Given a large number of samples, the conclusion—not detected—will be made in 5 percent of the samples that contain true concentrations at the minimum detectable concentration of 3s. 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 larger-than-5-percent probability of false negative results for samples with true concentrations between 1.6s and 3s. Although the radionuclide might have been detected, such detection may not be considered reliable; at 1.6s, the probability of a false negative is about 50 percent.

The critical level and minimum detectable concentration 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, with the number of gross counts for individual analyses, and for different radionuclides. In this report, radionuclide concentrations less than 3s are considered to be below a "reporting level." The critical level, minimum detectable concentration, and reporting level aid the reader in the interpretation of analytical results and do not represent absolute concentrations of radioactivity which may or may not have been detected.

Calculation of Estimated Experimental Standard Errors

The analytical results for radionuclides are presented with calculated analytical uncertainties. There is about a 67-percent probability that the true radionuclide concentration is in a range of the reported concentration plus or minus the uncertainty. The uncertainties are expressed as one sample standard deviation. The associated uncertainties presented with mean concentrations are experimental standard errors and are an estimate of the uncertainty of the mean concentration. The estimated experimental standard errors (EESE) were calculated with the following equation (Iman and Conover, 1983, p. 158):

$$EESE = \sigma / (n)^{0.5}$$

where σ = population standard deviation, and

n = sample size.

The population standard deviation, σ, is customarily estimated by **s** (the sample standard deviation) (Iman and Conover, 1983, p. 106). The sample standard deviation is the square root of the sample variance (Iman and Conover, 1983, p. 100-101).

DISSOLVED ANIONS AND TOTAL SODIUM

Water samples were analyzed for concentrations of dissolved bromide, chloride, fluoride, and sulfate, and concentrations of total sodium (table 3). Statistical parameters for the dissolved anions and total sodium by well are given in table 4. Concentrations of bromide in 69 samples ranged from less than the reporting level of 0.01 to 0.34 mg/L. The median and mean concentrations of bromide in 67 samples were 0.06 and 0.08 mg/L, respectively (table 4). Concentrations of chloride in 69 samples ranged from 4.8 to 140 mg/L and were distributed about median and mean concentrations of 32 and 36 mg/L, respectively. Concentrations of fluoride in 69 samples ranged from less than the reporting level of 0.1 to 0.7 mg/L. The median and mean concentrations of fluoride in 55 samples were 0.2 and 0.3 mg/L, respectively. Concentrations of sulfate in 69 samples ranged from 15 to 160 mg/L and were distributed about median and mean concentrations of 34 and 37 mg/L, respectively. Concentrations of sodium in 68 samples ranged from 5.7 to 20 mg/L and were distributed about median and mean concentrations of 13 and 13 mg/L, respectively.

SELECTED TOTAL RECOVERABLE TRACE ELEMENTS

Water samples were analyzed for concentrations of total recoverable arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc (table 5). Statistical parameters for selected trace elements by well are given in table 6. An additional water sample was collected from Water Supply INEL-1 (fig. 2) on July 30, 1990, and analyzed for concentrations of selected dissolved trace elements. The results of the analyses are given in table 7 and can be compared to concentrations of total trace elements given in table 5.

Arsenic.—Concentrations of arsenic in 69 samples ranged from 1 to 12 μg/L and were distributed about median and mean concentrations of 2 and 2 μg/L, respectively (table 6).

Barium.—Concentrations of barium in 68 samples ranged from less than the reporting level of 100 to 200 μg/L. The median and mean concentrations of 25 samples were 100 and 100 μg/L, respectively (table 6).

Cadmium.—Concentrations of cadmium in 66 samples were less than the reporting level of 1 μg/L. Two samples contained concentrations of 1 μg/L, each (table 5).

Chromium.—Concentrations of chromium in 68 samples ranged from 2 to 48 μg/L and were distributed about median and mean concentrations of 8 and 9 μg/L, respectively (table 6).

Copper.—Concentrations of copper in 68 samples ranged from less than the reporting level of 1 to 16 μg/L. The median and mean concentrations of 67 samples were 2 and 3 μg/L, respectively (table 6).

Iron.—Concentrations of iron in 69 samples ranged from less than the reporting level of 10 to 9,700 μg/L. The median and mean concentrations of 62 samples were 70 and 430 μg/L, respectively (table 6).

Lead.—Concentrations of lead in 68 samples ranged from less than the reporting level of 1 to 8 μg/L. The median and mean concentrations of 62 samples were 2 and 2 μg/L, respectively (table 6).

Manganese.—Concentrations of manganese in 69 samples ranged from less than the reporting level of 10 to 200 μg/L. The median and mean concentrations of 16 samples were 20 and 30 μg/L, respectively (table 6).

Mercury.—Concentrations of mercury in 65 samples were less than the reporting level of 0.1 μg/L. The remaining four samples had concentrations of 0.1 μg/L (table 5).

Nickel.—Concentrations of nickel in 68 samples ranged from less than the reporting level of 1 to 31 μg/L. The median and mean concentrations of 52 samples were 2 and 3 μg/L, respectively (table 6).

Selenium.—Concentrations of selenium in 69 samples ranged from less than the reporting level of 1 to 3 μg/L. The median and mean concentrations of 59 samples were 1 and 1 μg/L, respectively (table 6).

Silver.—Concentrations of silver in 69 samples were less than the reporting level of 1 μg/L (table 5).

Zinc.—Concentrations of zinc in 69 samples ranged from less than the reporting level of 10 to 190 μg/L. The median and mean concentrations of 41 samples were 90 and 80 μg/L, respectively (table 6).

NUTRIENTS, ORGANIC CARBON, PHENOLS, AND TURBIDITY

Water samples were analyzed for concentrations of dissolved ammonia as nitrogen, ammonia plus organic nitrogen as nitrogen, nitrite as nitrogen, nitrite plus nitrate as nitrogen, and orthophosphate as phosphorus (table 8). Samples were also analyzed for concentrations of total organic carbon and total phenols and measured for turbidity (table 9). Statistical parameters for dissolved nutrients, total organic carbon, total phenols, and turbidity by well are given in table 10.

Ammonia.—Concentrations of ammonia as nitrogen in 33 samples ranged from less than the reporting level of 0.01 to 0.03 mg/L. The median and mean concentrations of 12 samples were 0.02 and 0.02 mg/L, respectively (table 10).

Ammonia plus organic nitrogen.—Concentrations of ammonia plus organic nitrogen as nitrogen in 36 samples ranged from less than the reporting level of 0.2 to 1.2 mg/L. The median and mean concentrations of 22 samples were 0.4 and 0.4 mg/L, respectively (table 10).

Nitrite.—Concentrations of nitrite as nitrogen in 68 samples were less than the reporting level of 0.01 mg/L. One sample from USGS 12 (2/7/91) contained a concentration of 0.02 mg/L (table 8).

Nitrite plus nitrate.—Concentrations of nitrite plus nitrate as nitrogen in 69 samples ranged from 0.30 to 16 mg/L and were distributed about median and mean concentrations of 1.7 and 2.0 mg/L, respectively (table 10).

Orthophosphate.—Concentrations of orthophosphate as phosphorous in 36 samples ranged from less than the reporting level of 0.01 to 0.04 mg/L. The median and mean concentrations of 24 samples were 0.02 and 0.02 mg/L, respectively (table 10).

Organic carbon.—Concentrations of organic carbon in 69 samples ranged from less than the reporting level of 0.1 to 2.2 mg/L. The median and mean concentrations of 67 samples were 0.3 and 0.4 mg/L, respectively (table 10).

Phenols.—Concentrations of phenols in 69 samples ranged from less than the reporting level of 1 to 8 µg/L. The median and mean concentrations of 52 samples were 2 and 3 µg/L, respectively (table 10).

Turbidity.—Measurements of turbidity in 69 samples ranged from 0.2 to 59 nephelometric turbidity units (NTU) and were distributed about median and mean measurements of 0.4 and 1.7 NTU, respectively (table 10).

EXTRACTABLE ACID AND BASE/NEUTRAL ORGANIC COMPOUNDS

Water samples were analyzed by the NWQL for 54 extractable acid and base/neutral organic compounds (table 11). Concentrations of compounds that are larger than the reporting level (table 11) are listed in table 12. Compounds in table 12 that are not listed in table 11 are tentatively identified organic compounds (TIOC's[1]).

PESTICIDES

Concentrations of 15 organochlorine insecticides, gross polychlorinated biphenyls, gross polychlorinated naphthalenes and 4 chlorophenoxy acid herbicides (table 13) were determined by the NWQL. Pesticides were not detected in any wells at concentrations larger than the reporting levels.

GROSS ALPHA- AND GROSS BETA-PARTICLE RADIOACTIVITY

Concentrations of both dissolved and suspended gross alpha- and gross beta-particle radioactivity were determined for the 69 samples using a residue procedure. Concentrations of gross alpha-particle radioactivity are listed in table 14; statistical parameters are given in table 15. Concentrations of gross beta-particle radioactivity are listed in table 16; statistical parameters are given in table 17.

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. For convenience, laboratories report the radioactivity as if it were all given off by one radionuclide. In this report, concentrations are reported two ways: as natural uranium in micrograms per liter and as thorium-230 in picocuries per liter.

Gross alpha-particle radioactivity was measured in both the dissolved and suspended fractions of the water samples from selected wells at the NRF and vicinity (table 14). All of the samples contained concentrations of gross alpha-particle radioactivity in the dissolved fraction larger than the reporting level of 3**s**. Concentrations of uranium ranged from 1.67±0.424 to 5.17±0.70 μg/L, and were distributed about median and mean concentrations of 3.70±0.64 and 3.65±0.09 μg/L, respectively (table 15). Concentrations of thorium-230 ranged from 1.04±0.270 to 3.72±0.500 pCi/L, and were distributed about median and mean concentrations of 2.55±0.438 and 2.50±0.065 pCi/L, respectively.

Two of the samples contained concentrations of gross alpha-particle radioactivity in the suspended fraction—reported as uranium—larger than the reporting level. A sample from USGS 15, collected on August 6, 1990, and its quality assurance replicate, QAS-6, contained 1.76±0.56 and 9.10±3.00 μg/L, respectively (table 14). The reason for the discrepancy is unknown. Concentrations

[1]Data for TIOC's in this report are based on comparison of sample spectra with library spectra followed by visual examination by gas chromatography and mass spectrometry analysts. TIOC data have not been confirmed by direct comparison with reference standards. Therefore, TIOC identification is tentative, and reported concentrations are semiquantitative.

of uranium (suspended) were distributed about median and mean concentrations of -0.018±0.084 and 0.141±0.135 μg/L, respectively. One of the samples contained a concentration of gross alpha-particle radioactivity in the suspended fraction—reported as thorium-230—larger than the reporting level. A sample from USGS 15, collected on August 6, 1990, contained 2.20±0.71 pCi/L (table 14). The reason for the discrepancy is unknown. Concentrations of thorium-230 (suspended) were distributed about median and mean concentrations of -0.01±0.046 and 0.128±0.110 pCi/L, respectively (table 15).

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. For convenience, laboratories report the radioactivity as if it were all given off by one radionuclide or a chemically similar pair of radionuclides in equilibrium. In this report, concentrations are reported two ways: as strontium-90 in equilibrium with yttrium-90 (Sr^{90}/Y^{90}) in picocuries per liter, and as cesium-137 in picocuries per liter.

Gross beta-particle radioactivity was measured in both the dissolved and suspended fractions of the water samples from selected wells at the NRF and vicinity (table 16). All of the water samples contained concentrations of gross beta-particle radioactivity in the dissolved fraction larger than the reporting level. Concentrations of Sr^{90}/Y^{90} ranged from 1.42±0.282 to 4.32±0.56 pCi/L, and were distributed about median and mean concentrations of 2.79±0.62 and 2.82±0.08 pCi/L, respectively (table 17). Concentrations of cesium-137 ranged from 1.95±0.411 to 5.76±0.75 pCi/L and were distributed about median and mean concentrations of 3.78±0.73 and 3.77±0.10 pCi/L, respectively.

Three of the samples contained concentrations of gross beta-particle radioactivity in the suspended fraction—reported as Sr^{90}/Y^{90}—larger than the reporting level. A sample from USGS 12 collected on April 11, 1991 and a sample from USGS 15 collected on August 6, 1990 and its quality assurance replicate, QAS-6, contained concentrations of 0.621±0.200, 1.68±0.330, and 5.74±0.80 pCi/L, respectively. The reason for the discrepancy is unknown. The concentrations of Sr^{90}/Y^{90} (suspended) in the samples were distributed about median and mean concentrations of 0.193±0.228 and 0.312±0.086 pCi/L, respectively. Three of the samples contained concentrations of gross beta-particle radioactivity in the suspended fraction—reported as cesium-137—larger than the reporting level. A sample from USGS 12 collected on April 11, 1991 and a sample from USGS 15 collected on August 6, 1990 and its quality assurance replicate, QAS-6, contained concentrations of 0.639±0.205, 2.12±0.414, and 7.40±1.02 pCi/L, respectively. The reason for the discrepancy is unknown. The concentrations of cesium-137 (suspended) in the samples were distributed about median and mean concentrations of 0.211±0.268 and 0.359±0.118 pCi/L, respectively.

SELECTED RADIUM ISOTOPES

Radium-226 and radium-228 are naturally occurring decay products of uranium-238 and thorium-232, respectively. Concentrations of radium-226 for 68 samples (table 18) were determined by using a radon emanation procedure; concentrations of radium-228 for the samples (table 18) were determined by using a separation and beta counting procedure. Statistical parameters by well for radium-226 and radium-228 are given in table 19.

Concentrations of radium-226 in 63 of the 68 water samples from the wells at the NRF and vicinity were larger than the reporting level. Concentrations ranged from -0.002±0.004 to 0.975±0.008 pCi/L and were distributed about median and mean concentrations of 0.079±0.008 and 0.084±0.015 pCi/L, respectively (table 19). Concentrations of radium-228 in 5 of the 69 samples were larger than the reporting level. Concentrations ranged from -0.133±0.200 to 0.545±0.176 pCi/L and were distributed about median and mean concentrations of 0.157±0.020 and 0.212±0.019 pCi/L, respectively (table 19).

MISCELLANEOUS DATA

As part of a special request, concentrations of 36 purgeable organic compounds (table 20) in 4 samples from 4 wells were determined by the NWQL using a method that conforms to U.S. Environmental Protection Agency method 524.2 (Pritt and Jones, 1989; M.P. Schroeder, USGS, written commun., 1991). Samples were collected from NRF-1 (December 6, 1990), NRF-2 (December 5, 1990), NRF-3 (December 6, 1990), and NRF-4 (December 5, 1990). No purgeable organic compounds were present in any sample at concentrations larger than the reporting level of 0.2 g/L. TIOC's were not identified in any of the samples.

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 ultimately results in their conversion to stable isotopes of lead (Haglund, 1972, p. 1216). Total uranium is a measurement of the combined concentrations of these three isotopes. One sample from NRF-3 (March 21, 1990) was analyzed for dissolved total uranium and contained a concentration of 2.51±0.406 μg/L.

Water samples were collected from the Central Facilities Area (CFA) water supply and the NRF water supply for comparison. The samples were analyzed for 54 extractable acid and base/neutral organic compounds (table 11), 36 purgeable organic compounds (table 20), and 12 total recoverable trace elements (table 21). No extractable acid and base/neutral organic compounds were present in either sample at concentrations larger than reporting levels. The CFA water supply contained 2.8 μg/L of bromoform, 0.7 μg/L of dibromochloromethane, and 0.3 μg/L of trichloroethylene. The NRF water supply contained 0.4 μg/L of bromoform. A trip blank contained 0.2 μg/L of ethylbenzene, 1.0 μg/L of dichloromethane, 1.2 μg/L of total xylenes, 0.2 μg/L of 1,3,5-trimethylbenzene, and

0.8 μg/L of 1,2,4-trimethylbenzene. Concentrations of arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, and zinc in the CFA water supply and the NRF water supply are given in table 21.

SUMMARY

The USGS, in response to a request from the U.S. Department of Energy's Pittsburgh Naval Reactors Office, Idaho Branch Office, sampled 12 wells as part of a long-term project to monitor water quality of the Snake River Plain aquifer in the vicinity of the NRF, INEL, Idaho. Water samples were collected and analyzed for manmade contaminants and naturally occurring constituents. Sixty samples were collected from eight ground-water monitoring wells and four production wells. Ten quality assurance samples also were collected and analyzed. The ranges of concentrations of dissolved anions and total sodium follow: bromide, from less than the reporting level to 0.34 mg/L; chloride, 4.8 to 140 mg/L; fluoride, from less than the reporting level to 0.7 mg/L; sodium, 5.7 to 20 mg/L, and sulfate, 15 to 160 mg/L.

Samples were analyzed for 13 trace elements. Concentrations of cadmium, mercury, and silver were either less than or equal to the laboratory reporting levels. Concentrations of barium, copper, iron, lead, manganese, nickel, selenium, and zinc ranged from less than the laboratory reporting levels to 200, 16, 9,700, 8, 200, 31, 3, and 190 μg/L, respectively. The respective ranges of concentrations for arsenic and chromium were 1 to 12 μg/L and 2 to 48 μg/L. The predominant category of nitrogen-bearing compounds in these samples was nitrite plus nitrate, which ranged in concentration from 0.30 to 16 mg/L, expressed as nitrogen.

Concentrations of total organic carbon ranged from less than 0.1 to 2.2 mg/L. Total phenols in 52 of 69 samples ranged from 1 to 8 μg/L. Turbidity measurements ranged from 0.2 to 59 NTU. One or more extractable acid and base/neutral organic compounds were present in water from 16 of 69 samples. Pesticides were not detected in any wells at concentrations larger than the reporting level.

Concentrations of dissolved gross alpha- and gross beta-particle radioactivity in all samples exceeded the reporting level. Most of the samples contained concentrations of suspended gross alpha- and gross beta-particle radioactivity less than the reporting level. Radium-226 concentrations were larger than the reporting level in 63 of 68 samples; radium-228 concentrations were larger than the reporting level in 5 of the 69 samples.

SELECTED REFERENCES

Claassen, H.C., 1982, Guidelines and techniques for obtaining water samples that accurately represent the water chemistry of an aquifer: U.S. Geological Survey Open-File Report 82-1024, 49 p.

Currie, L.A., 1984, Lower limit of detection—Definition and elaboration of a proposed position for radiological effluent and environmental measurements: U.S. Nuclear Regulatory Commission NUREG/CR-4077, 139 p.

Fishman, M.J., and Friedman, L.C., eds., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 545 p.

Friedman, L.C., and Erdmann, D.E., 1982, Quality assurance practices for the chemical and biological analyses of water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A6, 181 p.

Goerlitz, D.F., and Brown, Eugene, 1972, Methods for analysis of organic substances in water: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A3, 40 p.

Haglund, D.S., 1972, Uranium—Element and geochemistry, in Fairbridge, R.W., ed., The encyclopedia of geochemistry and environmental sciences: Stroudsbery, Pa., Dowden, Hutchinson, and Ross, p. 1,215-1,222.

Hardy, M.A., Leahy, P.P., and Alky, W.M., 1989, Well installation and documentation, and ground-water sampling protocols for the pilot national water-quality assessment program: U.S. Geological Survey Open-File Report 89-396, 36 p.

Iman, R.L., and Conover, W.J., 1983, A modern approach to statistics: New York, John Wiley & Sons, Inc., 497 p.

Jones, B.E., 1987, Quality control manual of the U.S. Geological Survey's National Water Quality Laboratory: U.S. Geological Survey Open-File Report 87-457, 17 p.

Knobel, L.L., Bartholomay, R.C., Wegner, S.J., and Edwards, D.D., 1992, Chemical constituents in water from wells in the vicinity of the Naval Reactors Facility, Idaho National Engineering Laboratory, Idaho, 1989-90: U.S. Geological Survey Open-File Report 92-156 (DOE/ID-22103), 38 p.

Mann, L.J., 1986, Hydraulic properties of rock units and chemical quality of water for INEL-1--a 10,365-foot deep test hole drilled at the Idaho National Engineering Laboratory, Idaho: U.S. Geological Survey Water-Resources Investigations Report 86-4020 (DOE/ID-22070), 23 p.

----- 1989, Tritium concentrations in flow from selected springs that discharge to the Snake River, Twin Falls-Hagerman area, Idaho: U.S. Geological Survey Water-Resources Investigations Report 89-4156 (DOE/ID-22084), 20 p.

Orr, B.R., and Cecil, L.D., 1991, Hydrologic conditions and distribution of selected chemical constituents in water, Snake River Plain aquifer, Idaho National Engineering Laboratory, Idaho, 1986 to 1988: U.S. Geological Survey Water-Resources Investigations Report 91-4047 (DOE/ID-22096), 56 p.

Pritt, J.W., 1989, Quality assurance of sample containers and preservatives at the U.S. Geological Survey National Water Quality Laboratory, in Pederson, G.L. and Smith, M.M. compilers, U.S. Geological Survey Second National Symposium on Water Quality—Abstracts of the Technical Sessions, Orlando, Fla., November 12-17, 1989: U.S. Geological Survey Open-File Report 89-409, p. 75.

Pritt, Jeffrey, and Jones, B.E., eds., 1989, 1990 National Water Quality Laboratory services catalog: U.S. Geological Survey Open-File Report 89-386, unnumbered.

Stevens, H.H., Jr., Ficke, J.F., and Smoot, G.F., 1975, Water temperature--influential factors, field measurement, and data presentation: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. D1, 65 p.

Thatcher, L.L., Janzer, V.J., and Edwards, K.W., 1977, Methods for determination of radioactive substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A5, 95 p.

U.S. Environmental Protection Agency, 1989, Protection of Environment, Code of Federal Regulations 40: Office of the Federal Register, National Archives and Records Administration, pts. 190 to 299, 1,027 p.

U.S. Geological Survey, 1985, National water summary, 1984--Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

Wegner, S.J., 1989, Selected water quality assurance data for water samples collected by the U.S. Geological Survey, Idaho National Engineering Laboratory, Idaho, 1980 to 1988: U.S. Geological Survey Water-Resources Investigations Report 89-4168 (DOE/ID-22085), 91 p.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., 1987, Method for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A3, 80 p.

Wood, W.W., 1981, Guidelines for collection and field analysis of ground-water samples for selected unstable constituents: U.S. Geological Survey Techniques of Water-Resources Investigations, book 1, chap. D2, 24 p.

Table 1.—*Containers and preservatives used for water samples, Naval Reactors Facility and vicinity*

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. mL, milliliter; °C, degrees Celsius; L, liter; HNO_3, nitric acid; $K_2Cr_2O_7$, potassium dichromate; $HgCl_2$, mercuric chloride; NaCl, sodium chloride; H_3PO_4, phosphoric acid; $CuSO_4$, copper sulfate; HCl, hydrochloric acid. Samples were shipped by overnight-delivery mail]

Type of constituent	Container		Preservative		Other treatment
	Type	Size	Type	Quantity	
Anions	Polyethylene	250 mL	None	None	Filter
Sodium	Polyethylene, acid-rinsed	250 mL	HNO_3	1 mL	None
Trace elements, total recoverable	Polyethylene, acid-rinsed	500 mL	HNO_3	2 mL	None
	Polyethylene, acid-rinsed	250 mL	HNO_3	1 mL	None
Mercury, total	Glass, acid-rinsed	250 mL	$K_2Cr_2O_7$/ HNO_3	10 mL	None
Nutrients, total	Polyethylene, brown	250 mL	$HgCl_2$/ NaCl	1 mL	Chill 4°C
Total organic carbon	Glass, baked	125 mL	None	None	Chill 4°C
Phenols, total	Glass, baked	1 L	H_3PO_4/ $CuSO_4$	10 mL	Chill 4°C
Turbidity	Polyethylene	125 mL	None	None	None
Extractable acid and base/neutral organic compounds	Glass, baked	1 L	None	None	Chill 4°C
Pesticides	Glass, baked	1 L	None	None	Chill 4°C
Gross alpha and beta	Polyethylene, acid-rinsed	1 L	None	None	None

Table 1.—*Containers and preservatives used for water samples, Naval Reactors Facility and vicinity*—Continued

Type of constituent	Container		Preservative		Other treatment
	Type	Size	Type	Quantity	
Radium-226	Polyethylene, acid-rinsed	1 L	HCl	5 mL	Filter
Radium-228	Polyethylene, acid-rinsed	1 L	HCl	5 mL	Filter
Purgeable organic compounds	Glass, baked	40 mL	None	None	Chill 4°C

Table 2.—***Results of field measurements for pH, specific conductance, and temperature of water, Naval Reactors Facility and vicinity***

[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. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation), RESL, Radiological and Environmental Sciences Laboratory. Values for field measurements for each pair of primary and replicate samples are the same]

Well identifier	Date sampled (m/d/y)	Time	pH	Specific conduct-ance	Temper-ature	Remarks
QAS-8	11/2/90	1100	6.2	18.2	24.0	blank, deionized water from RESL
NRF-1	3/21/90	1235	8.0	555	12.5	
	6/19/90	1345	8.0	580	12.0	
	8/7/90	1245	7.7	555	12.5	
	10/2/90	1405	7.8	550	12.5	
	12/6/90	1030	8.0	560	11.0	
NRF-2	3/21/90	1130	7.9	610	13.0	
	3/21/90	1000	7.9	610	13.0	QAS-2, replicate
	6/19/90	1115	7.9	650	12.0	
	8/7/90	1110	7.8	625	12.5	
	10/2/90	1255	7.8	685	13.0	
	12/5/90	1010	8.2	670	11.5	
NRF-3	3/21/90	1410	7.9	550	11.5	
	6/19/90	1325	8.0	570	12.0	
	8/7/90	1315	7.8	570	12.0	
	10/2/90	1330	7.7	550	12.0	
	12/6/90	1150	8.2	550	10.5	
NRF-4	6/19/90	0940	7.9	610	12.0	
	8/7/90	1000	7.8	595	13.0	
	10/2/90	1125	7.7	580	12.5	
	12/5/90	1145	8.0	600	12.0	
	2/7/91	1045	7.8	605	11.5	
	2/7/91	1400	7.8	605	11.5	QAS-12, replicate
USGS 12	8/6/90	1515	7.9	595	12.5	
	10/10/90	1150	7.8	545	12.0	
	12/11/90	1245	7.9	552	12.0	
	2/7/91	1425	7.8	600	13.0	
	4/11/91	1125	7.8	560	14.0	

Table 2.—***Results of field measurements for pH, specific conductance, and temperature of water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Time	pH	Specific conduct- ance	Temper- ature	Remarks
USGS 15	8/6/90	1145	7.8	590	11.5	
	8/6/90	1200	7.8	590	11.5	QAS-6, replicate
	10/9/90	1440	7.8	450	11.5	
	12/13/90	1450	8.2	327	12.0	
	2/11/91	1450	8.0	328	12.0	
	4/12/91	1745	8.1	301	11.5	
USGS 17	3/20/90	1130	8.2	291	14.0	
	6/7/90	0940	8.2	298	13.0	
	8/2/90	1055	8.2	305	13.5	
	10/10/90	1450	8.2	292	13.5	
	12/10/90	1140	8.2	295	13.0	
USGS 97	3/19/90	1320	8.0	570	12.0	
	6/7/90	1150	7.8	585	12.0	
	6/7/90	1200	7.8	585	12.0	QAS-3, replicate
	8/1/90	1245	7.9	585	12.0	
	10/4/90	1055	7.4	560	12.0	
	12/7/90	1330	7.9	595	11.5	
	12/7/90	1300	7.9	595	11.5	QAS-10, replicate
USGS 98	3/19/90	1000	8.0	406	12.5	
	6/5/90	1000	8.0	425	12.0	
	7/30/90	1055	8.0	420	12.5	
	7/30/90	1200	8.0	420	12.5	QAS-5, replicate
	10/3/90	1015	7.8	392	12.0	
	12/7/90	1005	8.1	405	12.0	
USGS 99	3/20/90	0925	7.9	511	12.5	
	6/5/90	1350	7.9	520	12.0	
	8/1/90	1010	8.0	530	12.0	
	10/3/90	1335	7.8	495	12.0	
	10/3/90	1330	7.8	495	12.0	QAS-7, replicate
	12/10/90	1015	8.0	508	11.5	

Table 2.—*Results of field measurements for pH, specific conductance, and temperature of water, Naval Reactors Facility and vicinity*—Continued

Well identifier	Date sampled (m/d/y)	Time	pH	Specific conductance	Temperature	Remarks
USGS 102	8/1/90	1415	8.0	570	12.0	
	10/4/90	1245	7.8	538	12.0	
	12/10/90	1315	8.0	555	11.5	
	12/10/90	1230	8.0	555	11.5	QAS-11, replicate
	2/7/91	1035	8.0	550	11.5	
	4/11/91	1245	7.9	544	13.0	
Water Supply INEL-1	3/19/90	1210	7.9	772	12.0	
	6/5/90	1215	7.9	795	12.0	
	7/30/90	1315	7.9	800	12.5	
	10/3/90	1210	7.7	765	12.0	
	12/7/90	1145	7.9	760	12.0	
	12/7/90	1100	7.9	760	12.0	QAS-9, replicate

Table 3.—***Concentrations of dissolved anions and total sodium in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in milligrams per liter. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); <, concentration is less than the indicated reporting level; SR, sample ruined]

Well identifier	Date sampled (m/d/y)	Bromide	Chloride	Fluoride	Sulfate	Sodium
QAS-8	11/2/90	<0.01	<0.1	<0.1	<1.0	0.3
NRF-1	3/21/90	.06	33	<.1	43	13
	6/19/90	.07	33	.3	36	13
	8/7/90	.07	33	.5	36	13
	10/2/90	.07	34	<.1	35	13
	12/6/90	.06	33	.2	37	13
NRF-2	3/21/90	.07	45	<.1	52	17
QAS-2	3/21/90	.06	45	<.1	51	17
	6/19/90	.08	43	.3	44	20
	8/7/90	.08	46	.5	44	18
	10/2/90	.07	39	<.1	39	17
	12/5/90	.06	50	.3	49	19
NRF-3	3/21/90	.06	30	.1	35	13
	6/19/90	.07	34	.4	38	13
	8/7/90	.07	32	.6	35	14
	10/2/90	.07	31	<.1	34	12
	12/6/90	.06	31	.1	37	13
NRF-4	6/19/90	.05	42	.3	43	18
	8/7/90	.07	37	.6	39	15
	10/2/90	.08	41	<.1	41	16
	12/5/90	.06	42	.2	47	16
	2/7/91	.06	41	.1	45	14
QAS-12	2/7/91	.07	40	.2	38	16
USGS 12	8/6/90	.08	32	.4	32	10
	10/10/90	.07	32	.1	33	12
	12/11/90	.06	35	.2	35	12
	2/7/91	.07	34	.1	33	12
	4/11/91	.06	33	.2	32	SR

Table 3.—***Concentrations of dissolved anions and total sodium in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Bromide	Chloride	Fluoride	Sulfate	Sodium
USGS 15	8/6/90	.07	31	.4	31	18
QAS-6	8/6/90	.07	31	.4	30	19
	10/9/90	.04	19	.1	26	15
	12/13/90	.02	9.9	.6	22	7.6
	2/11/91	.02	7.5	.1	19	7.3
	4/12/91	.02	4.8	.1	15	7.8
USGS 17	3/20/90	.02	7.9	.3	19	6.0
	6/7/90	<.01	7.4	.1	18	7.0
	8/2/90	.03	6.4	.2	18	5.7
	10/10/90	.02	5.2	.3	20	6.5
	12/10/90	<.01	6.6	.2	19	6.3
USGS 97	3/19/90	.06	30	.2	32	13
	6/7/90	.06	31	<.1	34	15
QAS-3	6/7/90	.06	34	.4	34	14
	8/1/90	.08	33	.1	33	12
	10/4/90	.07	33	<.1	36	15
	12/7/90	.06	32	.1	36	13
QAS-10	12/7/90	.06	33	.1	37	14
USGS 98	3/19/90	.04	13	.2	20	9.6
	6/5/90	.04	28	.3	37	8.8
	7/30/90	.04	18	.4	22	8.1
QAS-5	7/30/90	.04	18	.7	23	8.0
	10/3/90	.04	14	<.1	19	9.1
	12/7/90	.03	14	.2	25	9.4
USGS 99	3/20/90	.05	16	.2	26	11
	6/5/90	.05	40	.3	47	13
	8/1/90	.05	22	.2	25	10
	10/3/90	.05	19	<.1	23	12
QAS-7	10/3/90	.05	19	<.1	23	11
	12/10/90	.04	20	.1	27	13

Table 3.—***Concentrations of dissolved anions and total sodium in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Bromide	Chloride	Fluoride	Sulfate	Sodium
USGS 102	8/1/90	.07	28	.2	28	11
	10/4/90	.07	30	<.1	34	12
	12/10/90	.05	28	.2	160	13
QAS-11	12/10/90	.06	30	.1	33	14
	2/7/91	.07	30	.2	31	12
	4/11/91	.07	31	.2	32	11
Water Supply INEL-1	3/19/90	.32	110	.2	52	18
	6/5/90	.33	140	.3	84	20
	7/30/90	.33	110	.5	60	17
	10/3/90	.34	110	<.1	54	19
	12/7/90	.29	110	.1	53	18
QAS-9	12/7/90	.29	110	.1	53	18

Table 4.—***Statistical parameters for dissolved anions and total sodium, by well***

[Units are milligrams per liter. Values are derived from table 3. See figure 2 for location of wells. Quality assurance replicates are included in the statistical parameters. Mean and median sample size: includes all samples with concentrations greater than laboratory reporting level]

	Statistical parameter					
Constituent	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			NRF-1			
Bromide	0.06	0.07	0.07	0.07	5	5
Chloride	33	34	33	33	5	5
Fluoride	<.1	.5	.3	.3	5	3
Sulfate	35	43	36	37	5	5
Sodium	13	13	13	13	5	5
			NRF-2			
Bromide	.06	.08	.07	.07	6	6
Chloride	39	50	45	45	6	6
Fluoride	<.1	.5	.3	.4	6	3
Sulfate	39	52	46.5	46	6	6
Sodium	17	20	17.5	18	6	6
			NRF-3			
Bromide	.06	.07	.07	.07	5	5
Chloride	30	34	31	32	5	5
Fluoride	<.1	.6	.25	.3	5	4
Sulfate	34	38	35	36	5	5
Sodium	12	14	13	13	5	5
			NRF-4			
Bromide	.05	.08	.065	.06	6	6
Chloride	37	42	41	40	6	6
Fluoride	<.1	.6	.2	.3	6	5
Sulfate	38	47	42	42	6	6
Sodium	14	18	16	16	6	6
			USGS 12			
Bromide	.06	.08	.07	.07	5	5
Chloride	32	35	33	33	5	5
Fluoride	.1	.4	.2	.2	5	5
Sulfate	32	35	33	33	5	5
Sodium	10	12	12	12	4	4

Table 4.—***Statistical parameters for dissolved anions and total sodium, by well***—Continued

Constituent	Statistical parameter					
	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			USGS 15			
Bromide	.02	.07	.03	.04	6	6
Chloride	4.8	31	14.45	17	6	6
Fluoride	.1	.6	.25	.3	6	6
Sulfate	15	31	24	24	6	6
Sodium	7.3	19	11.4	12	6	6
			USGS 17			
Bromide	<.01	.03	.02	.02	5	3
Chloride	5.2	7.9	6.6	6.7	5	5
Fluoride	.1	.3	.2	.2	5	5
Sulfate	18	20	19	19	5	5
Sodium	5.7	7.0	6.3	6.3	5	5
			USGS 97			
Bromide	.06	.08	.06	.06	7	7
Chloride	30	34	33	32	7	7
Fluoride	<.1	.4	.1	.2	7	5
Sulfate	32	37	34	35	7	7
Sodium	12	15	14	14	7	7
			USGS 98			
Bromide	.03	.04	.04	.04	6	6
Chloride	13	28	16	18	6	6
Fluoride	<.1	.7	.3	.4	6	5
Sulfate	19	37	22.5	24	6	6
Sodium	8.0	9.6	8.95	8.8	6	6
			USGS 99			
Bromide	.04	.05	.05	.05	6	6
Chloride	16	40	19.5	23	6	6
Fluoride	<.1	.3	.2	.2	6	4
Sulfate	23	47	25.5	28	6	6
Sodium	10	13	11.5	12	6	6

Table 4.—***Statistical parameters for dissolved anions and total sodium, by well***—Continued

	Statistical parameter					
Constituent	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			USGS 102			
Bromide	.05	.07	.07	.06	6	6
Chloride	28	31	30	30	6	6
Fluoride	<.1	.2	.2	.2	6	5
Sulfate	28	160	32.5	53	6	6
Sodium	11	14	12	12	6	6
			Water Supply INEL-1			
Bromide	.29	.34	.325	.32	6	6
Chloride	110	140	110	12	6	6
Fluoride	<.1	.5	.2	.2	6	5
Sulfate	52	84	53.5	59	6	6
Sodium	17	20	18	18	6	6
			All wells			
Bromide	<.01	.34	.06	.08	69	67
Chloride	4.8	140	32	36	69	69
Fluoride	<.1	.7	.2	.3	69	55
Sulfate	15	160	34	37	69	69
Sodium	5.7	20	13	13	68	68

Table 5.—***Concentrations of selected total recoverable trace elements in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in micrograms per liter. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); <, concentration is less than the indicated reporting level; SR, sample ruined]

Well identifier	Date sampled (m/d/y)	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
QAS-8	11/2/90	<1	<100	<1	1	1	<10	<1	<10	<0.1	1	<1	<1	<10
NRF-1	3/21/90	2	<100	<1	9	3	50	1	<10	<.1	2	1	<1	<10
	6/19/90	2	100	<1	9	3	30	1	<10	<.1	<1	2	<1	<10
	8/7/90	2	<100	<1	8	4	40	2	<10	<.1	1	1	<1	<10
	10/2/90	2	200	<1	10	3	120	3	20	<.1	3	1	<1	20
	12/6/90	2	100	<1	8	6	80	2	<10	<.1	3	1	<1	20
NRF-2	3/21/90	2	<100	<1	14	16	50	2	<10	<.1	3	1	<1	<10
QAS-2	3/21/90	2	<100	<1	14	3	50	1	<10	<.1	2	2	<1	<10
	6/19/90	2	100	<1	14	4	40	1	<10	<.1	<1	2	<1	<10
	8/7/90	2	<100	<1	13	2	40	1	<10	<.1	1	1	<1	<10
	10/2/90	2	200	<1	10	1	50	1	20	<.1	2	1	<1	10
	12/5/90	2	100	<1	14	2	<10	2	<10	<.1	2	<1	<1	<10
NRF-3	3/21/90	2	<100	<1	8	4	110	1	<10	<.1	1	2	<1	10
	6/19/90	2	100	<1	8	6	60	1	<10	<.1	1	2	<1	<10
	8/7/90	2	<100	<1	9	1	70	1	<10	<.1	1	1	<1	20
	10/2/90	2	200	<1	8	2	50	2	20	<.1	1	1	<1	20
	12/6/90	2	<100	<1	7	2	150	2	<10	<.1	<1	1	<1	40

Table 5.—***Concentrations of selected total recoverable trace elements in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
NRF-4	6/19/90	2	100	1	11	2	1400	2	<10	<.1	3	2	<1	<10
	8/7/90	2	<100	<1	9	2	30	1	<10	<.1	1	1	<1	<10
	10/2/90	2	<100	<1	10	2	20	1	20	<.1	2	2	<1	<10
	12/5/90	2	100	<1	11	2	<10	<1	<10	<.1	1	1	<1	<10
	2/7/91	2	100	<1	10	2	50	<1	<10	<.1	<1	2	<1	10
QAS-12	2/7/91	2	100	<1	10	3	30	1	<10	<.1	<1	2	<1	<10
USGS 12	8/6/90	2	<100	<1	8	1	10	<1	<10	<.1	<1	1	<1	<10
	10/10/90	2	200	<1	8	1	40	1	<10	<.1	<1	1	<1	10
	12/11/90	1	100	<1	7	1	110	1	<10	<.1	1	1	<1	10
	2/7/91	2	100	<1	7	2	60	1	<10	<.1	<1	2	<1	<10
	4/11/91	1	SR	SR	SR	SR	140	SR	<10	.1	SR	3	<1	<10
USGS 15	8/6/90	2	<100	<1	21	7	4600	1	100	<.1	15	1	<1	30
QAS-6	8/6/90	12	<100	<1	48	2	9700	3	200	.1	31	1	<1	50
	10/9/90	2	<100	<1	8	1	<10	<1	<10	<.1	<1	1	<1	<10
	12/13/90	2	<100	<1	7	2	<10	1	<10	<.1	2	<1	<1	<10
	2/11/91	2	<100	<1	8	5	20	<1	<10	<.1	2	<2	<1	10
	4/12/91	2	<100	<1	8	<1	20	2	<10	<.1	1	1	<1	<10
USGS 17	3/20/90	2	<100	<1	2	3	240	2	<10	.1	2	<1	<1	<10
	6/7/90	2	<100	<1	3	6	90	1	<10	<.1	3	1	<1	10
	8/2/90	2	<100	<1	3	1	340	1	10	<.1	1	<1	<1	<10
	10/10/90	2	<100	<1	3	1	50	1	<10	<.1	<1	<1	<1	20
	12/10/90	2	<100	<1	2	1	50	1	10	<.1	1	<1	<1	<10

Table 5.—***Concentrations of selected total recoverable trace elements in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
USGS 97	3/19/90	2	200	<1	7	3	60	6	<10	<.1	2	2	<1	170
	6/7/90	2	100	<1	8	4	90	3	<10	<.1	1	2	<1	80
QAS-3	6/7/90	2	100	<1	9	3	40	3	<10	<.1	1	2	<1	80
	8/1/90	2	<100	1	8	7	40	5	<10	<.1	8	2	<1	110
	10/4/90	2	200	<1	7	1	320	3	10	<.1	<1	2	<1	120
	12/7/90	2	<100	<1	7	5	<10	1	<10	<.1	<1	1	<1	120
QAS-10	12/7/90	1	<100	<1	7	3	<10	5	<10	<.1	1	1	<1	110
USGS 98	3/19/90	2	<100	<1	4	4	80	4	<10	<.1	1	1	<1	190
	6/5/90	2	<100	<1	7	2	40	2	<10	<.1	1	1	<1	120
	7/30/90	2	<100	<1	8	1	50	1	<10	<.1	<1	1	<1	120
QAS-5	7/30/90	1	<100	<1	7	1	40	1	<10	<.1	<1	1	<1	110
	10/3/90	2	<100	<1	7	2	100	2	<10	<.1	2	<1	<1	120
	12/7/90	2	<100	<1	6	3	30	2	<10	<.1	2	<1	<1	140
USGS 99	3/20/90	1	<100	<1	7	15	1900	8	<10	<.1	3	1	<1	160
	6/5/90	1	<100	<1	7	2	50	3	<10	<.1	1	1	<1	90
	8/1/90	1	200	<1	6	3	180	2	<10	<.1	1	1	<1	100
	10/3/90	2	<100	<1	5	1	230	3	30	<.1	1	1	<1	90
QAS-7	10/3/90	2	<100	<1	6	1	320	3	20	<.1	3	1	<1	80
	12/10/90	2	100	<1	6	3	610	4	10	<.1	2	<1	<1	130

Table 5.—***Concentrations of selected total recoverable trace elements in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
USGS 102	8/1/90	2	200	<1	8	1	<10	1	<10	<.1	1	2	<1	<10
	10/4/90	2	<100	<1	7	1	70	<1	<10	<.1	<1	2	<1	<10
	12/10/90	2	100	<1	8	2	60	1	<10	<.1	2	1	<1	<10
QAS-11	12/10/90	2	100	<1	8	1	200	1	10	<.1	1	1	<1	<10
	2/7/91	2	100	<1	10	3	1300	3	20	<.1	1	1	<1	20
	4/11/91	1	<100	<1	6	2	300	2	<10	<.1	2	2	<1	<10
Water Supply														
INEL-1	3/19/90	1	<100	<1	10	2	400	3	<10	.1	1	2	<1	170
	6/5/90	1	<100	<1	12	2	470	2	<10	<.1	1	3	<1	120
	7/30/90	1	<100	<1	12	1	230	2	<10	<.1	1	3	<1	120
	10/3/90	1	<100	<1	10	3	830	2	20	<.1	4	1	<1	140
	12/7/90	1	<100	<1	10	2	210	1	10	<.1	2	2	<1	130
QAS-9	12/7/90	1	<100	<1	10	2	150	2	<10	<.1	<1	2	<1	120

Table 6.—***Statistical parameters for selected total recoverable trace elements, by well***
[Units are milligrams per liter. Values are derived from table 5. See figure 2 for location of wells. Quality assurance replicates are included in the statistical parameters. Mean and median sample size: includes all samples with concentrations greater than laboratory reporting level]

	Statistical parameter					
Constituent	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			NRF-1			
Arsenic	2	2	2	2	5	5
Barium	<100	200	100	100	5	3
Chromium	8	10	9	9	5	5
Copper	3	6	3	4	5	5
Iron	30	120	50	60	5	5
Lead	1	3	2	2	5	5
Nickel	<1	3	2.5	2	5	4
Selenium	1	2	1	1	5	5
			NRF-2			
Arsenic	2	2	2	2	6	6
Barium	<100	200	100	100	5	3
Chromium	10	14	14	13	6	6
Copper	1	16	2.5	5	6	6
Iron	<10	50	50	50	6	5
Lead	1	2	1	1	6	6
Nickel	<1	3	2	2	6	5
Selenium	<1	2	1	1	6	5
			NRF-3			
Arsenic	2	2	2	2	5	5
Chromium	7	9	8	8	5	5
Copper	1	6	2	3	5	5
Iron	50	150	70	90	5	5
Lead	1	2	1	1	5	5
Nickel	<1	1	1	1	5	4
Selenium	1	2	1	1	5	5
Zinc	<10	40	20	20	5	4
			NRF-4			
Arsenic	2	2	2	2	6	6
Barium	<100	100	100	100	6	4
Chromium	9	11	10	10	6	6

Table 6.—***Statistical parameters for selected total recoverable trace elements, by well***—Continued

Constituent	Statistical parameter: Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			NRF-4 (continued)			
Copper	2	3	2	2	6	6
Iron	<10	1400	30	310	6	5
Lead	<1	2	1	1	6	4
Nickel	<1	3	1.5	2	6	4
Selenium	1	2	2	2	6	6
			USGS 12			
Arsenic	1	2	2	2	5	5
Barium	<100	200	100	100	4	3
Chromium	7	8	7.5	8	4	4
Copper	1	2	1	1	4	4
Iron	10	140	60	70	5	5
Lead	<1	1	1	1	4	3
Selenium	1	3	1	2	5	5
			USGS 15			
Arsenic	2	12	2	4	6	6
Chromium	7	48	8	17	6	6
Copper	<1	7	2	3	6	5
Iron	<10	9700	2310	3600	6	4
Lead	<1	3	1.5	2	6	4
Nickel	<1	31	2	10	6	5
Selenium	<1	1	1	1	6	4
Zinc	<10	50	30	30	6	3
			USGS 17			
Arsenic	2	2	2	2	5	5
Chromium	2	3	3	3	5	5
Copper	1	6	1	2	5	5
Iron	50	340	90	150	5	5
Lead	1	2	1	1	5	5
Nickel	<1	3	1.5	2	5	4

Table 6.—***Statistical parameters for selected total recoverable trace elements, by well***—Continued

Constituent	Statistical parameter					
	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			USGS 97			
Arsenic	1	2	2	2	7	7
Barium	<100	200	150	200	7	4
Chromium	7	9	7	8	7	7
Copper	1	7	3	4	7	7
Iron	<10	320	60	110	7	5
Lead	1	6	3	4	7	7
Nickel	<1	8	1	3	7	5
Selenium	1	2	2	2	7	7
Zinc	80	170	110	110	7	7
			USGS 98			
Arsenic	1	2	2	2	6	6
Chromium	4	8	7	6	6	6
Copper	1	4	2	2	6	6
Iron	30	100	45	60	6	6
Lead	1	4	2	2	6	6
Nickel	<1	2	1.5	2	6	4
Selenium	<1	1	1	1	6	4
Zinc	110	190	120	130	6	6
			USGS 99			
Arsenic	1	2	1.5	2	6	6
Chromium	5	7	6	6	6	6
Copper	1	15	2.5	4	6	6
Iron	50	1900	275	550	6	6
Lead	2	8	3	4	6	6
Manganese	<10	30	20	20	6	3
Nickel	1	3	1.5	2	6	6
Selenium	<1	1	1	1	6	5
Zinc	80	160	95	110	6	6
			USGS 102			
Arsenic	1	2	2	2	6	6
Barium	<100	200	100	100	6	4
Chromium	6	10	8	8	6	6
Copper	1	3	1.5	2	6	6

Table 6.—***Statistical parameters for selected total recoverable trace elements, by well***—Continued

Constituent	Statistical parameter: Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
			USGS 102 (continued)			
Iron	<10	1300	200	390	6	5
Lead	<1	3	1	2	6	5
Nickel	<1	2	1	1	6	5
Selenium	1	2	1.5	2	6	6
			Water Supply INEL-1			
Arsenic	1	1	1	1	6	6
Chromium	10	12	10	11	6	6
Copper	1	3	2	2	6	6
Iron	150	830	315	380	6	6
Lead	1	3	2	2	6	6
Nickel	<1	4	1	2	6	5
Selenium	1	3	2	2	6	6
Zinc	120	170	125	130	6	6
			All wells			
Arsenic	1	12	2	2	69	69
Barium	<100	200	100	100	68	25
Chromium	2	48	8	9	68	68
Copper	<1	16	2	3	68	67
Iron	<10	9700	70	430	69	62
Lead	<1	8	2	2	68	62
Manganese	<10	200	20	30	69	16
Nickel	<1	31	2	3	68	52
Selenium	<1	3	1	1	69	59
Zinc	<10	190	90	80	69	41

Table 7.—***Concentrations of selected dissolved trace elements in water from Water Supply INEL-1, in the vicinity of the Naval Reactors Facility***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in micrograms per liter. Water sample was collected on July 30, 1990, as part of a special request. <, concentration is less than indicated reporting level]

Trace element	Concentration
Arsenic	1
Barium	74
Cadmium	<1
Chromium	10
Iron	29
Lead	<1
Mercury	.1
Selenium	3
Silver	<1

Table 8.—***Concentrations of dissolved nutrients in water, Naval Reactors Facility and vicinity***
[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in milligrams per liter. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); <, concentration is less than the indicated reporting level; NR, analysis not requested]

Well identifier	Date sampled (m/d/y)	Ammonia (as nitrogen)	Ammonia plus organic nitrogen (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Ortho phosphate (as phosphorus)
QAS-8	11/2/90	0.01	<0.2	<0.01	<0.1	<0.1
NRF-1	3/21/90	NR	NR	<.01	1.6	NR
	6/19/90	NR	NR	<.01	1.6	NR
	8/7/90	NR	NR	<.01	1.6	NR
	10/2/90	<.01	.5	<.01	1.6	<.01
	12/6/90	.03	<.2	<.01	1.5	.02
NRF-2	3/21/90	NR	NR	<.01	1.9	NR
QAS-2	3/21/90	NR	NR	<.01	1.8	NR
	6/19/90	NR	NR	<.01	1.7	NR
	8/7/90	NR	NR	<.01	1.8	NR
	10/2/90	<.01	.4	<.01	1.7	<.01
	12/5/90	.03	<.2	<.01	1.7	.02
NRF-3	3/21/90	NR	NR	<.01	1.6	NR
	6/19/90	NR	NR	<.01	1.6	NR
	8/7/90	NR	NR	<.01	1.7	NR
	10/2/90	<.01	.5	<.01	1.6	<.01
	12/6/90	.02	<.2	<.01	1.6	.02
NRF-4	6/19/90	NR	NR	<.01	1.9	NR
	8/7/90	NR	NR	<.01	1.8	NR
	10/2/90	<.01	.5	<.01	1.9	.01
	12/5/90	.03	<.2	<.01	1.8	.02
	2/7/91	.01	.5	<.01	1.8	.02
QAS-12	2/7/91	.02	1.1	<.01	1.8	.04
USGS 12	8/6/90	NR	NR	<.01	1.6	NR
	10/10/90	<.01	.3	<.01	1.7	.01
	12/11/90	.02	.2	<.01	1.8	.02
	2/7/91	<.01	.3	.02	1.7	.02
	4/11/91	NR	<.2	<.01	1.7	<.01

Table 8.—***Concentrations of dissolved nutrients in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Ammonia (as nitrogen)	Ammonia plus organic nitrogen (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Ortho phosphate (as phosphorus)
USGS 15	8/6/90	NR	NR	<.01	1.8	NR
QAS-6	8/6/90	NR	NR	<.01	16	NR
	10/9/90	<.01	<.2	<.01	1.2	<.01
	12/13/90	.01	<.2	<.01	.40	.02
	2/11/91	<.01	.3	<.01	.31	<.01
	4/12/91	NR	<.2	<.01	.31	<.01
USGS 17	3/20/90	NR	NR	<.01	.30	NR
	6/7/90	NR	NR	<.01	.30	NR
	8/2/90	NR	NR	<.01	1.6	NR
	10/10/90	<.01	.2	<.01	.30	<.01
	12/10/90	<.01	.4	<.01	.30	.02
USGS 97	3/19/90	NR	NR	<.01	2.0	NR
	6/7/90	NR	NR	<.01	1.8	NR
QAS-3	6/7/90	NR	NR	<.01	1.8	NR
	8/1/90	NR	NR	<.01	1.8	NR
	10/4/90	<.01	<.2	<.01	1.9	.02
	12/7/90	<.01	<.2	<.01	1.8	.02
QAS-10	12/7/90	.01	<.2	<.01	1.8	.03
USGS 98	3/19/90	NR	NR	<.01	3.0	NR
	6/5/90	NR	NR	<.01	1.1	NR
	7/30/90	NR	NR	<.01	1.1	NR
QAS-5	7/30/90	NR	NR	<.01	1.1	NR
	10/3/90	<.01	.3	<.01	1.0	<.01
	12/7/90	.01	<.2	<.01	1.1	.01
USGS 99	3/20/90	NR	NR	<.01	1.5	NR
	6/5/90	NR	NR	<.01	1.6	NR
	8/1/90	NR	NR	<.01	1.6	NR
	10/3/90	<.01	.5	<.01	1.5	.01
QAS-7	10/3/90	<.01	.3	<.01	1.5	<.01
	12/10/90	<.01	.3	<.01	1.5	.02

Table 8.—***Concentrations of dissolved nutrients in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Ammonia (as nitrogen)	Ammonia plus organic nitrogen (as nitrogen)	Nitrite (as nitrogen)	Nitrite plus nitrate (as nitrogen)	Ortho phosphate (as phos-phorus)
USGS 102	8/1/90	NR	NR	<.01	.30	NR
	10/4/90	<.01	<.2	<.01	1.7	.01
	12/10/90	<.01	<.2	<.01	1.7	.02
QAS-11	12/10/90	<.01	.2	<.01	1.7	.02
	2/7/91	<.01	.4	<.01	1.6	.02
	4/11/91	NR	.5	<.01	1.7	.01
Water Supply						
INEL-1	3/19/90	NR	NR	<.01	5.6	NR
	6/5/90	NR	NR	<.01	5.4	NR
	7/30/90	NR	NR	<.01	5.6	NR
	10/3/90	<.01	1.2	<.01	5.5	<.01
	12/7/90	.02	.4	<.01	5.1	.01
QAS-9	12/7/90	.02	.3	<.01	5.0	<.01

Table 9.—***Concentrations of total organic carbon and total phenols in water, and turbidity, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in milligrams per liter for total organic carbon, micrograms per liter for total phenols, and nephelometric turbidity units for turbidity. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); <, concentration is less than the indicated reporting level]

Well identifier	Date sampled (m/d/y)	Organic carbon	Phenols	Turbidity
QAS-8	11/2/90	0.5	2	3.0
NRF-1	3/21/90	.2	4	3.2
	6/19/90	.2	4	.4
	8/7/90	.5	3	.3
	10/2/90	.4	<1	.4
	12/6/90	.5	1	.4
NRF-2	3/21/90	.4	<1	.4
QAS-2	3/21/90	.3	3	1.1
	6/19/90	.3	3	.4
	8/7/90	.4	2	.3
	10/2/90	.4	<1	.3
	12/5/90	.6	6	.6
NRF-3	3/21/90	.3	3	.4
	6/19/90	.2	3	.3
	8/7/90	.4	7	.6
	10/2/90	.5	<1	.3
	12/6/90	.6	<1	.4
NRF-4	6/19/90	.3	4	.2
	8/7/90	.4	4	.3
	10/2/90	.5	1	.5
	12/5/90	.4	8	.6
	2/7/91	.3	4	.5
QAS-12	2/7/91	.3	2	.4
USGS 12	8/6/90	.3	<1	.4
	10/10/90	.4	1	.7
	12/11/90	.7	<1	.3
	2/7/91	.3	2	.4
	4/11/91	.6	<1	.6

Table 9.—***Concentrations of total organic carbon and total phenols in water, and turbidity, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Organic carbon	Phenols	Turbidity
USGS 15	8/6/90	1.5	7	22
QAS-6	8/6/90	2.2	5	59
	10/9/90	.3	1	.3
	12/13/90	.2	<1	.3
	2/11/91	<.1	2	.3
	4/12/91	<.1	<1	.3
USGS 17	3/20/90	.1	<1	1.0
	6/7/90	.1	3	.4
	8/2/90	.1	1	.3
	10/10/90	.1	3	1.0
	12/10/90	.2	1	.7
USGS 97	3/19/90	.4	1	.4
	6/7/90	.2	3	.4
QAS-3	6/7/90	.2	3	.3
	8/1/90	.3	2	.5
	10/4/90	.5	1	.3
	12/7/90	.3	2	.4
QAS-10	12/7/90	.4	1	.2
USGS 98	3/19/90	.1	1	.2
	6/5/90	.3	4	.9
	7/30/90	.2	2	.5
QAS-5	7/30/90	.3	1	.3
	10/3/90	.2	2	.3
	12/7/90	.1	2	.5
USGS 99	3/20/90	.2	<1	.7
	6/5/90	.3	4	.6
	8/1/90	.3	3	.2
	10/3/90	.4	<1	.4
QAS-7	10/3/90	.4	<1	.4
	12/10/90	.3	2	.3

Table 9.—***Concentrations of total organic carbon and total phenols in water, and turbidity, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Organic carbon	Phenols	Turbidity
USGS 102	8/1/90	.3	2	.8
	10/4/90	.4	1	1.1
	12/10/90	.4	1	.6
QAS-11	12/10/90	.3	<1	.7
	2/7/91	.4	1	.3
	4/11/91	.4	<1	.3
Water Supply				
INEL-1	3/19/90	.6	<1	.4
	6/5/90	.7	5	1.0
	7/30/90	.9	1	.5
	10/3/90	.9	2	1.0
	12/7/90	1.0	2	.6
QAS-9	12/7/90	1.6	1	.5

Table 10.—***Statistical parameters for dissolved nutrients, total organic carbon, total phenols, and turbidity, by well***

[Units are milligrams per liter for dissolved nutrients and total organic carbon, micrograms per liter for total phenols, and nephelometric turbidity units for turbidity. Values are derived from tables 8-9. See figure 2 for location of wells. Quality assurance replicates were included in the statistical parameters. Mean and median sample size: includes all samples with concentrations greater than laboratory reporting level]

	Statistical parameter					
Constituent	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
		NRF-1				
Nitrite plus nitrate	1.5	1.6	1.6	1.6	5	5
Organic carbon	.2	.5	.4	.4	5	5
Phenols	<1	4	3.5	3	5	4
Turbidity	.3	3.2	.4	.9	5	5
		NRF-2				
Nitrite plus nitrate	1.7	1.9	1.75	1.8	6	6
Organic carbon	.3	.6	.4	.4	6	6
Phenols	<1	6	3	4	6	4
Turbidity	.3	1.1	.4	.5	6	6
		NRF-3				
Nitrite plus nitrate	1.6	1.7	1.6	1.6	5	5
Organic carbon	.2	.6	.4	.4	5	5
Phenols	<1	7	3	4	5	3
Turbidity	.3	.6	.4	.4	5	5
		NRF-4				
Ammonia	<.01	.03	.02	.02	4	3
Ammonia plus organic nitrogen	<.2	1.1	.5	.7	4	3
Nitrite plus nitrate	1.8	1.9	1.8	1.8	6	6
Orthophosphate	.01	.04	.02	.02	4	4
Organic carbon	.3	.5	.35	.4	6	6
Phenols	1	8	4	4	6	6
Turbidity	.2	.6	.45	.4	6	6
		USGS 12				
Ammonia plus organic nitrogen	<.2	.3	.3	.3	4	3
Nitrite plus nitrate	1.6	1.8	1.7	1.7	5	5
Orthophosphate	<.01	.02	.02	.02	4	3

Table 10.—***Statistical parameters for dissolved nutrients, total organic carbon, total phenols, and turbidity, by well***—Continued

Constituent	Statistical parameter					
	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
		USGS 12 (continued)				
Organic carbon	.3	.7	.4	.5	5	5
Turbidity	.3	.7	.4	.5	5	5
		USGS 15				
Nitrite plus nitrate	.31	16	.8	3.3	6	6
Organic carbon	<.1	2.2	.9	1.0	6	4
Phenols	<1	7	3.5	4	6	4
Turbidity	.3	59	.3	14	6	6
		USGS 17				
Nitrite plus nitrate	.30	1.6	.30	.56	5	5
Organic carbon	.1	.2	.1	.1	5	5
Phenols	<1	3	2	2	5	4
Turbidity	.3	1.0	.7	.7	5	5
		USGS 97				
Nitrite plus nitrate	1.8	2.0	1.8	1.8	7	7
Orthophosphate	.02	.03	.02	.02	3	3
Organic carbon	.2	.5	.3	.3	7	7
Phenols	1	3	2	2	7	7
Turbidity	.2	.5	.4	.4	7	7
		USGS 98				
Nitrite plus nitrate	1.0	3.0	1.1	1.4	6	6
Organic carbon	.1	.3	.2	.2	6	6
Phenols	1	4	2	2	6	6
Turbidity	.2	.9	.4	.4	6	6
		USGS 99				
Ammonia plus organic nitrogen	.3	.5	.3	.4	3	3
Nitrite plus nitrate	1.5	1.6	1.5	1.5	6	6
Organic carbon	.2	.4	.3	.3	6	6
Phenols	<1	4	3	3	6	3
Turbidity	.2	.7	.4	.4	6	6

Table 10.—***Statistical parameters for dissolved nutrients, total organic carbon, total phenols, and turbidity, by well***—Continued

	Statistical parameter					
Constituent	Minimum	Maximum	Median	Mean	Sample size	Mean and median sample size
		USGS 102				
Ammonia plus organic nitrogen	<.2	.5	.4	.4	5	3
Nitrite plus nitrate	.30	1.7	1.7	1.4	6	6
Orthophosphate	.01	.02	.02	.02	5	5
Organic carbon	.3	.4	.4	.4	6	6
Phenols	<1	2	1	1	6	4
Turbidity	.3	1.1	.65	.6	6	6
		Water Supply INEL-1				
Ammonia plus organic nitrogen	.3	1.2	.4	.6	3	3
Nitrite plus nitrate	5.0	5.6	5.45	5.4	6	6
Organic carbon	.6	1.6	.9	1.0	6	6
Phenols	<1	5	2	2	6	5
Turbidity	.4	1.0	.55	.7	6	6
		All wells				
Ammonia	<.01	.03	.02	.02	33	12
Ammonia plus organic nitrogen	<.2	1.2	.4	.4	36	22
Nitrite plus nitrate	.30	16	1.7	2.0	69	69
Orthophosphate	<.01	.04	.02	.02	36	24
Organic carbon	<.1	2.2	.3	.4	69	67
Phenols	<1	8	2	3	69	52
Turbidity	.2	59	.4	1.7	69	69

Table 11.—***Extractable acid and base/neutral organic compounds for which water samples were analyzed***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using gas chromatography to separate the compounds and mass spectrometry and flame ionization for identification and quantification. Initial extraction was with methylene chloride. Reporting levels are in micrograms per liter (Pritt and Jones, 1989)]

Compound	Reporting level	Compound	Reporting level
Acenaphthene	5.0	2,4-Dinitrophenol	20.0
Acenaphthylene	5.0	2,4-Dinitrotoluene	5.0
Anthracene	5.0	2,6-Dinitrotoluene	5.0
Benzo (a) anthracene	10.0	Di-n-octylphthalate	10.0
Benzo (b) fluoranthene	10.0	bis (2-Ethylhexyl) phthalate	5.0
Benzo (k) fluoranthene	10.0	Fluoranthene	5.0
Benzo (g,h,i) perylene	10.0	Fluorene	5.0
Benzo (a) pyrene	10.0	Hexachlorobenzene	5.0
4-Bromophenyl phenyl ether	5.0	Hexachlorobutadiene	5.0
Butyl benzyl phthalate	5.0	Hexachlorocyclopentadiene	5.0
bis (2-Chloroethoxy) methane	5.0	Hexachloroethane	5.0
bis (2-Chloroethyl) ether	5.0	Indeno (1,2,3-cd) pyrene	10.0
bis (2-Chloroisopropyl) ether	5.0	Isophorone	5.0
4-Chloro-3-methylphenol	30.0	2-Methyl-4,6-dinitrophenol	30.0
2-Chloronaphthalene	5.0	Naphthalene	5.0
2-Chlorophenol	5.0	Nitrobenzene	5.0
4-Chlorophenyl phenyl ether	5.0	2-Nitrophenol	5.0
Chrysene	10.0	4-Nitrophenol	30.0
Dibenzo (a,h) anthracene	10.0	n-Nitrosodimethylamine	5.0
1,2-Dichlorobenzene	5.0	n-Nitrosodi-n-propylamine	5.0
1,3-Dichlorobenzene	5.0	n-Nitrosodiphenylamine	5.0
1,4-Dichlorobenzene	5.0	Pentachlorophenol	30.0
2,4-Dichlorophenol	5.0	Phenanthrene	5.0
Diethyl phthalate	5.0	Phenol	5.0
Dimethyl phthalate	5.0	Pyrene	5.0
2,4-Dimethylphenol	5.0	1,2,4-Trichlorobenzene	5.0
Di-n-butyl phthalate	5.0	2,4,6-Trichlorophenol	20.0

Table 12.—***Concentrations of selected extractable acid and base/neutral organic compounds in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Units are micrograms per liter for concentrations (generally accurate to one order of magnitude) and minutes for retention time. See figure 2 for location of wells. Retention time, the time required for a compound to pass through the column of a gas chromatograph; CAS, Chemical Abstract Services; #, retention time was not reported by the laboratory; ?, exact compound unknown. Compounds listed in table 11 that are not listed in this table were detected in concentrations less than the reporting level; compounds not listed in table 11 that are listed in this table are TIOC's (tentatively identified organic compounds). Data for TIOC's in this report are based on a comparison of sample spectra with library spectra followed by visual examination by gas chromatography and mass spectrometry analysts. TIOC data have not been confirmed by direct comparison with reference standards. Therefore, TIOC identification is tentative, and reported concentrations are semiquantitative]

Well identifier	Date sampled (m/d/y)	Compound	Concentration	Retention time	Remarks
NRF-1	8/7/90	Acid ester	2.0	39.63	
	10/2/90	Alkane	.3	36.68	
		Alkane	.7	38.04	
		Alkane	.7	40.61	
		Alkane	.5	41.81	
		Alkane	.3	42.97	
		Alkane	.2	44.09	
	12/6/90	Alkane	.5	40.51	
		Alkane	.5	41.73	
NRF-3	3/21/90	Diethyl phthalate	5.6	#	CAS No. 88-66-2
	8/7/90	Acid ester	2.0	39.61	
	10/2/90	Unknown	.2	38.09	
NRF-4	2/7/91	Unknown	.1	29.36	

Table 12.—***Concentrations of selected extractable acid and base/neutral organic compounds in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Compound	Concen-tration	Retention time	Remarks
USGS 12	10/10/90	Alkane	.2	35.48	
		Alkane	.3	36.75	
		Unknown	1.0	38.16	
		Phenol, 4,4'-thiobis [2-(1,1-dimethyleth)]	.4	42.98	CAS No. 96695
	2/7/91	Unknown	.1	13.23	
		Unknown	.1	23.38	
		Organic acid ?	.1	25.43	
QAS-6	8/6/90	Acid ester	1.0	39.61	Replicate of USGS 15
USGS 17	3/20/90	Diethyl phthalate	6.7	#	CAS No. 88-66-2
	8/2/90	Long chain ester (?)	.8	39.58	
		Alkane	2.0	43.53	
		Alkane	1.0	44.76	
		Unknown	3.0	45.23	
		Alkane	5.0	45.98	
		Alkane	2.0	47.13	
		Alkane	5.0	48.27	
		Alkane	2.0	49.40	
		Alkane	2.0	50.63	
USGS 97	10/4/90	Benzene, 1,2-dimethyl-	.3	6.61	CAS No. 95476
		Octadecanoic acid	3.0	34.77	CAS No. 57114
		Phenol, 4,4'-(1-methylethylidene)bis-	30.0	35.17	CAS No. 80057

Table 12.—***Concentrations of selected extractable acid and base/neutral organic compounds in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Compound	Concen-tration	Retention time	Remarks
USGS 99	10/3/90	Siloxane	.6	28.52	
		Siloxane	.2	30.41	
	12/10/90	Phenol, 4,4'-(1-methylethylidene)bis-	1.0	35.00	CAS No. 80057
USGS 102	10/4/90	Siloxane	.3	28.64	
	2/7/91	bis (2-Ethylhexyl) phthalate	5.0	#	CAS No. 117-81-7
QAS-9	12/7/90	Phenol, 4,4'-(1-methylethylidene)bis-	2.0	34.99	Replicate Water Supply INEL-1, CAS No. 80057

Table 13.—***Pesticides for which water samples were analyzed***
[Reporting levels are from Pritt and Jones (1989). Units are in micrograms per liter]

Organochlorine insecticides			
Insecticide	Reporting level	Insecticide	Reporting level
Aldrin	0.01	Heptachlor	0.01
Chlordane	1.0	Heptachlor epoxide	.01
DDD	.01	Lindane	.01
DDE	.01	Methoxychlor	.01
DDT	.01	Mirex	.01
Dieldrin	.01	Perthane	.1
Endosulfan	.01	Toxaphene	1.0
Endrin	.01		

Gross polychlorinated compounds	
Compound	Reporting level
Gross polychlorinated biphenyls (PCB)	0.1
Gross polychlorinated naphthalenes (PCN)	.1

Chlorophenoxy acid herbicides			
Herbicide	Reporting level	Herbicide	Reporting level
2,4-D	0.01	Silvex	0.01
2,4-DP	.01	2,4,5-T	.01

Table 14.—***Concentrations of gross alpha-particle radioactivity in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using a residue procedure. Analytical results and uncertainties—for example, **4.38±0.66**—in indicated units. Analytical uncertainties are reported as 1s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in boldface type. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); μg/L, microgram per liter; pCi/L, picocurie per liter. Raw field samples were processed in laboratory prior to analyses]

Well identifier	Date sampled (m/d/y)	Dissolved as uranium (μg/L)	Dissolved as thorium-230 (pCi/L)	Suspended as uranium (μg/L)	Suspended as thorium-230 (pCi/L)
QAS-8	11/2/90	0.084±0.150	0.057±0.102	-0.236±0.144	-0.126±0.080
NRF-1	3/21/90	**4.38±0.66**	**2.97±0.457**	-.076±0.104	-.040±0.056
	6/19/90	**3.92±0.62**	**2.79±0.448**	.103±0.208	.060±0.122
	8/7/90	**4.47±0.66**	**3.11±0.456**	-.038±0.178	-.020±0.095
	10/2/90	**3.62±0.60**	**2.52±0.422**	.157±0.198	.088±0.112
	12/6/90	**4.94±0.68**	**3.42±0.476**	.094±0.228	.050±0.122
NRF-2	3/21/90	**4.25±0.66**	**2.86±0.450**	.273±0.230	.143±0.121
QAS-2	3/21/90	**4.47±0.72**	**2.75±0.471**	.038±0.156	.020±0.082
	6/19/90	**2.76±0.54**	**1.92±0.378**	-.009±0.220	-.005±0.128
	8/7/90	**5.05±0.70**	**3.57±0.50**	-.243±0.167	-.132±0.094
	10/2/90	**5.17±0.70**	**3.72±0.500**	.048±0.220	.026±0.120
	12/5/90	**4.26±0.64**	**3.05±0.457**	-.018±0.121	-.010±0.064
NRF-3	3/21/90	**3.82±0.60**	**2.51±0.406**	.129±0.154	.068±0.082
	6/19/90	**3.51±0.60**	**2.55±0.438**	-.037±0.170	-.021±0.100
	8/7/90	**2.99±0.53**	**2.09±0.372**	-.218±0.148	-.118±0.082
	10/2/90	**4.65±0.68**	**3.27±0.478**	-.104±0.204	-.057±0.112
	12/6/90	**4.00±0.61**	**2.78±0.428**	-.048±0.198	-.025±0.106
NRF-4	6/19/90	**4.40±0.68**	**3.19±0.492**	.281±0.239	.167±0.146
	8/7/90	**4.23±0.64**	**2.93±0.447**	0±0.214	0±0.112
	10/2/90	**3.27±0.54**	**2.31±0.385**	-.088±0.172	-.056±0.110
	12/5/90	**3.63±0.59**	**2.24±0.388**	-.076±0.136	-.040±0.073
	2/7/91	**3.95±0.60**	**2.72±0.409**	.037±0.108	.021±0.063
QAS-12	2/7/91	**4.40±0.64**	**3.15±0.458**	.209±0.187	.122±0.112

Table 14.—***Concentrations of gross alpha-particle radioactivity in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Dissolved as uranium (µg/L)	Dissolved as thorium-230 (pCi/L)	Suspended as uranium (µg/L)	Suspended as thorium-230 (pCi/L)
USGS 12	8/6/90	**4.27±0.65**	**3.07±0.467**	-.305±0.148	-.166±0.086
	10/10/90	**4.45±0.66**	**3.09±0.459**	.084±0.128	.046±0.070
	12/11/90	**4.45±0.64**	**3.07±0.451**	-.142±0.172	-.075±0.092
	2/7/91	**2.54±0.416**	**2.55±0.419**	.035±0.102	.022±0.066
	4/11/91	**3.59±0.57**	**2.48±0.390**	-.063±0.100	-.038±0.060
USGS 15	8/6/90	**3.48±0.58**	**2.44±0.407**	**1.76±0.56**	**2.20±0.71**
QAS-6	8/6/90	**2.41±0.52**	**1.51±0.336**	**9.10±3.00**	7.28±2.62
	10/9/90	**3.10±0.56**	**1.93±0.364**	.360±0.250	.189±0.132
	12/13/90	**2.55±0.490**	**1.79±0.345**	-.009±0.087	-.005±0.047
	2/11/91	**2.26±0.477**	**1.40±0.306**	.280±0.238	.156±0.134
	4/12/91	**2.34±0.465**	**1.61±0.323**	-.018±0.122	-.010±0.068
USGS 17	3/20/90	**2.97±0.56**	**2.05±0.387**	-.037±0.122	-.020±0.066
	6/7/90	**3.43±0.56**	**2.34±0.391**	-.037±0.174	-.022±0.101
	8/2/90	**1.67±0.424**	**1.04±0.270**	-.030±0.190	-.018±0.115
	10/10/90	**2.59±0.492**	**1.85±0.352**	.134±0.256	.071±0.136
	12/10/90	**2.97±0.54**	**1.85±0.352**	.178±0.158	.096±0.088
USGS 97	3/19/90	**4.54±0.69**	**3.08±0.476**	-.018±0.084	-.010±0.046
	6/7/90	**4.05±0.60**	**2.80±0.424**	.036±0.224	.022±0.137
QAS-3	6/7/90	**4.22±0.64**	**2.60±0.421**	0±0.195	0±0.121
	8/1/90	**3.38±0.56**	**2.33±0.394**	-.082±0.229	-.044±0.125
	10/4/90	**3.21±0.54**	**2.24±0.383**	-.122±0.118	-.066±0.064
	12/7/90	**2.64±0.493**	**1.82±0.341**	-.082±0.157	-.044±0.085
QAS-10	12/7/90	**3.86±0.60**	**2.76±0.434**	.084±0.126	.046±0.071
USGS 98	3/19/90	**3.85±0.65**	**2.69±0.458**	-.037±0.122	-.020±0.066
	6/5/90	**3.48±0.57**	**2.38±0.398**	-.099±0.195	-.059±0.117
	7/30/90	**3.44±0.62**	**2.16±0.401**	.037±0.232	.020±0.129
QAS-5	7/30/90	**2.60±0.51**	**1.81±0.359**	0±0.214	0±0.112
	10/3/90	**3.17±0.54**	**2.26±0.386**	-.137±0.166	-.074±0.090
	12/7/90	**2.64±0.492**	**1.81±0.342**	-.138±0.168	-.078±0.096

Table 14.—***Concentrations of gross alpha-particle radioactivity in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Dissolved		Suspended	
		as uranium (µg/L)	as thorium-230 (pCi/L)	as uranium (µg/L)	as thorium-230 (pCi/L)
USGS 99	3/20/90	**3.70±0.64**	**2.26±0.41**	.115±0.182	.060±0.096
	6/5/90	**3.72±0.58**	**2.57±0.404**	.028±0.137	.016±0.082
	8/1/90	**4.16±0.62**	**2.87±0.438**	-.176±0.208	-.094±0.112
	10/3/90	**3.31±0.56**	**2.30±0.390**	-.009±0.224	-.005±0.124
QAS-7	10/3/90	**3.91±0.61**	**2.71±0.425**	.081±0.232	.049±0.141
	12/10/90	**2.87±0.54**	**2.08±0.388**	.115±0.194	.062±0.106
USGS 102	8/1/90	**3.32±0.58**	**2.40±0.416**	-.118±0.198	-.064±0.109
	10/4/90	**4.24±0.63**	**2.92±0.442**	-.243±0.167	-.132±0.094
	12/10/90	**3.83±0.60**	**2.63±0.415**	.009±0.178	.005±0.102
QAS-11	12/10/90	**4.27±0.64**	**2.97±0.444**	-.245±0.183	-.144±0.110
	2/7/91	**4.07±0.62**	**2.84±0.437**	-.084±0.160	-.050±0.094
	4/11/91	**3.56±0.59**	**2.49±0.414**	-.181±0.134	-.100±0.074
Water Supply					
INEL-1	3/19/90	**3.51±0.63**	**2.16±0.408**	-.281±0.187	-.151±0.104
	6/5/90	**4.16±0.62**	**2.96±0.437**	.153±0.192	.093±0.118
	7/30/90	**4.76±0.72**	**2.98±0.474**	-.185±0.188	-.098±0.100
	10/3/90	**2.47±0.489**	**1.53±0.314**	-.139±0.168	-.078±0.096
	12/7/90	**3.58±0.60**	**2.23±0.389**	-.293±0.172	-.168±0.103
QAS-9	12/7/90	**3.86±0.60**	**2.67±0.414**	.048±0.220	.025±0.116

Table 15.—***Statistical parameters for gross alpha-particle radioactivity expressed as uranium and thorium-230, by well***

[Units are micrograms per liter for uranium and picocuries per liter for thorium-230. Values are derived from table 14. See figure 2 for location of wells. Quality assurance replicates are included in the statistical parameters]

Constituent	Statistical parameter				
	Minimum	Maximum	Median	Mean	Sample size
		NRF-1			
Uranium (dissolved)	3.62±0.60	4.94±0.68	4.38±0.66	4.27±0.23	5
Thorium-230 (dissolved)	2.52±0.422	3.42±0.476	2.97±0.457	2.96±0.151	5
Uranium (suspended)	-.076±0.104	.157±0.198	.094±0.228	.048±0.045	5
Thorium-230 (suspended)	-.040±0.056	.088±0.112	.050±0.122	.028±0.025	5
		NRF-2			
Uranium (dissolved)	2.76±0.54	5.17±0.70	4.365±0.482	4.33±0.35	6
Thorium-230 (dissolved)	1.92±0.378	3.72±0.500	2.955±0.321	2.98±0.264	6
Uranium (suspended)	-.243±0.167	.273±0.230	.0145±0.135	.015±0.067	6
Thorium-230 (suspended)	-.132±0.094	.143±0.121	.0075±0.076	.007±0.036	6
		NRF-3			
Uranium (dissolved)	2.99±0.53	4.65±0.68	3.82±0.60	3.79±0.27	5
Thorium-230 (dissolved)	2.09±0.372	3.27±0.478	2.55±0.438	2.64±0.193	5
Uranium (suspended)	-.218±0.148	.129±0.154	-.048±0.198	-.056±0.056	5
Thorium-230 (suspended)	-.118±0.082	.068±0.082	-.025±0.106	-.031±0.030	5
		NRF-4			
Uranium (dissolved)	3.27±0.54	4.40±0.64	4.09±0.44	3.98±0.19	6
Thorium-230 (dissolved)	2.24±0.388	3.19±0.492	2.825±0.303	2.76±0.167	6
Uranium (suspended)	-.088±0.172	.281±0.239	.0185±0.120	.060±0.062	6
Thorium-230 (suspended)	-.056±0.110	.167±0.146	.0105±0.064	.036±0.037	6
		USGS 12			
Uranium (dissolved)	2.54±0.416	4.45±0.64	4.27±0.65	3.86±0.366	5
Thorium-230 (dissolved)	2.48±0.390	3.09±0.459	3.07±0.467	2.85±0.175	5
Uranium (suspended)	-.305±0.148	.084±0.128	-.063±0.100	-.078±0.069	5
Thorium-230 (suspended)	-.166±0.086	.046±0.070	-.038±0.060	-.042±0.038	5
		USGS 15			
Uranium (dissolved)	2.26±0.477	3.48±0.58	2.48±0.36	2.69±0.20	5
Thorium-230 (dissolved)	1.40±0.306	2.44±0.407	1.70±0.236	1.78±0.153	5
Uranium (suspended)	-.018±0.122	9.10±3.00	.320±0.173	1.91±1.46	5
Thorium-230 (suspended)	-.010±0.068	7.28±2.62	.1725±0.094	1.64±1.18	5

Table 15.—***Statistical parameters for gross alpha-particle radioactivity expressed as uranium and thorium-230, by well***—Continued

Constituent	Statistical parameter Minimum	Maximum	Median	Mean	Sample size
			USGS 17		
Uranium (dissolved)	1.67±0.424	3.43±0.56	2.97±0.56	2.73±0.30	5
Thorium-230 (dissolved)	1.04±0.270	2.34±0.391	1.85±0.352	1.83±0.216	5
Uranium (suspended)	-.037±0.174	.178±0.158	-.030±0.190	.042±0.047	5
Thorium-230 (suspended)	-.022±0.101	.096±0.088	-.018±0.115	.021±0.026	5
			USGS 97		
Uranium (dissolved)	2.64±0.493	4.54±0.69	3.86±0.60	3.70±0.25	7
Thorium-230 (dissolved)	1.82±0.341	3.08±0.476	2.60±0.421	2.52±0.159	7
Uranium (suspended)	-.122±0.118	.084±0.126	-.018±0.084	-.026±0.028	7
Thorium-230 (suspended)	-.066±0.064	.046±0.071	-.010±0.046	-.014±0.015	7
			USGS 98		
Uranium (dissolved)	2.60±0.51	3.85±0.65	3.305±0.41	3.20±0.20	6
Thorium-230 (dissolved)	1.81±0.359	2.69±0.458	2.21±0.278	2.18±0.139	6
Uranium (suspended)	-.138±0.168	.037±0.232	-.068±0.115	-.062±0.030	6
Thorium-230 (suspended)	-.078±0.096	.020±0.129	.0395±0.067	-.035±0.017	6
			USGS 99		
Uranium (dissolved)	2.87±0.54	4.16±0.62	3.71±0.43	3.61±0.19	6
Thorium-230 (dissolved)	2.08±0.388	2.87±0.438	2.435±0.28	2.46±0.12	6
Uranium (suspended)	-.176±0.208	.115±0.182	.0545±0.135	.026±0.045	6
Thorium-230 (suspended)	-.094±0.112	.062±0.106	.0325±0.082	.015±0.023	6
			USGS 102		
Uranium (dissolved)	3.32±0.058	4.27±0.64	3.95±0.43	3.88±0.16	6
Thorium-230 (dissolved)	2.40±0.416	2.97±0.444	2.735±0.301	2.71±0.096	6
Uranium (suspended)	-.245±0.183	.009±0.178	-.1495±0.120	-.144±0.040	6
Thorium-230 (suspended)	-.144±0.110	.005±0.102	-.082±0.066	-.081±0.023	6
			Water Supply INEL-1		
Uranium (dissolved)	2.47±0.489	4.76±0.72	3.72±0.42	3.72±0.32	6
Thorium-230 (dissolved)	1.53±0.314	2.98±0.474	2.45±0.284	2.42±0.228	6
Uranium (suspended)	-.293±0.172	.153±0.192	-.162±0.126	-.116±0.074	6
Thorium-230 (suspended)	-.168±0.103	.093±0.118	-.088±0.069	-.063±0.042	6

Table 15.—***Statistical parameters for gross alpha-particle radioactivity expressed as uranium and thorium-230, by well***—Continued

Constituent	Statistical parameter Minimum	Maximum	Median	Mean	Sample size
		All wells			
Uranium (dissolved)	1.67±0.424	5.17±0.70	3.70±0.64	3.65±0.09	69
Thorium-230 (dissolved)	1.04±0.270	3.72±0.500	2.55±0.438	2.50±0.065	69
Uranium (suspended)	-.305±0.148	9.10±3.00	-.018±0.084	.141±0.135	69
Thorium-230 (suspended)	-.168±0.103	7.28±2.62	-.01±0.046	.128±0.110	69

Table 16.—***Concentrations of gross beta-particle radioactivity in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using a residue procedure. Analytical results and uncertainties--for example, **3.34±0.51**--are in picocuries per liter. Analytical uncertainties are reported as 1s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in boldface type. See figure 2 for location of wells. Sr-90/Y-90, strontium 90 in equilibrium with yttrium-90; QAS, quality assurance sample (see Quality Assurance section in text for explanation). Raw field samples were processed in laboratory prior to analyses]

Well identifier	Date Sampled (m/d/y)	Dissolved as Sr-90/Y-90	Dissolved as cesium-137	Suspended as Sr-90/Y-90	Suspended as cesium-137
QAS-8	11/2/90	0.249±0.178	0.260±0.187	-0.048±0.238	-0.049±0.244
NRF-1	3/21/90	**3.34±0.51**	**4.37±0.67**	.193±0.228	.242±0.286
	6/19/90	**2.75±0.484**	**3.84±0.72**	.317±0.236	.394±0.293
	8/7/90	**2.71±0.478**	**3.78±0.73**	.330±0.235	.345±0.246
	10/2/90	**2.28±0.412**	**3.15±0.62**	.199±0.253	.211±0.268
	12/6/90	**2.30±0.388**	**3.03±0.51**	.187±0.230	.193±0.238
NRF-2	3/21/90	**3.48±0.51**	**4.69±0.68**	.298±0.242	.311±0.252
QAS-2	3/21/90	**2.85±0.490**	**3.81±0.66**	-.114±0.218	-.144±0.276
	6/19/90	**3.35±0.76**	**4.60±0.84**	.178±0.238	.226±0.302
	8/7/90	**2.98±0.465**	**3.91±0.61**	-.126±0.258	-.134±0.273
	10/2/90	**2.83±0.478**	**3.75±0.64**	.602±0.252	.630±0.264
	12/5/90	**4.32±0.56**	**5.76±0.75**	.077±0.242	.080±0.250
NRF-3	3/21/90	**3.04±0.54**	**3.96±0.70**	.121±0.244	.143±0.288
	6/19/90	**1.86±0.435**	**2.56±0.63**	-.230±0.246	-.289±0.310
	8/7/90	**3.20±0.50**	**4.31±0.68**	.280±0.218	.355±0.276
	10/2/90	**2.25±0.408**	**3.00±0.54**	.566±0.260	.600±0.276
	12/6/90	**2.49±0.415**	**3.26±0.54**	.590±0.240	.616±0.250
NRF-4	6/19/90	**3.12±0.54**	**4.39±0.81**	.242±0.246	.286±0.290
	8/7/90	**2.09±0.414**	**2.91±0.61**	.264±0.267	.271±0.274
	10/2/90	**2.94±0.472**	**3.84±0.62**	.060±0.246	.062±0.254
	12/5/90	**3.21±0.477**	**4.28±0.64**	.130±0.227	.136±0.237
	2/7/91	**2.55±0.436**	**3.37±0.58**	.174±0.242	.182±0.254
QAS-12	2/7/91	**3.43±0.52**	**4.56±0.68**	.617±0.274	.638±0.284

Table 16.—***Concentrations of gross beta-particle radioactivity in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date Sampled (m/d/y)	Dissolved as Sr-90/Y-90	Dissolved as cesium-137	Suspended as Sr-90/Y-90	Suspended as cesium-137
USGS 12	8/6/90	**3.96±0.56**	**5.27±0.76**	-.016±0.241	-.019±0.284
	10/10/90	**2.51±0.406**	**3.29±0.54**	.199±0.253	.211±0.268
	12/11/90	**3.53±0.492**	**4.71±0.66**	.349±0.242	.360±0.250
	2/7/91	**2.41±0.448**	**3.21±0.60**	.423±0.262	.438±0.270
	4/11/91	**2.46±0.410**	**3.26±0.54**	**.621±0.200**	**.639±0.205**
USGS 15	8/6/90	**2.95±0.498**	**3.91±0.66**	**1.68±0.330**	**2.12±0.414**
QAS-6	8/6/90	**3.20±0.60**	**4.38±0.88**	**5.74±0.80**	**7.40±1.02**
	10/9/90	**2.03±0.362**	**2.73±0.485**	.158±0.248	.163±0.256
	12/13/90	**1.52±0.296**	**2.04±0.431**	.171±0.244	.176±0.250
	2/11/91	**1.42±0.282**	**1.95±0.411**	.444±0.260	.464±0.272
	4/12/91	**1.74±0.398**	**2.36±0.463**	.361±0.248	.378±0.259
USGS 17	3/20/90	**2.80±0.41**	**3.56±0.52**	.057±0.222	.059±0.232
	6/7/90	**3.00±0.322**	**4.07±0.52**	.330±0.234	.414±0.293
	8/2/90	**2.27±0.340**	**2.99±0.50**	.216±0.229	.226±0.240
	10/10/90	**2.00±0.324**	**2.69±0.478**	.303±0.257	.313±0.266
	12/10/90	**2.25±0.333**	**3.04±0.50**	.257±0.214	.268±0.224
USGS 97	3/19/90	**3.15±0.52**	**4.09±0.68**	.210±0.244	.266±0.308
	6/7/90	**2.68±0.492**	**3.58±0.66**	.090±0.234	.114±0.296
QAS-3	6/7/90	**2.52±0.482**	**3.37±0.64**	.252±0.218	.314±0.270
	8/1/90	**2.79±0.62**	**3.83±0.68**	.156±0.228	.161±0.235
	10/4/90	**2.72±0.412**	**3.59±0.54**	.285±0.230	.298±0.240
	12/7/90	**3.49±0.482**	**4.66±0.64**	.114±0.203	.119±0.212
QAS-10	12/7/90	**2.58±0.418**	**3.43±0.56**	.180±0.234	.191±0.248
USGS 98	3/19/90	**2.71±0.422**	**3.58±0.56**	-.012±0.234	-.014±0.277
	6/5/90	**3.64±0.465**	**4.87±0.62**	.678±0.232	.843±0.288
	7/30/90	**2.13±0.344**	**2.92±0.52**	.452±0.249	.464±0.256
QAS-5	7/30/90	**2.75±0.393**	**3.59±0.52**	.089±0.220	.093±0.230
	10/3/90	**2.38±0.354**	**3.30±0.54**	.610±0.277	.630±0.286
	12/7/90	**2.06±0.466**	**2.83±0.51**	.044±0.236	.046±0.242

Table 16.—***Concentrations of gross beta-particle radioactivity in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date Sampled (m/d/y)	Dissolved as Sr-90/Y-90	Dissolved as cesium-137	Suspended as Sr-90/Y-90	Suspended as cesium-137
USGS 99	3/20/90	**3.42±0.52**	**4.50±0.68**	.158±0.256	.163±0.264
	6/5/90	**2.99±0.472**	**3.93±0.62**	.336±0.237	.398±0.280
	8/1/90	**1.73±0.365**	**2.40±0.54**	.181±0.234	.187±0.242
	10/3/90	**1.75±0.360**	**2.33±0.478**	-.165±0.254	-.169±0.260
QAS-7	10/3/90	**3.28±0.470**	**4.28±0.62**	-.086±0.258	-.088±0.266
	12/10/90	**2.68±0.412**	**3.53±0.54**	.074±0.222	.077±0.230
USGS 102	8/1/90	**2.60±0.429**	**3.54±0.65**	-.034±0.232	-.043±0.292
	10/4/90	**3.44±0.458**	**4.63±0.62**	.578±0.275	.597±0.284
	12/10/90	**2.66±0.430**	**3.56±0.58**	.116±0.229	.123±0.242
QAS-11	12/10/90	**3.14±0.466**	**4.18±0.62**	-.051±0.229	-.052±0.236
	2/7/91	**2.37±0.406**	**3.11±0.53**	.193±0.242	.199±0.248
	4/11/91	**2.98±0.460**	**4.01±0.62**	-.019±0.236	-.020±0.244
Water Supply					
INEL-1	3/19/90	**4.12±0.62**	**5.51±0.84**	.193±0.228	.242±0.286
	6/5/90	**3.59±0.62**	**4.80±0.82**	-.026±0.221	-.033±0.280
	7/30/90	**3.39±0.56**	**4.52±0.76**	.006±0.234	.008±0.296
	10/3/90	**3.32±0.53**	**4.38±0.70**	.270±0.228	.282±0.239
	12/7/90	**4.27±0.60**	**5.72±0.80**	.042±0.220	.043±0.228
QAS-9	12/7/90	**3.91±0.57**	**5.22±0.76**	.357±0.246	.378±0.260

Table 17.—***Statistical parameters for gross beta-particle radioactivity expressed as strontium-90 in equilibrium with yttrium-90 and as cesium-137, by well***

[Units are picocuries per liter. Values are derived from table 16. See figure 2 for location of wells. Quality assurance replicates are included in the statistical parameters. Sr-90/Y-90, Strontium-90 in equilibrium with yttrium-90]

Constituent	Statistical parameter				
	Minimum	Maximum	Median	Mean	Sample size
			NRF-1		
Sr-90/Y-90 (dissolved)	2.28±0.412	3.34±0.51	2.71±0.478	2.68±0.193	5
Cesium-137 (dissolved)	3.03±0.51	4.37±0.67	3.78±0.73	3.63±0.25	5
Sr-90/Y-90 (suspended)	.187±0.230	.330±0.235	.199±0.253	.245±0.032	5
Cesium-137 (suspended)	.193±0.238	.394±0.293	.242±0.286	.277±0.039	5
			NRF-2		
Sr-90/Y-90 (dissolved)	2.83±0.478	4.32±0.56	3.165±0.45	3.30±0.23	6
Cesium-137 (dissolved)	3.75±0.64	5.76±0.75	4.255±0.52	4.42±0.32	6
Sr-90/Y-90 (suspended)	-.126±0.258	.602±0.252	.1275±0.170	.152±0.112	6
Cesium-137 (suspended)	-.144±0.276	.630±0.264	.153±0.196	.162±0.120	6
			NRF-3		
Sr-90/Y-90 (dissolved)	1.86±0.435	3.20±0.50	2.49±0.415	2.57±0.248	5
Cesium-137 (dissolved)	2.56±0.63	4.31±0.68	3.26±0.54	3.42±0.32	5
Sr-90/Y-90 (suspended)	-.230±0.246	.590±0.240	.280±0.218	.265±0.152	5
Cesium-137 (suspended)	-.289±0.310	.616±0.250	.355±0.276	.285±0.168	5
			NRF-4		
Sr-90/Y-90 (dissolved)	2.09±0.414	3.43±0.52	3.03±0.36	2.89±0.20	6
Cesium-137 (dissolved)	2.91±0.61	4.56±0.68	4.06±0.45	3.89±0.26	6
Sr-90/Y-90 (suspended)	.060±0.246	.617±0.274	.208±0.173	.248±0.080	6
Cesium-137 (suspended)	.062±0.254	.638±0.284	.2265±0.187	.262±0.083	6
			USGS 12		
Sr-90/Y-90 (dissolved)	2.41±0.448	3.96±0.56	2.51±0.406	2.97±0.32	5
Cesium-137 (dissolved)	3.21±0.60	5.27±0.76	3.29±0.54	3.95±0.43	5
Sr-90/Y-90 (suspended)	-.016±0.241	.621±0.200	.349±0.242	.315±0.107	5
Cesium-137 (suspended)	-.019±0.284	.639±0.205	.360±0.250	.326±0.110	5
			USGS 15		
Sr-90/Y-90 (dissolved)	1.42±0.282	3.20±0.60	1.885±0.269	2.14±0.308	6
Cesium-137 (dissolved)	1.95±0.411	4.38±0.88	2.545±0.335	2.90±0.415	6
Sr-90/Y-90 (suspended)	.158±0.248	5.74±0.80	.4025±0.180	1.43±0.894	6
Cesium-137 (suspended)	.163±0.256	7.40±1.02	.421±0.188	1.78±1.16	6

Table 17.—***Statistical parameters for gross beta-particle radioactivity expressed as strontium-90 in equilibrium with yttrium-90 and as cesium-137, by well***—Continued

	Statistical parameter				
Constituent	Minimum	Maximum	Median	Mean	Sample size
		USGS 17			
Sr-90/Y-90 (dissolved)	2.00±0.324	3.00±0.322	2.27±0.340	2.46±0.187	5
Cesium-137 (dissolved)	2.69±0.478	4.07±0.52	3.04±0.50	3.27±0.24	5
Sr-90/Y-90 (suspended)	.057±0.222	.330±0.234	.257±0.214	.233±0.048	5
Cesium-137 (suspended)	.059±0.232	.414±0.293	.268±0.224	.256±0.058	5
		USGS 97			
Sr-90/Y-90 (dissolved)	2.52±0.482	3.49±0.482	2.72±0.412	2.85±0.132	7
Cesium-137 (dissolved)	3.37±0.64	4.66±0.64	3.59±0.54	3.79±0.17	7
Sr-90/Y-90 (suspended)	.090±0.234	.285±0.230	.180±0.234	.184±0.027	7
Cesium-137 (suspended)	.114±0.296	.314±0.270	.191±0.248	.209±0.032	7
		USGS 98			
Sr-90/Y-90 (dissolved)	2.06±0.466	3.64±0.465	2.545±0.275	2.61±0.236	6
Cesium-137 (dissolved)	2.83±0.51	4.87±0.62	3.44±0.39	3.52±0.30	6
Sr-90/Y-90 (suspended)	-.012±0.234	.678±0.232	.2705±0.166	.310±0.125	6
Cesium-137 (suspended)	-.014±0.277	.843±0.288	.2785±0.172	.344±0.144	6
		USGS 99			
Sr-90/Y-90 (dissolved)	1.73±0.365	3.42±0.52	2.835±0.313	2.64±0.303	6
Cesium-137 (dissolved)	2.33±0.478	4.50±0.68	3.73±0.41	3.50±0.38	6
Sr-90/Y-90 (suspended)	-.165±0.254	.336±0.237	.116±0.169	.083±0.075	6
Cesium-137 (suspended)	-.169±0.260	.398±0.280	.120±0.175	.095±0.083	6
		USGS 102			
Sr-90/Y-90 (dissolved)	2.37±0.406	3.44±0.458	2.82±0.315	2.86±0.161	6
Cesium-137 (dissolved)	3.11±0.53	4.63±0.62	3.785±0.42	3.84±0.22	6
Sr-90/Y-90 (suspended)	-.051±0.229	.578±0.275	.0485±0.164	.130±0.098	6
Cesium-137 (suspended)	-.052±0.236	.597±0.284	.0515±0.172	.134±0.101	6
		Water Supply INEL-1			
Sr-90/Y-90 (dissolved)	3.32±0.53	4.27±0.60	3.75±0.42	3.77±0.16	6
Cesium-137 (dissolved)	4.38±0.70	5.72±0.80	5.01±0.56	5.02±0.22	6
Sr-90/Y-90 (suspended)	-.026±0.221	.357±0.246	.1175±0.158	.140±0.064	6
Cesium-137 (suspended)	-.033±0.280	.378±0.260	.1425±0.183	.153±0.069	6

Table 17.—***Statistical parameters for gross beta-particle radioactivity expressed as strontium-90 in equilibrium with yttrium-90 and as cesium-137, by well***—Continued

Constituent	Statistical parameter				
	Minimum	Maximum	Median	Mean	Sample size
		All wells			
Sr-90/Y-90 (dissolved)	1.42±0.282	4.32±0.56	2.79±0.62	2.82±0.08	69
Cesium-137 (dissolved)	1.95±0.411	5.76±0.75	3.78±0.73	3.77±0.10	69
Sr-90/Y-90 (suspended)	-.230±0.246	5.74±0.80	.193±0.228	.312±0.086	69
Cesium-137 (suspended)	-.289±0.310	7.40±1.02	.211±0.268	.359±0.118	69

Table 18.—***Concentrations of radium-226 and radium-228 in water, Naval Reactors Facility and vicinity***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using radon emanation for radium-226 and separation and beta counting for radium-228. Analytical results are in picocuries per liter. Analytical uncertainties are reported as 1s. Concentrations that exceed the reporting level of 3 times the 1s value are shown in boldface type. See figure 2 for location of wells. QAS, quality assurance sample (see Quality Assurance section in text for explanation); NA, analyses not performed by laboratory. Raw field samples were processed in laboratory prior to analyses]

Well identifier	Date sampled (m/d/y)	Radium-226	Radium-228
QAS-8	11/2/90	**0.075±0.008**	.472±0.195
NRF-1	3/21/90	**.026±0.004**	.152±0.140
	6/19/90	**.102±0.009**	**.157±0.020**
	8/7/90	**.067±0.009**	.142±0.222
	10/2/90	**.135±0.011**	.473±0.204
	12/6/90	**.082±0.008**	.134±0.116
NRF-2	3/21/90	NA	.045±0.126
QAS-2	3/21/90	-.002±0.004	.144±0.164
	6/19/90	**.067±0.007**	.144±0.181
	8/7/90	**.089±0.010**	.193±0.230
	10/2/90	**.065±0.007**	.147±0.179
	12/5/90	**.068±0.010**	.264±0.186
NRF-3	3/21/90	.0087±0.0038	.113±0.123
	6/19/90	**.063±0.008**	.126±0.320
	8/7/90	**.145±0.013**	.087±0.233
	10/2/90	**.083±0.010**	.091±0.187
	12/6/90	**.081±0.009**	.018±0.110
NRF-4	6/19/90	**.106±0.009**	-.133±0.200
	8/7/90	**.019±0.005**	.020±0.217
	10/2/90	**.975±0.008**	.170±0.178
	12/5/90	**.112±0.012**	.232±0.128
	2/7/91	**.035±0.007**	.370±0.160
QAS-12	2/7/91	**.023±0.004**	.215±0.140

Table 18.—***Concentrations of radium-226 and radium-228 in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Radium-226	Radium-228
USGS 12	8/6/90	**.050±0.008**	.307±0.390
	10/10/90	.009±0.007	.152±0.138
	12/11/90	**.129±0.011**	.524±0.156
	2/7/91	**.024±0.004**	.050±0.113
	4/11/91	**.018±0.006**	.079±0.108
USGS 15	8/6/90	**.102±0.009**	.058±0.378
QAS-6	8/6/90	**.048±0.007**	.539±0.448
	10/9/90	**.087±0.009**	.299±0.154
	12/13/90	**.080±0.009**	**.449±0.148**
	2/11/91	**.017±0.004**	.094±0.122
	4/12/91	**.022±0.004**	.199±0.136
USGS 17	3/20/90	**.037±0.004**	.304±0.166
	6/7/90	**.079±0.008**	-.049±0.167
	8/2/90	**.050±0.007**	.275±0.431
	10/10/90	**.093±0.009**	.132±0.176
	12/10/90	**.101±0.009**	.352±0.132
USGS 97	3/19/90	**.018±0.004**	.075±0.149
	6/7/90	**.097±0.009**	.111±0.183
QAS-3	6/7/90	**.088±0.009**	.393±0.224
	8/1/90	**.054±0.008**	.324±0.411
	10/4/90	**.149±0.013**	**.486±0.154**
	12/7/90	**.086±0.008**	.224±0.130
QAS-10	12/7/90	**.094±0.010**	.096±0.118
USGS 98	3/19/90	**.022±0.004**	.154±0.142
	6/5/90	**.051±0.006**	.372±0.383
	7/30/90	**.093±0.010**	-.070±0.237
QAS-5	7/30/90	**.054±0.008**	.260±0.211
	10/3/90	**.086±0.009**	.372±0.231
	12/7/90	**.071±0.008**	.154±0.134

Table 18.—***Concentrations of radium-226 and radium-228 in water, Naval Reactors Facility and vicinity***—Continued

Well identifier	Date sampled (m/d/y)	Radium-226	Radium-228
USGS 99	3/20/90	**.016±0.005**	.141±0.124
	6/5/90	**.064±0.007**	.109±0.396
	8/1/90	**.096±0.009**	.034±0.186
	10/3/90	.011±0.008	.442±0.173
QAS-7	10/3/90	**.109±0.010**	.449±0.207
	12/10/90	**.087±0.008**	.328±0.141
USGS 102	8/1/90	**.131±0.011**	.079±0.181
	10/4/90	**.142±0.012**	.070±0.110
	12/10/90	**.087±0.009**	.222±0.126
QAS-11	12/10/90	**.116±0.011**	.256±0.122
	2/7/91	**.028±0.004**	.137±0.125
	4/11/91	.015±0.006	.231±0.127
Water Supply INEL-1	3/19/90	**.044±0.006**	**.545±0.176**
	6/5/90	**.079±0.008**	.140±0.172
	7/30/90	**.072±0.010**	.305±0.305
	10/3/90	**.115±0.011**	.433±0.228
	12/7/90	**.089±0.010**	.256±0.132
QAS-9	12/7/90	**.152±0.013**	**.437±0.140**

Table 19.—***Statistical parameters for radium-226 and radium-228, by well***
[Units are picocuries per liter. Values are derived from table 18. See figure 2 for location of wells. Quality assurance replicates are included in the statistical parameters]

Constituent	Statistical parameter				
	Minimum	Maximum	Median	Mean	Sample size
			NRF-1		
Radium-226	0.026±0.004	0.135±0.011	0.082±0.008	0.082±0.018	5
Radium-228	.134±0.116	.473±0.204	.152±0.140	.212±0.065	5
			NRF-2		
Radium-226	-.002±0.004	.089±0.010	.067±0.007	.057±0.015	5
Radium-228	.045±0.126	.264±0.186	.1455±0.103	.156±0.029	6
			NRF-3		
Radium-226	.0087±0.0038	.145±0.013	.081±0.009	.076±0.022	5
Radium-228	.018±0.110	.126±0.320	.091±0.187	.087±0.019	5
			NRF-4		
Radium-226	.019±0.005	.975±0.008	.0705±0.056	.212±0.154	6
Radium-228	-.133±0.200	.370±0.160	.1925±0.137	.146±0.072	6
			USGS 12		
Radium-226	.009±0.007	.129±0.011	.024±0.004	.046±0.022	5
Radium-228	.050±0.113	.524±0.156	.152±0.138	.222±0.088	5
			USGS 15		
Radium-226	.017±0.004	.102±0.009	.064±0.047	.059±0.014	6
Radium-228	.058±0.378	.539±0.448	.249±0.180	.273±0.079	6
			USGS 17		
Radium-226	.037±0.004	.101±0.009	.079±0.008	.072±0.012	5
Radium-228	-.049±0.167	.352±0.132	.275±0.431	.203±0.073	5
			USGS 97		
Radium-226	.018±0.004	.149±0.013	.088±0.009	.084±0.015	7
Radium-228	.075±0.149	.486±0.154	.224±0.130	.244±0.061	7
			USGS 98		
Radium-226	.022±0.004	.093±0.010	.0625±0.045	.063±0.011	6
Radium-228	-.070±0.237	.372±0.231	.207±0.151	.207±0.068	6

Table 19.—***Statistical parameters for radium-226 and radium-228, by well***—Continued

Constituent	Statistical parameter				
	Minimum	Maximum	Median	Mean	Sample size
		USGS 99			
Radium-226	.011±0.008	.109±0.010	.0755±0.054	.064±0.017	6
Radium-228	.034±0.186	.449±0.207	.2345±0.179	.250±0.073	6
		USGS 102			
Radium-226	.015±0.006	.142±0.012	.1015±0.072	.086±0.022	6
Radium-228	.070±0.110	.256±0.122	.1795±0.130	.166±0.033	6
		Water Supply INEL-1			
Radium-226	.044±0.006	.152±0.013	.084±0.060	.092±0.015	6
Radium-228	.140±0.172	.545±0.176	.369±0.265	.353±0.060	6
		All wells			
Radium-226	-.002±0.004	.975±0.008	.079±0.008	.084±0.015	68
Radium-228	-.133±0.200	.545±0.176	.157±0.020	.212±0.019	69

Table 20.—***Purgeable organic compounds for which water samples were analyzed***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory using an analytical method that conforms to U.S. Environmental Protection Agency method 524.2. Reporting level for all compounds is 0.2 micrograms per liter (Pritt and Jones, 1989)]

Compound	Compound
Benzene	Cis-1,3-Dichloropropene
Bromoform	Trans-1,3-Dichloropropene
Carbon tetrachloride	1,3-Dichloropropene
Chlorobenzene	Ethylbenzene
Chloroethane	Methyl bromide
2-Chloroethyl vinyl ether	Styrene
Chloroform	Methylene chloride
Chloromethane	1,1,2,2-Tetrachloroethane
Dibromochloromethane	Tetrachloroethylene
Dichlorobromomethane	Toluene
1,2-Dichlorobenzene	Trichlorofluoromethane
1,3-Dichlorobenzene	1,1,1-Trichloroethane
1,4-Dichlorobenzene	1,1,2-Trichloroethane
Dichlorodifluoromethane	Trichloroethylene
1,2-Dibromoethane	Vinyl chloride
1,1-Dichloroethane	Xylenes, mixed
1,2-Dichloroethane	
1,1-Dichloroethylene	
1,2-trans-Dichloroethylene	
1,2-Dichloropropane	

Table 21.—***Concentrations of selected total recoverable trace elements in water from the Central Facilities Area water supply and the Naval Reactors Facility water supply***

[Analyses were performed by the U.S. Geological Survey's National Water Quality Laboratory. Analytical results are in micrograms per liter. Water samples were collected on March 18, 1991 for comparison. See figure 1 for location of facilities. <, concentration is less than indicated reporting level]

Trace elements	Central Facilities Area water supply	Naval Reactors Facility water supply
Arsenic	1	1
Barium	<100	<100
Cadmium	<1	8
Chromium	11	11
Copper	4	3
Iron	1,300	550
Lead	1	3
Manganese	20	20
Nickel	2	1
Selenium	3	6
Silver	<1	<1
Zinc	10	20