PURGEABLE ORGANIC COMPOUNDS IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO

by Larry J. Mann and LeRoy L. Knobel

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CONVERSION FACTORS

For readers who prefer to use metric units, factors for terms used in this report are listed below.

Multiply	By	To obtain
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
gallon (gal)	3.785	liter (L)
square mile (mi^2)	2.590	square kilometer (km^2)

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ABSTRACT

Reconnaissance-level sampling for purgeable organic compounds in ground water was conducted at the Idaho National Engineering Laboratory during June to November 1987. Water samples from 81 wells that tap the Snake River Plain aquifer and that are equipped with dedicated pumps were collected and analyzed for 36 purgeable organic compounds. Twelve compounds were detected in the samples, including carbon tetrachloride; 1,1,1-trichloroethane; trichloroethylene; tetrachloroethylene; and toluene. Except for one sample, the maximum concentration of purgeable organic compounds was 7.7 μg/L (micrograms per liter). One injection well used to dispose of waste water prior to 1973, however, yielded water that contained 35,000 μg/L of trichloroethylene and 22,000 μg/L of 1,2-trans-dichloroethylene.

A water sample from a discontinuous perched-water zone at the Radioactive Waste Management Complex was collected using a thief sampler. The water contained 1,200 μg/L of carbon tetrachloride, 860 μg/L of trichloroethylene, and 650 μg/L of chloroform. The ground-water samples were analyzed at the U.S. Geological Survey's National Water Quality Laboratory in Arvada, Colorado. In addition, 39 duplicate samples were analyzed at the Environmental Chemistry Laboratory operated by the U.S. Department of Energy's contractor, EG&G Idaho, Inc. Methods used to collect the water samples and quality assurance instituted for the sampling program are described in detail.

INTRODUCTION

The INEL (Idaho National Engineering Laboratory) includes about 890 mi^2 of the eastern Snake River Plain in southeastern Idaho (fig. 1). The INEL was established in 1949 and is used by the U.S. Department of Energy to test different types of nuclear reactors. The INEL is one of the main centers in the United States for developing peacetime uses of atomic energy.

During June to November 1987, a reconnaissance-level sampling program was conducted to document the concentration of purgeable organic compounds in ground water at the INEL. Water samples were collected from 30 production wells and 52 ground-water quality monitoring wells; 81 of these wells tap the Snake River Plain aquifer and 1 taps a perched-water zone. Organic compounds historically have been used for degreasing, decontamination, and construction and maintenance activities in conjunction with the operation of nuclear reactors, the processing of nuclear fuel, and at reactor-support facilities. In addition, an estimated 88,400 gal of organic waste were disposed of prior to 1970 at the Subsurface Disposal Area at the Radioactive Waste Management Complex (D.E. Kudera, EG&G Idaho, Inc., written commun., 1987). The buried waste includes an estimated 24,400 gal of carbon

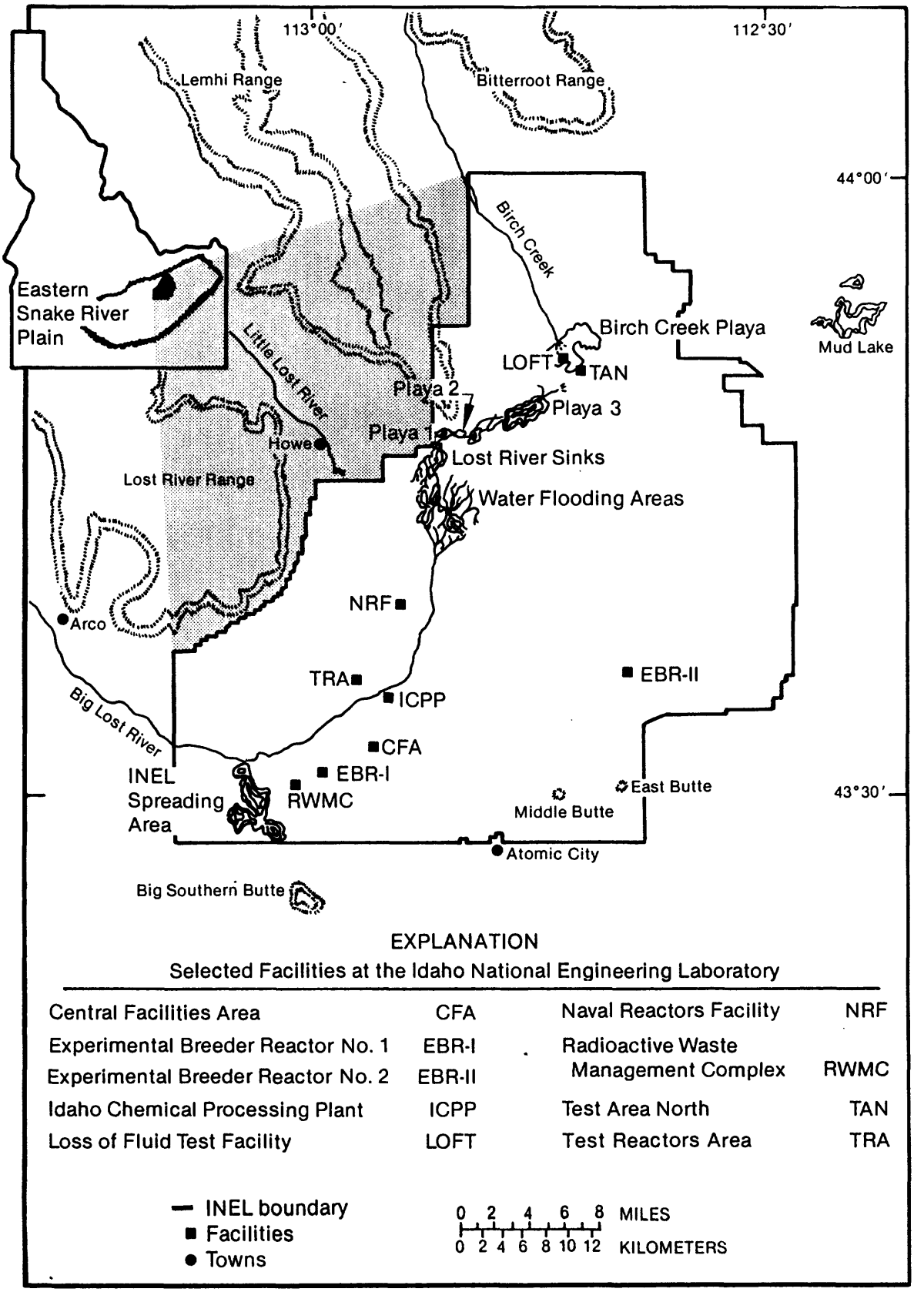

Figure 1.--Location of the Idaho National Engineering Laboratory and selected facilities.

tetrachloride. The remaining volume consists of about 39,000 gal of lubricating oil used in machinery processes and about 25,000 gal of other organic compounds including trichloroethane, trichloroethylene, perchloroethylene, toluene and benzene. This report describes the methods used to collect the water samples and the quality assurance instituted for the sampling program, and summarizes the concentrations of purgeable organic compounds detected in the water samples. The sampling program was conducted by the U.S. Geological Survey in cooperation with the Department of Energy.

Geohydrologic Setting

The eastern Snake River Plain is a northeast trending structural basin about 200 mi long and 50 to 70 mi wide. The plain is underlain by a layered sequence of basaltic lava flows and cinder beds intercalated with alluvium and lakebed sedimentary deposits. Individual flows range from 10 to 50 ft in thickness, although the average thickness may be from 20 to 25 ft (Mundorff and others, 1964, p. 143). The sedimentary deposits consist mainly of lenticular beds of sand, silt and clay with lesser amounts of gravel. Locally, rhyolitic lava flows and tuffs are exposed at the land surface or occur at depth. The basaltic lava flows and intercalated sedimentary deposits combine to form the Snake River Plain aquifer, which is the main source of ground water on the plain. The depth to water in the aquifer ranges from about 200 ft in the northern part of the INEL to more than 900 ft in the southern part.

The INEL obtains its entire water supply from the aquifer. Aqueous chemical and radioactive wastes generated at the INEL were discharged to ponds and wells from 1952 to 1983. Since 1983, most of the aqueous wastes have been discharged to unlined infiltration ponds. Many of the waste constituents enter the aquifer indirectly following percolation through the unsaturated zone; prior to 1984, much of the waste was injected directly into the aquifer using deep wells.

Previous Investigations

The U.S. Geological Survey has conducted geologic, hydrologic and water-quality investigations at the INEL since it was selected as a reactor testing area in 1949. Ground-water quality studies routinely include selected common ions, trace elements and radionuclides. Organic compounds in ground water were first investigated in 1980; results of the investigation are described in a report by Leenheer and Bagby (1982).

During that study, 77 wells were sampled for dissolved organic carbon and 4 wells and several potential sources were sampled for insecticides and herbicides. Water samples from 14 wells were collected and analyzed for volatile and semivolatile organic compounds. These compounds were generally below the reporting level of 10 μg/L (micrograms per liter); a reporting level is the lowest measured concentration of a constituent that may be reliably reported using a given analytical method (Feltz and others, 1985). During the June to November 1987 sampling program, the reporting level for purgeable organic compounds was generally 0.2 μg/L except for samples

collected in June 1987 and a sample at the TAN disposal well; for the June 1987 samples the reporting level was 3.0 µg/L and for the disposal well sample it was 20 µg/L owing to large concentrations of purgeable organic compounds. A reporting level of 0.2 µg/L was selected to detect concentrations of purgeable organic compounds that would not be observed at the higher reporting levels of 3.0 or 10 µg/L.

Acknowledgments

The authors gratefully acknowledge the many employees of the Department of Energy and its contractors at the INEL who aided in the sampling program. A large part of the administrative coordination was provided by T.F. Gesell and Isamu Aoki of the Department of Energy's Idaho Operations Office and by J.L. Clark and W.L. Bodily of EG&G Idaho, Inc., a Department of Energy contractor at the INEL. Special thanks are due to Messrs. A.C. Miskin and R.E. Prine, and Ms. D.G. Avery of EG&G for their participation in collecting the samples and documenting field conditions.

METHODS AND QUALITY ASSURANCE

The methodology used in sampling for purgeable organic compounds generally followed the guidelines established by the U.S. Geological Survey's Organic Substances Task Group (W.L. Bradford, U.S. Geological Survey, written commun., 1985). The methods used in the field and quality assurance practices are outlined in following sections.

Sample Containers

Baked 40-milliliter amber glass vials with inert septum caps, supplied by the U.S. Geological Survey's National Water Quality Laboratory in Arvada, Colorado, were used to collect the water samples. The vials are speciality containers cleaned in compliance with U.S. Environmental Protection Agency Federal Regulations 40-136 and 40-141. Four vials were collected at each site and care was taken to exclude air bubbles from the samples. The samples were protected from direct sunlight and were sealed and chilled at 4 degrees Celsius to minimize the loss of purgeable organic compounds through the septum cap.

Sampling Locations and Decontamination Procedures

Samples were collected at 82 locations as follows: 28 production wells equipped with sample delivery lines at the well head; 2 production wells equipped with water taps located downstream from pressure tanks; 51 groundwater quality monitoring wells equipped with dedicated submersible pumps; and 1 well tapping a perched-water zone that required the use of a thief sampling device. The 30 production wells are equipped with dedicated pumps and supply lines and did not require decontamination. To divert excess flow and facilitate sample collection, monitoring wells equipped with dedicated pumps were fitted with a portable discharge line about 2.5 ft long. The discharge line was 1.5 in. I.D. (inside diameter) galvanized-steel pipe

equipped with a brass valve to control the flow rate. A galvanized T-joint was inserted into the line between the well head and the control valve and a series of galvanized pipes, a brass valve to control the flow rate of the sampling port, and galvanized connectors were attached to the T-joint to reduce the diameter so that a 9/32 in. I.D. stainless steel delivery pipe could be attached as the sampling point. The 9/32 in. I.D. stainless-steel pipe was bent 90 degrees to facilitate sample collection. All fittings and pipes were rinsed with deionized water before installation at the well head. Subsequent flushing by several hundred to thousands of gallons of water pumped from the well ensured that the portable discharge line was as clean of purgeable organic compounds as reasonably possible. The thief sampler used for sampling the well tapping the perched-water zone was washed with hot water and detergent and rinsed with deionized water prior to use. A detailed discussion of techniques used for obtaining samples from wells that represent aquifer water chemistry is presented by Claassen (1982).

Sample Collection

To ensure that water representative of the Snake River Plain aquifer was sampled, a volume of water equivalent to a minimum of three well-bore volumes was pumped from each well; at most wells, 5 to 10 well-bore volumes were pumped prior to collecting the samples. The diameter of the well bore, rather than the volume of the casing, was used to calculate the minimum volume because of the potentially large difference between the two. In addition, temperature, specific conductance, and pH were monitored during pumping, using methods described by Wood (1981). When these measurements stabilized, indicating probable hydraulic and chemical stability, a water sample was collected using the following protocol:

1. Field person responsible for collecting the water sample wore disposable vinyl gloves and stood upwind from the point of collection.

2. The outside of the sample delivery line was rinsed thoroughly with well water.

3. The sample delivery line was inserted to the bottom of the sample vial and a minimum of three vial volumes was allowed to overflow the vial.

4. The vial was lowered gently; care was taken to ensure that air bubbles did not form in the vial.

5. The vial was capped immediately and inspected for air bubbles; if bubbles were detected, the vial was drained, reflushed and refilled.

6. The exterior of the vial was dried, sealed with laboratory film, labeled and stored in an ice chest.

7. Steps 3 through 6 were repeated until the required number of vials were collected successfully.

8. The vials were transferred to a secured refrigerator until they could be transported to the U.S. Geological Survey's National Water Quality Laboratory or to EG&G's Environmental Chemistry Laboratory for analysis. Samples submitted for analysis to the National Water Quality Laboratory were transported in a sealed ice chest by overnight-delivery mail and usually were received by the laboratory within 10 days of collection. Those submitted to the Environmental Chemistry Laboratory were hand delivered within 3 days of collection.

Conditions at the well 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 analyzing laboratory. These records are available for inspection at the U.S. Geological Survey Project Office at the INEL.

Quality Assurance

A detailed description of internal quality control and of the overall quality assurance practices used by the U.S. Geological Survey's National Water Quality Laboratory is provided in a report by Friedman and Erdmann (1982). Additional quality assurance instituted for this sampling program included: five blind replicates--duplicate samples with a different sample identification number sent to the same laboratory; two blank samples containing deionized water; and an equipment blank--deionized-water rinsate to identify potential contamination introduced by the thief sampling device. Ground-water and quality-assurance samples were analyzed by the National Water Quality Laboratory using methods prescribed by Wershaw and others (1987). As a general check of laboratory precision, 39 splits--duplicate samples submitted with the same sample identification number to a different laboratory--were sent for analysis to the EG&G Environmental Chemistry Laboratory. The reporting level used by EG&G's Environmental Chemistry Laboratory was 1 to 2 μg/L depending on the compound (P.N. Pink, EG&G Idaho, Inc., oral commun., 1987).

The blank samples and equipment blanks prepared with deionized water contained low levels of one or more of the following compounds: toluene, styrene, chloroform and dichlorodifluoromethane. All these compounds except styrene are common environmental contaminants and frequently occur in small concentrations in deionized water (L.D. Becker, U.S. Geological Survey, oral commun., 1987). The styrene probably is a contaminant from resin in the deionizing exchange column (D.R. Percival, Dept. of Energy, oral commun., 1987). Subsequent to the initial analytical results from the laboratory indicating that the deionized water was contaminated, purgeable organic compounds were removed by boiling the deionized water a minimum of 12 minutes.

The independent results reported by the 2 laboratories for the 39 splits were within 2 μg/L, except for 5 samples that had larger differences. In some wells slightly different concentrations--including 1 sample that was greater than 2 μg/L--of the same constituent were reported: trichloroethylene in wells ANP-8, TAN-1 and TAN-2; and tetrachloroethylene in well ANP-8. Four of the 5 wells that had cencentration differences of more than

2 μg/L had 1 or more constituent reported as present by 1 laboratory and reported as not detected by the other--wells CFA-1, Fire Station 2, OMRE and TRA-4. For the most part, the differences in the concentrations reported by the two laboratories were relatively minor and likely resulted from differences in analytical methods and the volume of sample analyzed. The U.S. Geological Survey's National Water Quality Laboratory used the U.S. Environmental Protection Agency's method 524 and EG&G's Environmental Chemistry Laboratory used method 624; method 524 requires that a 25 mL sample be analyzed and method 624 requires 5 mL. The reasons for the inconsistencies between the analyses of splits collected from CFA-1, Fire Station 2, OMRE and TRA-4 are not known; resampling will be required to resolve the differences.

PURGEABLE ORGANIC COMPOUNDS IN GROUND WATER

Eighty-one wells that tap the Snake River Plain aquifer at the INEL and that are equipped with dedicated submersible pumps were sampled for purgeable organic compounds. Well 92, which taps a shallow, discontinuous perched-water zone at the RWMC (Radioactive Waste Management Complex), was sampled with a thief sampler. The 36 purgeable organic compounds for which analyses were performed are shown on table 1; the locations of wells that were sampled are shown on figures 2 and 3.

Table 1.--Purgeable organic compounds for which analyses were performed on ground-water samples

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-Dibromoethylene	Vinyl chloride
1,1-Dichloroethane	Xylenes, mixed
1,2-Dichloroethane	
1,1-Dichloroethylene	
1,2-trans-Dichloroethylene	
1,2-Dichloropropane	

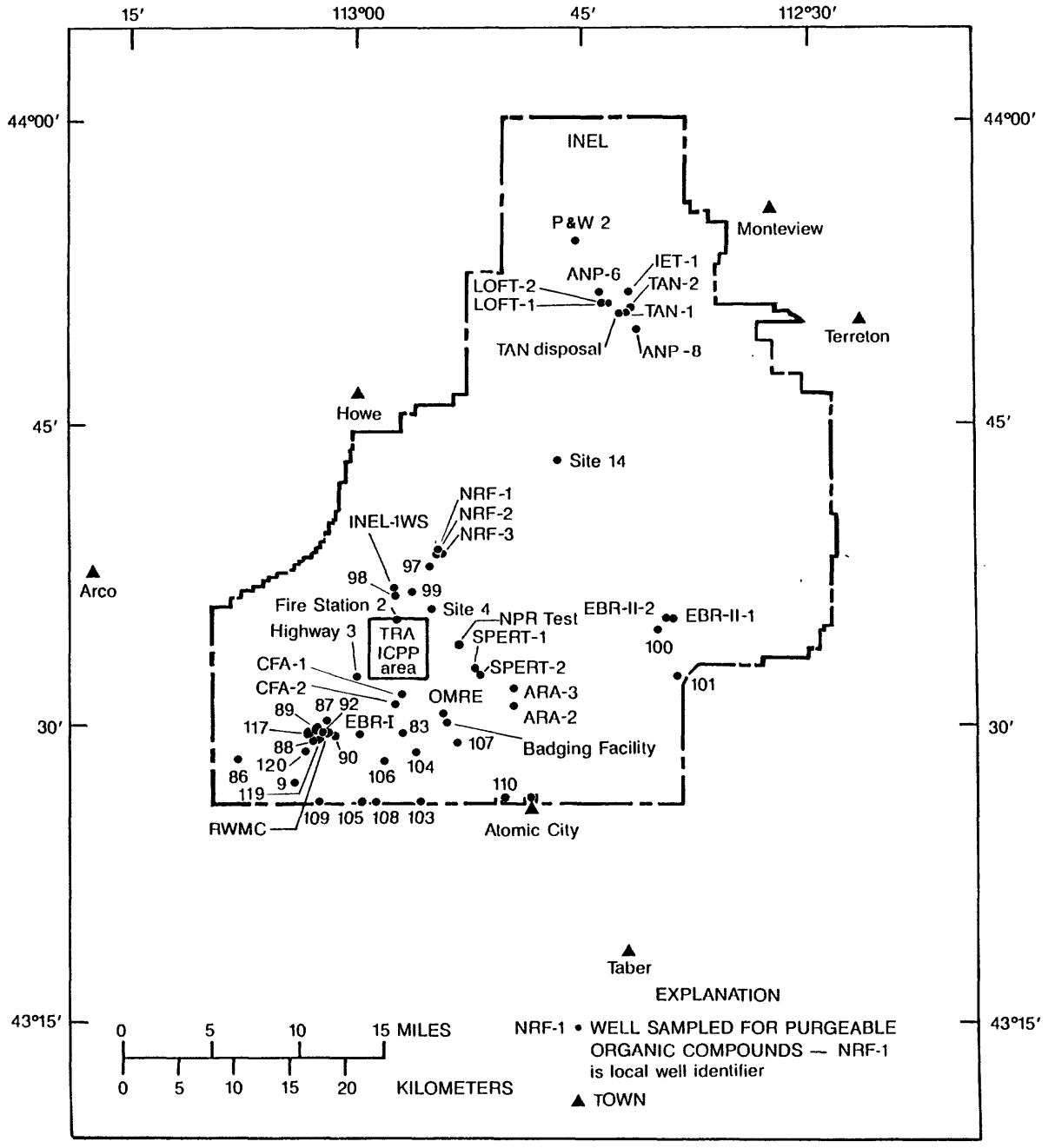

Figure 2.--Locations of wells sampled for purgeable organic compounds, June to November 1987.

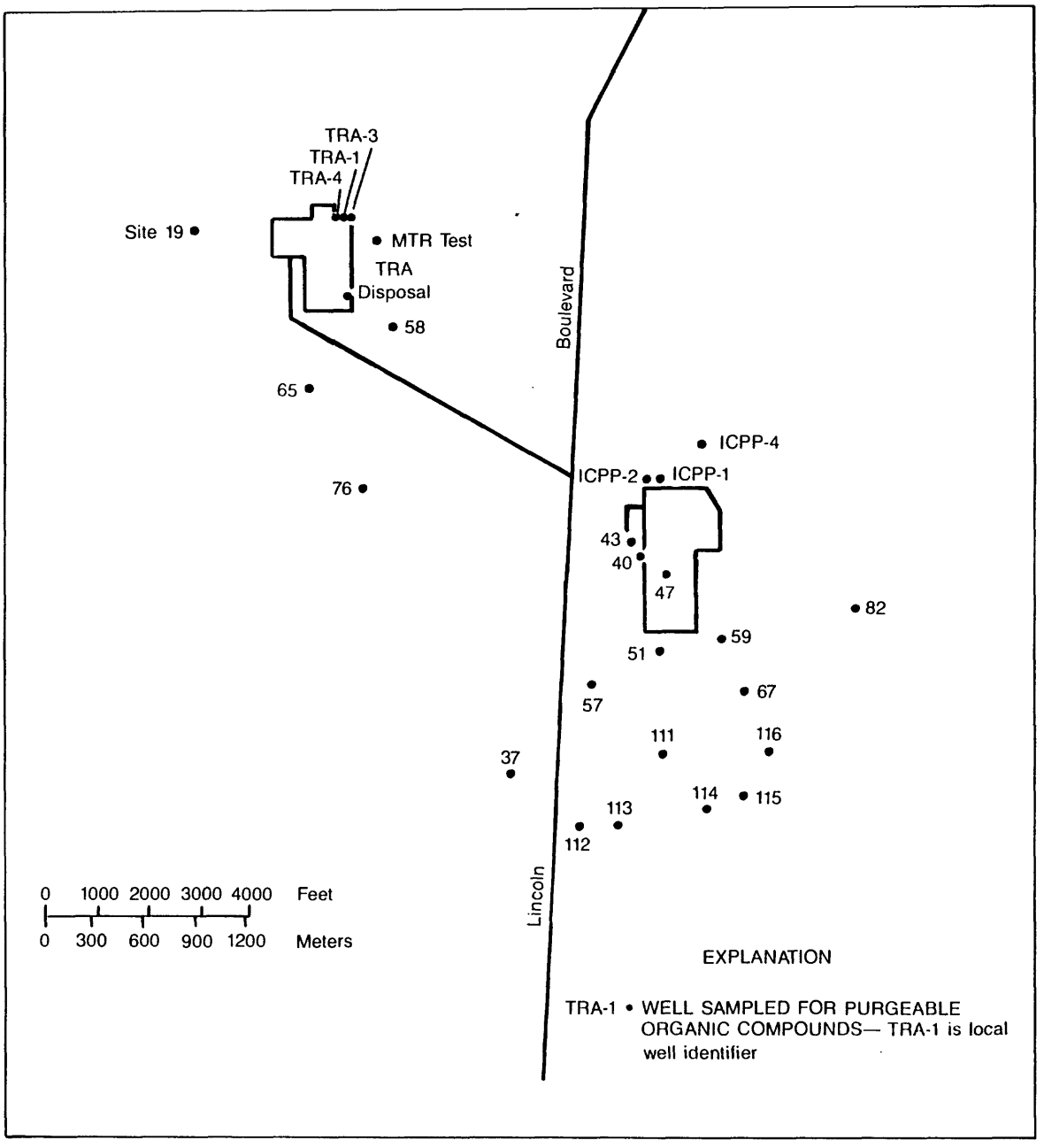

Figure 3.--Locations of wells sampled for purgeable organic compounds in the TRA-ICPP area.

The concentrations of selected purgeable organic compounds in ground water are included in tables 2 and 3 at the end of this report. Analyses by the U.S. Geological Survey's National Water Quality Laboratory are shown on table 2 and analyses by EG&G's Environmental Chemistry Laboratory are shown on table 3; only those compounds that were detected by the respective laboratories are shown on the tables.

Analyses indicated that water in the Snake River Plain aquifer locally contained detectable concentrations of 12 purgeable organic compounds. The prevalent compounds were: trichloroethylene; 1,1,1-trichloroethane; toluene; tetrachloroethylene; carbon tetrachloride; chloroform; 1,1-dichloroethylene; and dichlorodifluoromethane. Two additional compounds, 1,1,2,2-tetrachloroethane and 1,2-dichloropropane were detected in the perched-water zone at the RWMC. Concentrations of benzene, 1,2-dichlorobenzene, 1,2-trans-dichloroethylene, and 1,1-dichloroethane were detected in samples from one or two wells (table 2); other constituents listed on table 1 were below the reporting level of 0.2 µg/L.

Trichloroethylene and 1,1,1-trichloroethane were each detected in 22 wells that tap the Snake River Plain aquifer and in well 92 that taps a perched-water zone. The latter is the prevalent compound detected in wells near the ICPP (Idaho Chemical Processing Plant) and concentrations ranged from 0.2 to 1.1 µg/L. Trichloroethylene concentrations generally ranged from 0.2 to 7.7 µg/L and 1,1,1-trichloroethane ranged from 0.2 to 2.6 µg/L in wells tapping the aquifer, although the TAN disposal well, which has not been used to dispose of aqueous waste since 1972, contained 35,000 µg/L of trichloroethylene (table 2). Water from well 92 contained 860 µg/L of trichloroethylene and 140 µg/L of 1,1,1-trichloroethane. Wells yielding water containing one or both of these two constituents are located near several INEL facilities including the ICPP, RWMC, TAN (Test Area North), NRF (Naval Reactors Facility), TRA (Test Reactors Area), and CFA (Central Facilities Area) (see figure 1 for facility locations).

Toluene was detected in 8 wells and tetrachloroethylene in 6 wells tapping the aquifer and tetrachloroethylene was detected in water from well 92 (table 2). Toluene concentrations were 1.7 µg/L or less and tetrachloroethylene was generally less than 4.2 µg/L, although water from the TAN disposal well contained 170 µg/L, and well 92 contained 110 µg/L of tetrachloroethylene. Toluene and tetrachloroethylene were detected mainly in wells near the TAN and RWMC.

Carbon tetrachloride and chloroform were detected mainly in wells near the RWMC (see figure 2 and table 2). Carbon tetrachloride concentrations ranged from less than 0.2 to 6.6 µg/L in wells tapping the aquifer and was 1,200 µg/L in well 92. Chloroform concentrations ranged from less than 0.2 to 1.0 µg/L in well 88, which taps the aquifer, and 650 µg/L in well 92. In two other wells in the northern and central parts of the INEL, the chloroform concentration was 0.2 µg/L.

Dichlorodifluoromethane was detected in samples from 3 wells and 1,1-dichloroethylene in samples from 4 wells (table 2). Dichlorodifluoromethane concentrations were 0.4 µg/L or less and 1,1-dichloroethylene concentrations were 0.8 µg/L or less at three wells and 49 µg/L at the TAN disposal well.

Compounds detected at either 1 or 2 of the 82 wells sampled--1,1,2,2-tetrachloroethane, 1,2-dichloropropane, benzene, 1,2-dichlorobenzene, 1,2-trans-dichloroethylene, and 1,1-dichloroethane generally were at concentrations of 5.9 μg/L or less (table 2). However, a concentration of 22,000 μg/L of 1,2-trans-dichloroethylene was detected at the TAN disposal well.

SUMMARY

Reconnaissance-level sampling for purgeable organics in ground water at the INEL was conducted by the U.S. Geological Survey during June to November 1987. The sampling was done in cooperation with the U.S. Department of Energy. Water samples from the Snake River Plain aquifer were collected at 81 wells and 1 sample was collected from a discontinuous perched-water zone at the RWMC. The samples were analyzed for 36 purgeable organic compounds and a total of 14 compounds were detected in the samples, including: carbon tetrachloride, chloroform, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethyene, dichlorodifluoromethane, and toluene.

Except for 1 well, the maximum concentration of purgeable organic compounds in water obtained from wells that tap the Snake River Plain aquifer was 7.7 μg/L; the TAN disposal well, which was used for waste-water disposal prior to 1973, contained water with concentrations of 35,000 μg/L of trichloroethylene and 22,000 μg/L of 1,2-trans-dichloroethylene. The sample from the discontinuous perched-water zone at the RWMC--well 92--contained concentrations of 1,200 μg/L of carbon tetrachloride, 860 μg/L of trichloroethylene, and 650 μg/L of chloroform. This sample also contained concentrations of two compounds not detected in other wells: 1.0 μg/L of 1,1,2,2-tetrachloroethane and 5.9 μg/L of 1,2-dichloropropane.

A field logbook was maintained to record conditions at the well during sample collection and a chain-of-custody record was used to track samples from the time of collection until delivery to the analyzing laboratory. The ground-water samples were analyzed by the U.S. Geological Survey's National Water Quality Laboratory. In addition, 39 duplicate samples were sent to EG&G's Environmental Chemistry Laboratory for analysis. Methods used to collect the water samples and the quality assurance procedures instituted for the sampling program are described in detail.

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Tables 2 and 3

Table 2.--Concentrations of selected purgeable organic compounds in ground water

[Analyses by U.S. Geological Survey's National Water Quality Laboratory, Arvada, Colorado. Analytical results in μg/L (micrograms per liter); <0.2 indicates the concentration was less than the reporting level of 0.2 μg/L. Continued on following page.]

Well identifier	Date Sampled	Carbon tetrachloride	Chloroform	1,1,1-Trichloroethane	Trichloroethylene
9	07/30/87	<0.2	<0.2	<0.2	<0.2
	10/05/87	<0.2	<0.2	<0.2	<0.2
37	10/05/87	<0.2	<0.2	0.7	<0.2
40	10/13/87	<0.2	<0.2	0.3	<0.2
43	10/05/87	<0.2	<0.2	0.2	<0.2
47	10/26/87	<0.2	<0.2	<0.2	<0.2
51	10/13/87	<0.2	<0.2	0.7	<0.2
57	10/09/87	<0.2	<0.2	0.5	<0.2
58	10/08/87	<0.2	<0.2	<0.2	<0.2
59	10/06/87	<0.2	<0.2	<0.2	<0.2
65	10/14/87	<0.2	<0.2	1.1	0.2
67	10/06/87	<0.2	<0.2	0.6	<0.2
76	10/08/87	<0.2	<0.2	<0.2	<0.2
82	10/06/87	<0.2	<0.2	0.3	<0.2
83	10/14/87	<0.2	<0.2	<0.2	<0.2
86	08/04/87	<0.2	<0.2	<0.2	<0.2
	10/06/87	<0.2	<0.2	<0.2	<0.2
87	06/03/87	<3.0	<3.0	<3.0	<3.0
	08/11/87	0.3	<0.2	<0.2	<0.2
	09/23/87	0.7	<0.2	<0.2	0.2
88	06/03/87	6.6	<3.0	<3.0	<3.0
	07/08/87	2.7	<0.2	0.6	1.1
		3.2	<0.2	0.7	1.2
		3.1	<0.2	0.7	1.2
		2.9	<0.2	0.6	1.2
		2.8	<0.2	0.6	1.2
	07/15/87	4.4	1.0	0.9	1.4
	08/11/87	2.1	0.4	0.4	1.2
	09/22/87	2.9	0.7	0.5	1.1
89	06/03/87	<3.0	<3.0	<3.0	<3.0
	08/12/87	<0.2	<0.2	<0.2	<0.2
	09/22/87	<0.2	<0.2	<0.2	<0.2
90	06/03/87	<3.0	<3.0	<3.0	<3.0
	08/11/87	0.6	<0.2	0.2	0.2
	09/23/87	0.8	<0.2	0.2	0.3

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

[Well identifier: see figures 2 and 3 for location of wells; Blank - indicates sample vial contained deionized water. Remarks: QA Replicate - indicates a second sample submitted for analysis using a different identifier.]

Well identifier	Tetrachloroethylene	Dichlorodifluoromethane	Toluene	1,1-Dichloroethane	1,1-Dichloroethylene	Remarks
9	<0.2	<0.2	0.3	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
37	<0.2	<0.2	<0.2	<0.2	<0.2	
40	<0.2	<0.2	<0.2	<0.2	<0.2	
43	<0.2	<0.2	<0.2	<0.2	<0.2	
47	<0.2	<0.2	<0.2	<0.2	<0.2	
51	<0.2	<0.2	<0.2	<0.2	<0.2	
57	<0.2	<0.2	<0.2	<0.2	<0.2	
58	<0.2	<0.2	<0.2	<0.2	<0.2	
59	<0.2	<0.2	<0.2	<0.2	<0.2	
65	<0.2	<0.2	<0.2	<0.2	<0.2	
67	<0.2	<0.2	<0.2	<0.2	0.2	
76	<0.2	<0.2	<0.2	<0.2	<0.2	
82	<0.2	<0.2	<0.2	<0.2	<0.2	
83	<0.2	<0.2	<0.2	<0.2	<0.2	
86	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
87	<3.0	<3.0	<3.0	<3.0	<3.0	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
88	<3.0	<3.0	<3.0	<3.0	<3.0	
	0.2	0.3	<0.2	<0.2	<0.2	40 minutes of pumping
	0.2	<0.2	<0.2	<0.2	<0.2	1 hour of pumping
	0.2	<0.2	<0.2	<0.2	<0.2	2 hours of pumping
	0.2	<0.2	<0.2	<0.2	<0.2	3 hours of pumping
	0.2	<0.2	<0.2	<0.2	<0.2	4 hours of pumping
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
89	<3.0	<3.0	<3.0	<3.0	<3.0	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	0.3	<0.2	
90	<3.0	<3.0	<3.0	<3.0	<3.0	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Date Sampled	Carbon tetrachloride	Chloroform	1,1,1-Trichloroethane	Trichloroethylene
92	10/23/87	1,200	650	140	860
	10/22/87	<0.2	<0.2	0.2	<0.2
97	10/14/87	<0.2	<0.2	<0.2	<0.2
98	10/14/87	<0.2	<0.2	<0.2	<0.2
99	10/14/87	<0.2	<0.2	<0.2	<0.2
100	10/20/87	<0.2	<0.2	<0.2	<0.2
101	10/20/87	<0.2	<0.2	<0.2	<0.2
103	09/24/87	<0.2	<0.2	<0.2	<0.2
104	09/24/87	<0.2	<0.2	<0.2	<0.2
105	07/30/87	<0.2	<0.2	<0.2	<0.2
	09/28/87	<0.2	<0.2	<0.2	<0.2
		<0.2	<0.2	<0.2	<0.2
106	10/06/87	<0.2	<0.2	<0.2	<0.2
		<0.2	<0.2	<0.2	<0.2
107	10/09/87	<0.2	<0.2	<0.2	<0.2
108	09/28/87	<0.2	<0.2	<0.2	<0.2
109	07/31/87	<0.2	<0.2	<0.2	<0.2
	10/05/87	<0.2	<0.2	<0.2	<0.2
110	10/09/87	<0.2	<0.2	<0.2	<0.2
111	09/25/87	<0.2	<0.2	0.3	<0.2
112	09/25/87	<0.2	<0.2	0.6	<0.2
113	10/02/87	<0.2	<0.2	0.8	<0.2
114	10/09/87	<0.2	<0.2	1.1	<0.2
115	10/09/87	<0.2	<0.2	<0.2	<0.2
116	10/28/87	<0.2	<0.2	0.4	<0.2
117	10/19/87	<0.2	<0.2	<0.2	<0.2
		<0.2	<0.2	<0.2	<0.2
	11/05/87	<0.2	<0.2	<0.2	<0.2
119	11/06/87	<0.2	<0.2	<0.2	<0.2
		<0.2	<0.2	<0.2	<0.2
120	11/18/87	1.5	<0.2	0.5	0.5
		1.4	<0.2	0.4	0.4
ANP-6	10/28/87	<0.2	<0.2	<0.2	0.5
ANP-8	10/25/87	<0.2	<0.2	<0.2	7.5

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Tetrachloroethylene	Dichlorodifluoromethane	Toluene	1,1-Dichloroethane	1,1-Dichloroethylene	Remarks
92	110	<0.2	<0.2	13	0.8	1,1,2,2-Tetrachloroethane, 1.0 µg/L 1,2-Dichloropropane, 5.9 µg/L
	<0.2	<0.2	<0.2	<0.2	<0.2	Equipment blank for well 92; styrene, 0.5 µg/L
97	<0.2	<0.2	<0.2	<0.2	<0.2	
98	<0.2	<0.2	<0.2	<0.2	<0.2	
99	<0.2	<0.2	<0.2	<0.2	<0.2	
100	<0.2	<0.2	<0.2	<0.2	<0.2	
101	<0.2	<0.2	<0.2	<0.2	<0.2	
103	<0.2	<0.2	<0.2	<0.2	<0.2	
104	<0.2	<0.2	<0.2	<0.2	<0.2	
105	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	QA Replicate
106	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	QA Replicate
107	<0.2	<0.2	<0.2	<0.2	<0.2	
108	<0.2	<0.2	<0.2	<0.2	<0.2	
109	<0.2	<0.2	0.7	<0.2	<0.2	
	<0.2	<0.2	1.0	<0.2	<0.2	
110	<0.2	<0.2	<0.2	<0.2	<0.2	
111	<0.2	<0.2	<0.2	<0.2	<0.2	
112	<0.2	0.3	<0.2	<0.2	<0.2	
113	<0.2	0.4	<0.2	<0.2	<0.2	
114	<0.2	<0.2	<0.2	<0.2	<0.2	Benzene, 0.3 µg/L
115	<0.2	<0.2	<0.2	<0.2	<0.2	
116	<0.2	<0.2	<0.2	<0.2	<0.2	
117	<0.2	<0.2	0.3	<0.2	<0.2	
	<0.2	<0.2	0.4	<0.2	<0.2	QA Replicate
	<0.2	<0.2	<0.2	<0.2	<0.2	
119	<0.2	<0.2	1.2	<0.2	<0.2	
	<0.2	<0.2	1.0	<0.2	<0.2	QA Replicate
120	<0.2	<0.2	0.3	<0.2	<0.2	
	<0.2	<0.2	0.3	<0.2	<0.2	QA Replicate
ANP-6	<0.2	<0.2	<0.2	<0.2	<0.2	
ANP-8	4.2	<0.2	<0.2	<0.2	<0.2	

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Date Sampled	Carbon tetrachloride	Chloroform	1,1,1-Trichloroethane	Trichloroethylene
ARA-2	10/28/87	<0.2	<0.2	<0.2	0.2
ARA-3	10/28/87	<0.2	<0.2	<0.2	<0.2
Atomic City	10/29/87	<0.2	<0.2	<0.2	0.3
Badging Facility	10/24/87	<0.2	<0.2	1.0	<0.2
CFA-1	10/15/87	<0.2	<0.2	0.8	0.3
CFA-2	10/14/87	<0.2	<0.2	0.7	0.7
EBR-I	10/14/87	<0.2	<0.2	<0.2	<0.2
EBR-II-1	10/15/87	<0.2	<0.2	<0.2	<0.2
EBR-II-2	10/15/87	<0.2	<0.2	<0.2	<0.2
Fire Station 2	11/03/87	<0.2	<0.2	2.6	0.2
Highway-3	10/29/87	<0.2	<0.2	<0.2	0.8
ICPP-1	10/22/87	<0.2	<0.2	<0.2	<0.2
ICPP-2	10/22/87	<0.2	<0.2	<0.2	<0.2
ICPP-4	10/22/87	<0.2	<0.2	<0.2	<0.2
IET-1	10/27/87	<0.2	0.2	<0.2	1.3
INEL-1WS	10/26/87	<0.2	<0.2	<0.2	<0.2
LOFT-1	10/25/87	<0.2	<0.2	<0.2	<0.2
LOFT-2	10/26/87	<0.2	<0.2	<0.2	<0.2
MTR Test	10/07/87	<0.2	<0.2	<0.2	<0.2
NPR Test	10/15/87	<0.2	<0.2	<0.2	<0.2
	10/15/87	<0.2	<0.2	<0.2	<0.2
NRF-1	10/29/87	<0.2	<0.2	<0.2	<0.2
NRF-2	10/29/87	<0.2	<0.2	<0.2	1.3
NRF-3	10/29/87	<0.2	<0.2	<0.2	<0.2
OMRE	10/30/87	<0.2	<0.2	<0.2	<0.2
P&W-2	10/16/87	<0.2	<0.2	<0.2	<0.2
	10/23/87	<0.2	<0.2	<0.2	<0.2
RWMC	06/03/87	<3.0	<3.0	<3.0	<3.0
	08/11/87	1.0	<0.2	0.2	0.5
	09/23/87	1.3	<0.2	0.3	0.5
	10/14/87	1.5	<0.2	0.5	0.6
Site 4	11/03/87	<0.2	0.2	<0.2	<0.2

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Tetrachloroethylene	Dichlorodifluoromethane	Toluene	1,1-Dichloroethane	1,1-Dichloroethylene	Remarks
ARA-2	<0.2	<0.2	1.7	<0.2	<0.2	
ARA-3	<0.2	<0.2	<0.2	<0.2	<0.2	
Atomic City	<0.2	<0.2	<0.2	<0.2	<0.2	
Badging Facility	<0.2	<0.2	<0.2	<0.2	<0.2	
CFA-1	<0.2	<0.2	<0.2	<0.2	<0.2	
CFA-2	<0.2	<0.2	<0.2	<0.2	0.2	
EBR-I	<0.2	<0.2	<0.2	<0.2	<0.2	
EBR-II-1	<0.2	<0.2	<0.2	<0.2	<0.2	
EBR-II-2	<0.2	<0.2	<0.2	<0.2	<0.2	
Fire Station 2	<0.2	<0.2	<0.2	<0.2	<0.2	
Highway-3	<0.2	<0.2	<0.2	<0.2	<0.2	
ICPP-1	<0.2	<0.2	<0.2	<0.2	<0.2	
ICPP-2	<0.2	<0.2	<0.2	<0.2	<0.2	
ICPP-4	<0.2	<0.2	<0.2	<0.2	<0.2	
IET-1	1.2	<0.2	<0.2	<0.2	<0.2	1,2-Dichlorobenzene, 1.9 µg/L
INEL-1WS	<0.2	<0.2	<0.2	<0.2	<0.2	
LOFT-1	<0.2	<0.2	<0.2	<0.2	<0.2	
LOFT-2	<0.2	<0.2	<0.2	<0.2	<0.2	
MTR Test	<0.2	<0.2	<0.2	<0.2	<0.2	
NPR Test	<0.2	<0.2	0.8	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	QA Replicate
NRF-1	<0.2	<0.2	<0.2	<0.2	<0.2	
NRF-2	<0.2	<0.2	<0.2	<0.2	<0.2	1,2-trans-Dichloroethylene, 0.3 µg/L
NRF-3	<0.2	<0.2	<0.2	<0.2	<0.2	
OMRE	<0.2	<0.2	2.2	<0.2	<0.2	
P&W-2	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
RWMC	<3.0	<3.0	<3.0	<3.0	<3.0	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
	<0.2	<0.2	<0.2	<0.2	<0.2	
Site 4	<0.2	<0.2	<0.2	<0.2	<0.2	

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Date Sampled	Carbon tetrachloride	Chloroform	1,1,1-Trichloroethane	Trichloroethylene
Site 14	10/14/87	<0.2	<0.2	<0.2	<0.2
Site 19	10/07/87	<0.2	<0.2	0.2	<0.2
SPERT-1	10/24/87	<0.2	<0.2	<0.2	0.2
SPERT-2	10/24/87	<0.2	<0.2	<0.2	<0.2
TAN-1	10/23/87	<0.2	<0.2	<0.2	7.7
TAN-2	10/23/87	<0.2	<0.2	<0.2	5.4
TAN Disposal	10/27/87	<20	<20	<20	35,000
TRA-1	10/30/87	<0.2	<0.2	<0.2	0.2
TRA-3	10/27/87	<0.2	<0.2	<0.2	<0.2
TRA-4	10/30/87	<0.2	<0.2	<0.2	6.7
TRA Disposal	10/28/87	<0.2	<0.2	<0.2	4.0
Blank	10/07/87	<0.2	0.5	<0.2	<0.2
	10/15/87	<0.2	0.5	0.2	<0.2

Table 2.--Concentrations of selected purgeable organic compounds in ground water--Continued

Well identifier	Tetrachloroethylene	Dichlorodifluoromethane	Toluene	1,1-Dichloroethane	1,1-Dichloroethylene	Remarks
Site 14	<0.2	<0.2	<0.2	<0.2	<0.2	
Site 19	<0.2	<0.2	<0.2	<0.2	<0.2	
SPERT-1	<0.2	<0.2	<0.2	<0.2	<0.2	
SPERT-2	<0.2	<0.2	<0.2	<0.2	<0.2	
TAN-1	2.0	<0.2	<0.2	<0.2	<0.2	
TAN-2	1.1	<0.2	<0.2	<0.2	<0.2	
TAN Disposal	170	<20	<20	<20	49	1,2-trans-Dichloroethylene, 22,000 µg/L
TRA-1	<0.2	<0.2	<0.2	<0.2	<0.2	
TRA-3	<0.2	<0.2	<0.2	<0.2	<0.2	
TRA-4	<0.2	<0.2	3.4	<0.2	<0.2	
TRA Disposal	<0.2	<0.2	0.5	<0.2	<0.2	
Blank	<0.2	<0.2	0.2	<0.2	<0.2	Trichlorofluoromethane, 0.5 µg/L
	<0.2	<0.2	<0.2	<0.2	<0.2	Trichlorofluoromethane, 14 µg/L

Table 3.--Concentrations of selected purgeable organic compounds in duplicate ground-water samples

[Analyses by EG&G's Environmental Chemistry Laboratory; analytical results in micrograms per liter. Well identifier: see figures 2 and 3 for location of well.]

Well Identifier	Date Sampled	Constituent	Concentration
9	10/05/87	None detected	-
86	10/06/87	None detected	-
100	10/20/87	None detected	-
101	10/20/87	None detected	-
105	09/28/87	None detected	-
108	09/28/87	None detected	-
109	10/05/87	None detected	-
117	10/19/87	None detected	-
ANP-8	10/25/87	Trichloroethylene	5
		Tetrachloroethylene	3
ARA-2	10/28/87	None detected	-
ARA-3	10/28/87	None detected	-
Badging Facility	10/24/87	None detected	-
CFA-1	10/15/87	Chloroform	4
CFA-2	10/14/87	None detected	-
EBR-I	10/14/87	None detected	-
EBR-II-1	10/15/87	None detected	-
EBR-II-2	10/15/87	None detected	-
Fire Station 2	11/03/87	None detected	-
ICPP-1	10/22/87	None detected	-
ICPP-2	10/22/87	None detected	-
ICPP-4	10/22/87	None detected	-
LOFT-1	10/25/87	None detected	-
LOFT-2	10/26/87	None detected	-
NPR Test	10/15/87	None detected	-
NRF-1	10/29/87	None detected	-
NRF-2	10/29/87	None detected	-
NRF-3	10/29/87	None detected	-
OMRE	10/30/87	None detected	-

Table 3.--Concentrations of selected purgeable organic compounds in duplicate ground-water samples--Continued

Well Identifier	Date Sampled	Constituent	Concentration
P&W-2	10/16/87	None detected	-
	10/23/87	None detected	-
RWMC	10/14/87	None detected	-
Site 4	11/03/87	1,1,1-Trichloroethane	2
SPERT-1	10/24/87	None detected	-
SPERT-2	10/24/87	None detected	-
TAN-1	10/23/87	Trichloroethylene	6
TAN-2	10/23/87	Trichloroethylene	4
TRA-1	10/30/87	None detected	-
TRA-3	10/27/87	None detected	-
TRA-4	10/30/87	None detected	-