GROUND-WATER QUALITY IN THE CALUMET REGION OF NORTHWESTERN INDIANA AND NORTHEASTERN ILLINOIS, JUNE 1993

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 95-4244

Prepared in cooperation with the

U.S. ENVIRONMENTAL PROTECTION AGENCY

Ground-Water Quality in the Calumet Region of Northwestern Indiana and Northeastern Illinois, June 1993

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
acre	4,047	square meter
square mile (mi^2)	2.590	square kilometer
quart	1.057	liter
gallon (gal)	3.785	liter

Degree Celsius (°C) can be converted to degree Fahrenheit (°F) by use of the following equation:
F°= (1.8 C°) + 32

Abbreviated water-quality units used in this report: Chemical concentrations and water temperature are given in metric units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

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

The following abbreviations are used in this report:

CLP	Contract Laboratory Program
DO	dissolved oxygen
Eh	oxidation-reduction potential
MCL	Maximum Contaminant Level
mv	millivolt
PCB	polychlorinated biphenyl
pH	negative log base-10 of the hydrogen ion activity, in moles per liter
p,p′-DDD	dichlorodiphenyldichloroethane
p,p′-DDE	dichlorodiphenylethane
p,p′-DDT	dichlorodiphenyltrichloroethane
PTFE	polytetrafluoroethylene
RPD	relative percent difference
SC	specific conductance
SMCL	Secondary Maximum Contaminant Level
SVOC	semivolatile organic compound
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound
mg/L	milligram per liter (equal to one part per million)
µg/L	microgram per liter (equal to one part per billion)
µS/cm	microsiemens per centimeter at 25° Celsius

ABSTRACT

Water samples were collected from 128 wells in a large industrial and urban area in northwestern Indiana and northeastern Illinois during June 1993. Samples were collected

Much of the Calumet Region is underlain by a relatively thin (less than 65 ft thick), but areally extensive, surficial sand aquifer known as the Calumet aquifer (Watson and others, 1989, p. 1). Flow in this aquifer is generally toward the major streams, some of which flow into Lake Michigan. The quality of water in the Calumet aquifer is of concern to Federal, State, and local environmental agencies because of the potential for contamination from anthropogenic sources and the potential for discharge of those contaminants to Lake Michigan.

More than 100 sites in the study area have been subject to investigation and regulation by environmental agencies (Watson and others, 1989, p. 2; Roadcap and Kelly, 1994, p. 28). At least seven sites are on the National Priority List for environmental cleanup by the USEPA. In 1991, the USEPA designated the Calumet Region as part of a Geographic Enforcement Initiative Area. By this designation, the USEPA recognized the importance of a regional approach to understanding ground-water flow and quality in the Calumet Region.

In 1992, the USGS measured ground-water levels in the Calumet Region in order to map water levels and describe regional ground-water flow. That investigation, reported by Kay and others (1996) was the first cooperative effort by the USEPA and USGS to study ground water in the Calumet Region. During June 1993, the USGS collected samples of ground water in the Calumet Region. The results of this second study, reported here, are used to describe regional ground-water quality.

Purpose and Scope

This report describes regional ground-water quality in the Calumet Region of northwestern Indiana and northeastern Illinois on the basis of results from chemical analyses of water samples collected from 128 wells during June 1993. Each well is screened in one of four geohydrologic units: the surficial sand aquifer (Calumet aquifer), the clay confining unit, confined sand aquifers, or the carbonate-bedrock (Silurian-Devonian) aquifer. Samples were analyzed for general water-quality properties, common ions, trace elements, volatile and semivolatile organic compounds, pesticides and polychlorinated biphenyls. Results are listed in tables and described with summary statistics. Selected results are plotted on maps and graphs to describe the chemical and the spatial variability of ground-water quality in the study area. Comparisons of water quality are made among the four geohydrologic units, between analyte concentrations and USEPA standards for drinking water, and between the less industrialized and less urbanized eastern part of the study area and the more industrialized and more urbanized western part.

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DESCRIPTION OF CALUMET REGION

The Calumet Region of northwestern Indiana and northeastern Illinois is the area encompassing the Calumet River system in Indiana and Illinois and Lake Calumet in Illinois. The approximately 240-mi^2 area of this study includes northwestern Porter County and northern Lake County in Indiana and southern Cook County in Illinois (fig. 1). The area is bounded by Lake Michigan and 80th Street on the north, the southern extent of the Little Calumet River and Interstate 80 on the south, Mineral Springs Road on the east, and Crawford Avenue on the west. Principal cities included in the study area are East Chicago, Gary, Hammond, and Whiting in Indiana and the southeastern part of Chicago in Illinois.

Land use in the Calumet Region is primarily residential and industrial (Kay and others, 1996). Large tracts of land along Lake Michigan and the Calumet River are used for steel production. Land used for the refining and storing of petrochemicals is located primarily near the Indiana Harbor Canal and at scattered locations along the Grand Calumet River, the Calumet Sag Channel, and near Lake Calumet. Numerous other industries in the study area include railcar, truck, and automobile assembly; scrap processing; and chemical manufacturing. Most of these are along and north of the Grand Calumet River in Indiana, along the Calumet River and Calumet Sag Channel, and near Lake Calumet in Illinois. The area south of the Grand Calumet River and areas north and west of Lake Calumet are primarily residential but include land for small industry, commercial, waste disposal, and recreational uses. Large areas used for treatment and disposal of wastes are located around Lake Calumet. The largest natural areas are in the eastern part of the study area.

Physiography and Climate

The study area is in the Eastern Lake Section of the Central Lowland Physiographic Province defined by Fenneman (1938). The Indiana part of the study area is in the Calumet Lacustrine Plain subdivision of the Northern Moraine and Lake Region defined by the Indiana Geological Survey (Malott, 1922, p. 113; Schneider, 1966, p. 50). The Calumet Lacustrine Plain extends westward into Illinois, where it is called the Chicago Lake Plain subsection of the Great Lakes Section by the Illinois State Geological Survey (Leighton and others, 1948, p. 21). This plain, which represents the former location of glacial Lake Chicago, is characterized by a flat to undulating surface that slopes gently toward Lake Michigan. Land-surface altitudes on the lake plain range from about 640 ft above sea level along the northern edge of the Valparaiso Moraine (south of the study area) to about 580 ft above sea level, the approximate stage of Lake Michigan.

The climate in the study area is classified as temperate continental. The mean annual temperature is about 10°C and the mean annual precipitation is about 35.7 in. (National Oceanic and Atmospheric Administration, 1982). More than half of the average annual precipitation falls from April through August. Although great variations in precipitation and temperature may occur during any year, summers are generally hot and humid, and winters are cold.

Geology

Geology of the bedrock and surficial deposits and in the study area were mapped by Schneider and Keller (1970). Bedrock deposits in Indiana were mapped by Gray and others (1987). Topography of the bedrock surface, thickness of unconsolidated deposits, and surficial geology in Indiana, were mapped by Gray (1982, 1983, 1989). Kay and others (1996) mapped the topography of the bedrock, the thickness of clay, and the thickness of sand in the study area. These maps, along with the references cited, form the basis for the following description of geology in the study area.

The study area is underlain by Silurian and Devonian bedrock, primarily dolomite, limestone, and shale. These rocks are the result of consolida-

FIG 1--FOLD OUT

tion of sediments originally deposited in shallow to moderately shallow water (Hartke and others, 1975, p. 5). The bedrock strata are fairly flat throughout the study area, except in the northeast where they dip slightly to the north and northeast. The surface of the bedrock is eroded. Bedrock-surface altitudes range from less than 425 to more than 625 ft above sea level. The high points are associated with reef deposits; the low points are bedrock valleys that mark the paths of preglacial drainage that flowed northward, toward the Michigan Basin, from a divide to the south and west.

Unconsolidated deposits in the study area are primarily silt, clay, and sand; small amounts of muck, peat, and gravel are found in places. Silt and clay are present at land surface in most of the Illinois part of the study area and are found at depth in the Indiana part of the study area. Sand is present at land surface in most of Indiana north of the Little Calumet River and east of Lake Calumet in Illinois (fig. 2). Most of these sediments originally were derived from glaciers and were laid down as lake-bottom and nearshore deposits of glacial Lake Chicago near the end of the Wisconsin glacial stage (Willman, 1971, p. 38–51; Hartke and others, 1975, p. 7). Subsequent lowering of lake stage exposed the sediments to erosion and deposition by water and wind. The unconsolidated sediments range in thickness from less than 5 ft to more than 200 ft (Kay and others, 1996).

Throughout most of the study area, a silty clay layer overlies the bedrock; in some places, however, the clay may overlie a thin (less than 5 ft) layer of poorly sorted silty sand and gravel on top of the bedrock (Cravens and Zahn, 1990, p.15). The clay layer, which ranges in thickness from less than 4 ft to about 200 ft (Kay and others, 1996), consists primarily of glacial till and lacustrine clay and may contain small to moderate amounts of gravel (Hartke and others, 1975, p. 7). The upper boundary of the till is eroded and represents a transition from deposition dominated by glacial processes to deposition dominated by lacustrine processes that resulted when the Wisconsin glacier retreated to the north and Lake Chicago was formed.

In the Indiana part of the study area, the clay layer is overlain by sand, including dune, beach, and lacustrine sediments that may contain thin, discontinuous layers of muck, peat, and organic materials. The sand is generally thickest in the eastern part of the study area. In the extreme eastern part of the study area, two sand layers are separated by a layer of silty clay. Thickness of sand in the study area ranges from 0 to more than 100 ft (Kay and others, 1996). The clay layer is overlain by sand in the eastern part of the study area in Illinois. Silt and clay are at land surface in the remainder of the study area in Illinois (fig. 2).

There are substantial areas of made or modified land in the study area (fig. 2). In some areas, the tops of dune ridges were removed and swampy land was dredged to provide fill for topographically low areas. In other places, materials such as slag and ash were used as fill. The areas near Wolf Lake, Lake George, and Lake Calumet have been altered substantially by dredging of sand and disposal of slag and waste materials. Along the shoreline of Lake Michigan, large areas of made land, primarily containing crushed and hot-poured slag, extend into the lake.

Hydrology

The study area is in parts of two surface-water drainage systems. The eastern part of the study area drains through the Indiana Harbor Canal and Burns Waterway into Lake Michigan and the St. Lawrence drainage system. The northern part of the study area in Illinois drains into Lake Michigan through the Calumet River. The western part of the study area drains through the Calumet Sag Channel into the Des Plaines River and the Mississippi drainage system.

FIG 2--FOLD OUT

The Grand Calumet, Little Calumet, and Calumet Rivers are the principal streams in the study area (fig. 1). The natural gradient and direction of flow in these streams have been altered

A clay confining unit underlies the Calumet aquifer and overlies the Silurian-Devonian aquifer in most of the study area. The confining unit is primarily silty clay but may contain sand and gravel in small, discontinuous zones. In the eastern part of the study area, confined sand aquifers are within and beneath the confining unit (Shedlock and others, 1994). The upper surface of the confining unit slopes toward Lake Michigan. The confining unit is thickest in the western one-third of the study area, where it is at the land surface. In this area, the water table is in the confining unit. Throughout most of the remainder of the study area, the confining unit restricts flow between the Calumet aquifer and the Silurian-Devonian aquifer.

The Silurian-Devonian aquifer underlies the entire study area. The aquifer is semiconfined except at Stoney Island (fig. 1), where the bedrock crops out and the water table is in the bedrock, and in areas northeast of Stoney Island and along the Calumet Sag Channel, where the bedrock is overlain by sand. The Silurian-Devonian aquifer is a source of water for industrial and commercial uses and, to a lesser extent, a source of drinking water. The aquifer is used extensively in the Illinois part of the study area but is not used substantially in Indiana.

The Silurian-Devonian aquifer is recharged by percolation of ground water from the Calumet aquifer through the clay confining unit. In places where the confining unit is absent, recharge is by infiltration of precipitation directly to the bedrock or through overlying deposits of sand. Within the study area, discharge from the Silurian-Devonian aquifer is primarily to areas of pumping.

METHODS OF STUDY

The methods described for this study include procedures for sample collection and sample analysis. Methods of quality assurance, which also are described, include onsite and laboratory procedures and a review by staff of USEPA.

Sample Collection and Analysis

Water samples were collected from 128 wells in northwestern Indiana and northeastern Illinois during June 14–28, 1993 (fig. 2). The wells were selected to provide data that would characterize the ground-water quality throughout the study area; however, access to the wells was a primary consideration in selection. A network of wells had been established in Indiana as a result of previous investigations by the U.S. Geological Survey (Watson and others, 1989; Fenelon and Watson, 1993; Shedlock and others, 1994; Kay and others, 1996). These wells were installed to determine directions of ground-water flow and characterize regional ground-water quality. Few of these wells were installed to monitor specific areas where ground-water contamination was known or suspected. The wells in Illinois were installed for more varied reasons. Previous investigations in the Illinois part of the study area were undertaken principally to monitor ground-water flow and quality at specific sites. One, more areally extensive, study by Roadcap and Kelly (1994) included the area around and east of Lake Calumet—an area that includes industrial, waste-treatment, and waste-disposal activities. The wells sampled in Illinois for this study are a combination of wells installed for the studies by Kay and others (1996) and Roadcap and Kelly (1994) and include several wells installed to monitor ground-water quality at specific sites where contamination of the ground water previously had been identified.

Multiple wells (two or more wells at the same location but completed at different depths) were sampled at 17 sites to identify differences in water quality with depth. Most of the wells in Indiana are completed in the Calumet aquifer; the wells in Illinois are completed in either the Calumet aquifer, the confining unit, or the Silurian-Devonian aquifer (table 1, appendix 1). Four wells in the eastern part of the study area are completed in confined sand aquifers within the confining unit. No bedrock wells in Indiana were sampled for this study. Sample numbers, that were given an “S” prefix, were assigned at each well according to the approximate order of collection.

At most wells, water samples were collected by means of low-flow, submersible sampling pumps. The pumps were constructed of chemically inert materials and were equipped with polytetrafluoroethylene (PTFE) discharge hoses. Eight wells were sampled by use of a PTFE or stainless-steel bailer; these wells either did not recharge quickly enough to allow use of a pump, were in remote locations that made the use of a pump impractical, or were known to contain water having large concentrations of organic compounds that would make pump decontamination difficult. All wells were sampled in accordance with procedures outlined by the USEPA (1987, p. 115–126). A sampling and analysis plan was prepared by the USGS and approved by the USEPA prior to sampling (R.T. Kay, U.S. Geological Survey, written commun., 1993).

At each well, the well depth and depth to water were measured by use of a steel tape, and the volume of water in the well was calculated. The pump was set in the well so that the pump intake was above the top of the open interval in wells completed below the water table and at least 1 ft above the bottom of the well in wells completed at the water table. During pumping, the pump discharge was connected to a flowthrough cell in which onsite measurements of water temperature, pH, oxidation-reduction potential, dissolved oxygen, and specific conductance were monitored by means of a multiprobe water-quality meter. The meters were calibrated daily by use of known reference standards. A minimum of three casing volumes of water was pumped from the well before samples were collected. If the onsite measurements had not stabilized to the established criteria (plus or minus 0.5°C for temperature, 0.25 pH units, 25 mv for oxidation-reduction potential, and 50 μS/cm for specific conductance) by the time three casing volumes were removed, a fourth casing volume of water was removed before sampling. For samples collected by use of a bailer and for wells in which water levels did not recover quickly from pumping, a minimum of two casing volumes of water was removed from the well before sampling. Onsite measurement of water from wells that were bailed was accomplished by pouring the water into a PTFE bucket and recording the readings by use of the multiprobe meter.

Samples were collected according to the type

Table 2. Sample container, preparation, and preservation requirements for ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[mL, milliliter; PTFE, polytetrafluoroethylene; HCl, hydrochloric acid; °C, degree Celsius; PCB, polychlorinated biphenyl; NaOH, sodium hydroxide; H_2SO_4, sulfuric acid; HNO_3, nitric acid]

Analyte	Sample container, preparation, and preservation
Volatile organic compounds	

Sampling-device blanks were collected after initial cleaning of the sampling pumps and before collecting the first sample. The sampling-device blanks were prepared by pumping distilled water through the sampling pump and filling sample bottles as though a regular sample were being collected. Sampling-device blanks were collected from each of the four pumps used to collect samples. Results of the analyses of these samples (R-01 through R-04) are listed in tables 3 through 7 (appendix 2). An additional sampling-device blank (R-05) was collected after cleaning the pump used whether the samples collected for analysis of VOC's were contaminated after collection. Results of analysis of the trip blanks are listed in table 5 (appendix 2). No VOC's were detected in any of the trip blanks, an indication that sample integrity was maintained during transport and storage.

Thirteen duplicate samples were collected and sent to the laboratories for the same chemical analyses as the regular samples (tables 8 through 12, appendix 2). An additional sample was collected from well BH31, and analytical results for that sample are included with the duplicate sample pair for comparison. One duplicate sample was collected for every 10 samples or portion of 10 samples. Two additional duplicate samples were collected for every 20 samples for use by the laboratories as matrix-spike samples. Samples and duplicate samples were collected sequentially from the same well.

Results of the duplicate-sample analyses indicate the random variation of the sample-collection procedure. The relative percent difference (RPD) was selected to compare concentrations between each sample and duplicate sample. The RPD was calculated for each analyte and duplicate sample pair by means of the formula

$$\text{RPD} = \frac{(\text{C1} - \text{C2}) \text{ x } 100 \text{ percent}}{(\text{C1} + \text{C2}) / 2} ,$$

where

C1 is the larger of the two concentrations, and

C2 is the smaller of the two concentrations (U.S. Environmental Protection Agency, 1989, p. 13).

The RPD was calculated for 30 analytes that were detected in the sample and the sample duplicate. Analytes that were detected in one but not both of the sample pairs, and analytes that were not detected in either of the sample pairs, are not included in the RPD analysis because of uncertainty in the actual concentration of analytes reported as less than the quantitation limit.

The RPD results (table 13) indicate only small differences between concentrations of most analytes in the sample pairs. Of the total number of individual comparisons, 178 had RPD's of less than 25 percent and 35 had RPD's of more than 25 percent. Although the range of RPD's was varied among analytes, 19 of the 30 analytes tested had median RPD's less than 10 percent. Only four analytes—suspended solids, aluminum, zinc, and acetone—had median RPD's that exceeded 25 percent. The large RPD's may have resulted from random variation in sampling procedures, in laboratory analyses, or in ground-water quality.

Acetone is the only target VOC detected in duplicate sample pairs (table 10, appendix 2). Acetone was detected in all of the three samples from BH31 (S-031, D-031, and S-036). The RPD between concentrations of acetone in the first sample and duplicate sample is about 82; however, concentrations of acetone in the first and the additional sample are identical. The consistent detection of acetone in water from BH31 confirms the presence of this compound in ground water and indicates the capability of detecting acetone in the samples. The large RPD between concentrations in the first and duplicate samples indicates inconsistent precision during sample collection or in determining concentrations of acetone. Acetone is commonly used in laboratories as a cleaning agent and solvent and is a potential contaminant of samples submitted for analysis. However, acetone was detected in only 4 of the 128 ground-water samples, indicating that acetone probably was not introduced into the samples at the laboratory. The other target VOC's were not tested by the duplicate sample analysis because no VOC's were detected in these samples.

Ten of the trace elements, seven SVOC's, and four pesticide compounds were detected at least once in either the sample or the duplicate sample but not in both samples (tables 9, 11, and 12, appendix 2). For most of these analytes, this pattern of detection is observed in 3 or fewer of the 13 sample pairs, and the reported concentrations are similar to, or less than, the laboratory quantitation limit. This pattern of detection is observed for

Table 13. Statistical summary of relative percent differences for analytes detected in both the sample and the duplicate sample

[RPD, relative percent difference; --, insufficient data]

Analyte	Number of sample pairs	Minimum RPD	Maximum RPD	Lower quartile	Median	Upper quartile	Number of sample pairs exceeding 25 RPD
Alkalinity	11	0	68.2	0.47	2.32	9.7	2
Ammonia nitrogen	10	0	50.0	6.0	12.75	28.5	3
Calcium	13	0	9.4	1.0	1.57	5.2	0
Chloride	11	.25	26.6	1.8	7.17	18	1
Dissolved solids	11	.77	8.1	1.6	2.54	5.1	0
Iron	13	0	61.9	1.1	8.51	8.1	1
Magnesium	12	0	10.7	.88	1.75	4.5	0
Manganese	12	0	22.7	1.4	1.93	4.0	0
Potassium	13	0	34.0	1.0	3.15	6.4	1
Silica	11	1.7	10.4	2.6	5.50	6.0	0
Sodium	13	0	16.9	.82	2.26	8.5	0
Sulfate	10	0	74.1	2.6	12.7	34	3
Suspended solids	11	0	73.7	2.0	45.4	64.2	7
Total organic carbon	10	2.4	99.4	5.4	11.0	53.5	3
Aluminum	5	3.3	78.2	--	46.8	--	3
Arsenic	7	0	69.1	--	9.52	--	2
Barium	12	0	27.2	.78	3.02	8.6	1
Copper	1	--	--	--	.53	--	0
Cyanide	2	.46	10.2	--	5.33	--	0
Lead	4	5.4	96.0	6.3	19.4	79.5	2
Mercury	5	7.4	85.7	7.7	16.7	74.5	2
Nickel	1	--	--	--	18.9	--	0
Selenium	2	2.7	9.5	--	6.10	--	0
Thallium	4	2.2	70.2	--	9.40	--	1
Vanadium	3	2.1	5.1	--	4.72	--	0
Zinc	2	40.9	44.4	--	42.6	--	2
Acetone	1	--	--	--	81.5	--	1
Phenol	1	--	--	--	8.00	--	0
Paracresol	1	--	--	--	13.3	--	0
Bis(2-ethylhexyl)phthalate	1	--	--	--	.29	--	0

bis(2-ethylhexyl)phthalate in six sample pairs, for lead in five sample pairs, and for mercury and thallium in four sample pairs. Although the reported concentrations are small, the inability to detect these analytes in both the sample and the sample duplicate implies uncertainty about their presence in the samples and indicates less precision in results for these analytes compared to the others, at least where concentrations were similar to the quantitation limit. Compounds containing polychlorinated biphenyls (PCB's) were not detected in any duplicate sample pairs and were not tested by the duplicate analysis.

Laboratory Procedures

Laboratory quality-assurance procedures are described in the USEPA Contract Laboratory Program (CLP). The contract between the laboratory and USEPA specifies the criteria for sample holding times, analytical procedures, quantitation limits, instrument calibration, and type and frequency of laboratory blanks and matrix-spike samples. The contract also requires specific documentation of the laboratory quality-assurance procedures (Simms and Daddow, 1994).

A data package was prepared by the contract laboratory for each group of samples processed. The data package included the analytical results for the regular samples and the onsite and laboratory quality-control samples. The data package also contained the documentation of the laboratory quality-assurance procedures. The data package was submitted to USEPA for review and validation.

U.S. Environmental Protection Agency Quality-Assurance Review

The USEPA reviews each data package from the contract laboratories. The review includes evaluation and validation of the data by means of a systematic procedure that has established criteria for determining the usability of the data (Simms and Daddow, 1994). The review covers all aspects of the laboratory contract and quality-assurance procedures and qualifies the data on the basis of review results.

Results of the USEPA review indicate that, for all analyses, the data are acceptable with the appropriate qualifications (Charles T. Elly, U.S. Environmental Protection Agency, Region 5, written commun., 1993). Many of the analytical data were qualified as "estimated" by the USEPA review. This qualification means that either contamination was suspected, the reported concentration is smaller than the contract-required quantitation limit but larger than zero, or the laboratory did not provide complete documentation of the quality-assurance procedures as established by the CLP. All tentatively identified organic compounds were qualified as estimated because both identification and quantitation are questionable. Estimated concentrations are usable for analyses of the data; however, the reported value may not be accurate or precise. In this report, estimated concentrations are identified by an "e" after the value.

Other data qualifiers applied by the USEPA quality-assurance review and used in this report are the "d" and "p" qualifiers. The "d" data qualifier identifies compounds that were detected in samples that were diluted. Samples were diluted if they were suspected to contain large concentrations on the basis of previous knowledge of water quality at a site or because contaminants (such as floating oil) were observed at the time of sampling. Samples also were diluted and re-analyzed if concentrations of one or more compounds exceeded the calibration range of the laboratory instruments used for the

An "R" data qualifier was applied during the USEPA review to a few results that were determined to be unusable. Results of 4 analyses for ammonia nitrogen and 25 analyses for thallium were qualified as unusable because the reported concentrations were less than the instrument detection limit as determined from laboratory calibration reports. Results qualified as unusable are not included in this report.

GROUND-WATER QUALITY

Discussion of the results of the analyses of the samples collected during this study are divided into two sections; onsite measurements and laboratory analyses. Laboratory analyses are subdivided into water-quality properties and common ions, trace elements, VOC's, SVOC's, and compounds containing pesticides or PCB's. The laboratories reported water-quality characteristics and some

Table 15. Statistical summary of onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993

[°C, degrees Celsius; mv, millivolts; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 °C]

Ground-water property and unit of measurement	Geohydrologic unit	Number of samples	Median	Minimum	Maximum
Temperature (°C)	All units	125	14.1	10.3	20.8
	Calumet aquifer	91	13.6	10.3	20.8
	Confining unit	20	14.8	12.8	20.5
	Confined sand aquifers	4	13.1	11.2	13.9
	Silurian-Devonian aquifer	10	16.2	14.1	18.6
pH (standard units)	All units	118	7.2	5.3	12.1
	Calumet aquifer	84	7.2	5.3	12.1
	Confining unit	20	7.35	6.5	12.1
	Confined sand aquifers	4	7.8	7.7	8.1
	Silurian-Devonian aquifer	10	8.0	6.7	9.1
Oxidation-reduction potential (mv)	All units	124	-64.5	-446	159
	Calumet aquifer	91	-75.0	-446	136
	Confining unit	19	79.0	-264	159
	Confined sand aquifer	4	-184	-202	-164
	Silurian-Devonian aquifer	10	-47.5	-180	109
Dissolved oxygen (mg/L)	All units	109	.5	0	9.1
	Calumet aquifer	80	.4	0	9.1
	Confining unit	16	1.8	.3	4.2
	Confined sand aquifer	4	.15	0	.3
	Silurian-Devonian aquifer	9	1.2	.4	1.6
Specific conductance (µS/cm)	All units	125	828	106	5,980
	Calumet aquifer	91	842	106	4,030
	Confining unit	20	1,750	192	5,980
	Confined sand aquifer	4	756	462	1,740
	Silurian-Devonian aquifer	10	484	290	3,630

Water Temperature

Ground-water temperatures were measured for 125 of the samples. Temperatures ranged from 10.3 to 20.8°C; the median was 14.1°C. The median ground-water temperature is 4°C warmer than the mean annual air temperature, 10.1°C, reported for Gary, Ind. (National Oceanic and Atmospheric Administration, 1982). Water temperatures measured in the flow-through cell can be affected by air temperature, length of the discharge tubing, or exposure to sunlight during the measurement; therefore, the temperature of the sample may not represent the temperature of ground water in the formation. The average air temperature during June 1993 at the Indiana Dunes National Lakeshore was 19.4°C (National Oceanic and Atmospheric Administration, 1993). The average air temperature was warmer than the average ground-water temperature—an indication that, for this study, temperatures measured in the flow-through cell most likely would be warmer than the ground-water temperature.

Water temperatures varied most in samples from the Calumet aquifer (table 15); in fact, the minimum and maximum temperatures for all wells were measured in samples from wells in the Calumet aquifer. Samples from wells in the confining unit had a slightly smaller range of temperature than samples from wells in the Calumet aquifer. Samples from wells in confined sand aquifers and in the Silurian-Devonian aquifer had the smallest ranges of water temperature, probably because fewer samples were collected from these geohydrologic units.

Comparison of water temperature at 16 sites where multiple wells are screened at different depths indicates no consistent trend. Water from deep wells was warmest at 11 sites and water from the shallow wells was warmest at 5 sites. Fenelon and Watson (1993, p. 43) reported seasonal reversals in the relative temperatures for water from shallow and deep wells in Lake County, such that water in shallow wells was colder than water in deep wells during spring but warmer during summer.

pH

Values of pH measured in water from 118 wells ranged from 5.3 to 12.1; the median is 7.2 (table 15). Half of the samples had values of pH that ranged from 6.9 to 7.6. The SMCL for pH is from 6.5 to 8.5. In most ground water in the United States, pH ranges from about 6 to about 8.5 (Hem, 1985, p. 63–64). In 89 percent of the samples for this study, pH was within this range. Water from nine wells had a pH of less than 6.5, and water from only one well, A20 (S-079), had a pH of less than 6. This well is in a residential area in the central part of the study area (fig. 2). The reason for this low pH is not known; it may be a result of measurement error. Fenelon and Watson (1993) reported three pH measurements for water from this same well that ranged from 7.2 to 7.4.

Samples from 12 wells had values of pH larger than 8.5. Except for well BH1D (S-089), these wells are installed in the Silurian-Devonian aquifer or are in areas of made or modified land that contain various amounts of slag. The largest pH values were measured in water from wells in areas where slag is present. In water from several of these wells, pH exceeded 11. Although slag was not observed near BH1D, the large value of pH for water from this well is similar to those measured in water from wells near slag.

The median pH for water from each of the four geohydrologic units indicates an increase in pH with depth (table 15). Because the bedrock is predominantly dolomite and limestone, an increase in pH of water from the Silurian-Devonian aquifer compared to water from shallow wells is expected in areas of natural water quality. The range of pH for the four units reflects the number of samples from each unit. Water from wells screened in the Calumet aquifer had the largest range of pH, and water from wells screened in confined sand aquifers had the smallest range.

Comparison of pH for water from multiple wells completed at different depths at 15 sites does not indicate an increase in pH with depth, as do the median values, except at three sites where the deep well is screened in a confined sand aquifer. Among six sites where the deep well is in the Silurian-Devonian aquifer, pH was higher in water from the Silurian-Devonian aquifer at three sites and was higher in the shallow-well water at three sites. At two sites, BH18 and FILO5-6, where pH was higher in shallow-well water than in water from the Silurian-Devonian aquifer, the shallow ground water is in contact with slag fill or industrial waste.

Oxidation-Reduction Potential

The Eh of water is an index of the exchange activity of electrons among elements in solution. Measurements of Eh describe the electric potential, using the potential of the hydrogen electrode as a reference point of zero. A positive potential indicates oxidizing conditions in the water; a negative potential indicates reducing conditions (Hem, 1985, p. 159).

Measurements of Eh were made in water from 124 wells. Values of Eh ranged from -446 to 159 mv; the median is -64.5 mv, an indication of reducing conditions in most ground water in the study area. In all, 82 measurements indicated reducing conditions, whereas 42 measurements indicated oxidizing conditions.

The median Eh for the four geohydrologic units indicated reducing conditions in the three were measured in water from deep wells than from shallow wells at 9 sites. At two sites, concentrations of DO were larger in water from deep wells; and at one site, concentrations in water from the shallow and deep wells were similar.

Specific Conductance

SC is a measure of the capability of a substance to conduct electricity across a unit length at a specific temperature. The SC of pure water is low, less than 10 µS/cm. Substances dissolved in the water increase the conductivity, so measurements of SC provide an indication of the amount of dissolved solids in the water (Hem, 1985, pp. 66–67).

SC was measured in water samples from 125 wells (table 15). Values of SC ranged from 106 to 5,980 µS/cm; the median was 828 µS/cm. The smallest SC was measured in water from well I22 (S-087), which is completed in the Calumet aquifer in a residential area between Wolf Lake and the Calumet River. The largest SC was measured in water from well I9 (S-067), which is completed in the confining unit in an area of fill southwest of Lake Calumet. Half of the measured SC values were between 450 and 1,540 µS/cm.

Median values of SC for each of the four geohydrologic units indicated that relatively large values of SC (greater than 1,000 µS/cm) were measured most frequently in water from wells in the confining unit and least frequently in water from the confined sand and Silurian-Devonian aquifers (table 15). The range of SC values in water from the confining unit was larger than the ranges for the three aquifer units.

Comparison of SC measurements for 16 multiple-well sites indicated a slight trend toward increasing SC with increasing depth. SC was largest in water from deep wells at 10 sites, largest in water from shallow wells at 5 sites, and similar at 1 site. Precipitation that recharges the ground water probably has small SC values. Willoughby (1995) reported that precipitation at Gary, Ind., has a median SC of about 22 µS/cm. As the water moves through the sediments, soluble materials are dissolved in the water, thereby increasing the SC. Under natural conditions and in homogeneous sediments, water from deep wells generally would have a larger SC than water from shallow wells because water from deep wells has been in contact with the sediments for a much longer time.

The distribution of measured SC values in water from wells completed near the water table in the Calumet aquifer and the confining unit is shown on figure 3. The general increase in SC from east to west across the study area indicates that ground water in the eastern part of the study area contains less dissolved substances than ground

fig 3--FOLD OUT

sulfate (table 16, appendix 3). The water-quality properties are either measurements of general properties (such as alkalinity) or determinations of concentrations of more than one substance (such as dissolved solids). The common ions are abundant, naturally occurring substances that are readily soluble in water and therefore constitute most of the dissolved substances in water. Ammonia nitrogen, the only nutrient analyzed for in this study, is included with the common ions. Iron and manganese commonly are reported as trace elements; however, they are grouped with common ions in this report because of the frequency of detection and relatively large concentrations compared to trace elements in this study. Analyses of water-quality properties and common-ion concentrations provide a basis for describing the general ground-water chemistry of the study area.

In order to compare chemical equivalence of the reported concentrations of ions in the water samples, the analytical results of selected water-quality characteristics and common ions were converted to milliequivalents per liter. Concentrations expressed as milliequivalents per liter account for differences in atomic weight and ionic charge of the ions considered in the analysis (Hem, 1985, p. 55–56). The total concentration of cations and anions in a sample can be calculated, and concentrations of specific ions can be expressed as percentages of those totals. Cations considered in this discussion are calcium, magnesium, sodium, and potassium. Anions considered are carbonate and bicarbonate (concentrations derived from alkalinity determinations), sulfate, and chloride. A multiple-technique computer program (Briel, 1993) was used to plot the results on trilinear diagrams to illustrate the general water quality.

Sample results are discussed in terms of the four geohydrologic units in the study area: the Calumet aquifer, the confining unit, confined sand aquifers, and the Silurian-Devonian aquifer. For this report, an ion is considered dominant if it comprises 50 percent or more of the total milliequivalents per liter of cations or anions in the sample. For all samples except three, the data are sufficient to be included in the discussion. Samples from wells I15 (S-51) and BH24 (S-57) were mislabeled, so it is uncertain which results correspond to which sample. The sample from FILO6 (S-128) was not included because the sample volume was insufficient for laboratory analysis.

Water from 90 wells in the Calumet aquifer had a wide range of chemistry, although 42 percent of the samples from this group were classified as calcium bicarbonate water types (fig. 4). Calcium was the dominant cation in water from 55 wells, sodium was the dominant cation in water from 11 wells, and magnesium was the dominant cation in water from 1 well in this group. Water from 23 wells contained no dominant cation. The dominant anion was bicarbonate in water from 48 wells, sulfate in water from 15 wells, and chloride in water from 12 wells. No dominant anion was determined for water from 15 wells.

Water from 38 wells in the Calumet aquifer was a calcium bicarbonate type, water from 11 wells was a calcium sulfate type, water from 6 wells was a sodium chloride type. The dominant cation-anion pairs were sodium bicarbonate for water from two wells, calcium chloride for water from one well, and magnesium bicarbonate for water from one well. Samples from the remaining 31 wells were classified as mixed water types.

The varied amounts of common ions in water from wells in the Calumet aquifer are explained easily by natural variation resulting from dissolution of soluble materials in the sediments that constitute this geohydrologic unit. Two exceptions, which may have resulted from human activities, are the presence of sulfate and chloride. The presence of sulfate may be related to disposal of slag or ash from coal burning. Except for well BH7S (S-065), the wells that contain water having large concentrations of sulfate are in areas of made or modified land. The presence of sodium chloride in water from shallow wells may be the result of roadway deicing salts.

Water from 21 wells in Illinois that are completed in the confining unit indicated no dominant water type for this geohydrologic unit (fig. 5).

fig 4

fig 5

Calcium was the dominant cation in water from seven wells, sodium was the dominant cation in

fig 6

fig 7

in the Silurian-Devonian aquifer is basic (pH greater than 7), an indication that the water has lost much of its capability to dissolve calcium and magnesium. The change in cation dominance results from preferential cation exchange when water that is saturated with dissolved calcium and magnesium comes into contact with clay minerals containing sodium (Freeze and Cherry, 1979, p. 287). Shale deposits that contain clay minerals are found within the bedrock in the study area (Shaver and others, 1986, p. 163–164; Willman, 1971, p. 29–30).

Water from well FILO5 differs from water from the other wells in the Silurian-Devonian aquifer. This well, as shown in other sections of this report, produces water that contains large amounts of dissolved substances. Well FILO5 is 80 ft deep and is near a waste-disposal facility southwest of Lake Calumet. The chemistry of the water from this well probably is not indicative of any natural process occurring throughout the aquifer.

Acidity and Alkalinity

Acidity and alkalinity were determined for samples from 125 wells (table 16, appendix 3). Alkalinity is a measure of the capacity of a solution to neutralize acids (Hem, 1985, p. 106). Acidity is a measure of a solution’s capacity to neutralize bases. Alkalinities for all samples ranged from 24.9 to 1,260 mg/L as calcium carbonate. Acidity was not detected in any samples.

The median alkalinity for water from the confining unit was slightly larger than median alkalinities for the three other geohydrologic units (table 17). Water from confined sand aquifers and the Silurian-Devonian aquifer had the smallest median alkalinities. The largest range of alkalinities was in water from the confining unit. Only one well, FILO1 (S-123), produced water having an alkalinity larger than 1,000 mg/L. This well is near an area of waste disposal, southwest of Lake Calumet. Wells 230-24 (S-017), D-5A (S-020), W-1A (S-028), MW-5 (S-042), I10 (S-064), B10 (S-077), BH18S (S-091), BH18I (S-109), and WS7 (S-121) produced water having alkalinities less than 100 mg/L. Seven of these wells are screened in the Calumet aquifer, and two are screened in the confining unit.

Comparison of alkalinity values for water from 17 sets of paired wells indicates that alkalinity generally decreased with increasing depth. Alkalinities were largest in water from shallow wells at 12 sites, largest in water from deep wells at 5 sites, and largest in water from an intermediate-depth well at 1 site.

Ammonia Nitrogen

Concentrations of ammonia nitrogen were determined for water from 121 wells (table 16, appendix 3). Detected concentrations of ammonia nitrogen ranged from 0.1 mg/L in water from seven wells to 96 mg/L in water from well FILO2 (S-127). Ammonia nitrogen was not detected in 17 samples. Ammonia nitrogen was detected in concentrations larger than 10 mg/L in water from eight wells: I1 (S-032), I13 (S-033), A3 (S-044), I10 (S-064), I8 (S-068), I2 (S-102), BH32 (S-110), and FILO2 (S-127). All of these wells are in or near areas of waste disposal or made or modified land. The second largest concentration of ammonia nitrogen was detected in water from well A3 (S-044), which is in an industrial area north of the Grand Calumet River and east of Gary Harbor. Large concentrations of ammonia nitrogen could indicate contamination resulting from disposal of sewage or organic waste (Hem, 1985, p. 124).

Median concentrations among the four geohydrologic units were largest in water from the confining unit and smallest in water from the Silurian-Devonian aquifer (table 17). The median concentration for water from the Calumet aquifer was slightly larger than the median concentration for water from confined sand aquifers, an indication that concentrations of ammonia nitrogen may decrease with increasing depth. However, comparison of concentrations of ammonia nitrogen in water from paired wells indicates an increase

Table 17. Statistical summary of water-quality properties and concentrations of common ions in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[mg/L, milligrams per liter; n.d., not detected; <, less than]

Property or constituent	Geohydrologic unit	Number of samples	Median concentration (mg/L)	Minimum concentration (mg/L)	Maximum concentration (mg/L)
Acidity	All units	125	n.d.	n.d.	n.d.
Alkalinity	All units	125	249	24.9	1,260
	Calumet aquifer	90	249	24.9	657
	Confining unit	21	304	53.7	1,260
	Confined sand aquifers	4	196.5	176	213
	Silurian-Devonian aquifer	10	201	160	814
Ammonia nitrogen	All units	121	.50	<.01	96
	Calumet aquifer	88	.55	<.01	90.3
	Confining unit	19	1.30	<.01	96
	Confined sand aquifers	4	.36	.31	.6
	Silurian-Devonian aquifer	10	.30	.10	.9
Calcium	All units	128	112.5	5.58	565
	Calumet aquifer	92	108.5	10.7	565
	Confining unit	22	202.5	5.58	528
	Confined sand aquifers	4	41.2	20.2	68.8
	Silurian-Devonian aquifer	10	15.1	9.18	320

Ch12

Table 17. Statistical summary of water-quality properties and concentrations of common ions in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Property or constituent	Geohydrologic unit	Number of samples	Median concentration (mg/L)	Minimum concentration (mg/L)	Maximum concentration (mg/L)
Manganese	All units	128	0.2175	<0.0016	3.33
	Calumet aquifer	92	.238	<.0016	3.33
	Confining unit	22	.337	.002	2.46
	Confined sand aquifers	4	.0368	.0208	.082
	Silurian-Devonian aquifer	10	.0101	.0029	.335
Potassium	All units	128	4.58	.459	161
	Calumet aquifer	92	4.56	.459	161
	Confining unit	22	10.2	2.47	135
	Confined sand aquifers	4	1.92	1.23	2.32
	Silurian-Devonian aquifer	10	3.11	2.08	8.14
Silica	All units	120	16.2	3.2	51.8
	Calumet aquifer	89	16.5	3.2	51.8
	Confining unit	19	19.0	3.4	34.0
	Confined sand aquifers	4	11.75	10.9	13.1
	Silurian-Devonian aquifer	8	10.6	7.43	13.0
Sodium	All units	128	53.7	1.11	1,450
	Calumet aquifer	92	36.2	1.11	570
	Confining unit	22	182	21.9	1,450
	Confined sand aquifers	4	95.65	74.1	243
	Silurian-Devonian aquifer	10	70.3	15.0	279
Sulfate	All units	125	78	<5	3,850
	Calumet aquifer	90	77.5	<5	2,070
	Confining unit	21	264	<5	3,850
	Confined sand aquifers	4	< 5	<5	<5
	Silurian-Devonian aquifer	10	34	<5	970
Suspended solids	All units	125	18.5	<3	5,312
	Calumet aquifer	90	13.7	<3	1,754
	Confining unit	21	47.5	6.5	920
	Confined sand aquifers	4	173	10	463
	Silurian-Devonian aquifer	10	278	5	5,312
Total organic carbon	All units	126	7.65	<2	209
	Calumet aquifer	90	7.1	<2	209
	Confining unit	22	10.9	3.3	123
	Confined sand aquifers	4	4	2.1	5.2
	Silurian-Devonian aquifer	10	7.1	<2	82.9

in concentrations with increasing depth. Concentrations of ammonia nitrogen were largest in water from deep wells at 10 sites and largest in water from shallow wells at 6 sites.

Calcium

Concentrations of calcium determined for samples from 128 wells (table 16, appendix 3) ranged from 5.58 to 565 mg/L; the median concentration was 112.5 mg/L. Calcium was the dominant cation in water from 63 of the 125 wells for which percentages of cations and anions were calculated. Water from the confining unit had the largest median concentration and water from the Silurian-Devonian aquifer had the smallest median concentration. The median concentration of calcium for water from confined sand aquifers was about half that of water from the Calumet aquifer (table 17).

Concentrations of calcium in water from paired wells show no consistent trend with depth. Concentrations of calcium were largest in water from shallow wells at 9 sites, largest in water from deep wells at 7 sites, and largest in water from an intermediate-depth well at 1 site.

Chloride

Concentrations of chloride determined for samples from 125 wells (table 16, appendix 3) ranged from 1.4 mg/L in water from well MW5 (S-042) to 2,600 mg/L in water from well I2 (S-102). The median concentration was 37.8 mg/L. Chloride was the dominant anion in water from 22 of the 125 samples for which percentages of cations and anions were calculated. Chloride concentrations in water from 28 wells exceeded the SMCL of 250 mg/L. Six wells produced water containing concentrations of chloride larger than 1,000 mg/L. Five of these wells are southwest of Lake Calumet near a wastewater-treatment facility. In addition, the six wells are shallow (15 ft deep or less), screened in the confining unit in areas containing fill, and near interstate highways, indicating the possibility of contamination of the shallow ground water by compounds in the fill materials and by highway deicing salts.

The median chloride concentration was largest for water from the confining unit and confined sand aquifers and smallest for water from the Calumet and Silurian-Devonian aquifers (table 17). Water from the confining unit had the largest range of chloride concentrations, and water from the Silurian-Devonian aquifer had the smallest range of chloride concentrations. Chloride concentrations were largest in water from shallow wells at nine paired-well sites and were largest in water from deep wells at seven sites.

Dissolved Solids

Concentrations of dissolved solids were determined for water samples from 125 wells (table 16, appendix 3). Concentrations of dissolved solids ranged from 95 mg/L in water from well W-1A (S-028) to 6,780 mg/L in water from well I2 (S-102): the median concentration was 674 mg/L (table 17). The largest median concentration of dissolved solids for the four geohydrologic units was for water from the confining unit. Water from the Silurian-Devonian aquifer had the smallest median concentration. Median concentrations for the confining unit and the Calumet aquifer exceed the SMCL of 500 mg/L. Comparison of dissolved-solids concentrations for water from 16 paired wells indicates larger concentrations in shallow wells than in deep wells at these sites. Concentrations of dissolved solids were largest in water from shallow wells at 10 sites and were largest in water from deep wells at 6 sites.

Water that is categorized as fresh generally contains concentrations of dissolved solids less than 1,000 mg/L. Water having concentrations of dissolved solids between 1,000 and 10,000 mg/L is categorized as brackish (Freeze and Cherry, 1979, p. 84). On the basis of this classification, brackish water was found in 41 of the sampled wells, although concentrations of dissolved solids in 22 of those wells were less than 2,000 mg/L. The median concentration of dissolved solids for water from the confining unit indicates brackish water in more than half of the wells sampled in this geohydrologic unit (table 17). Water from 11 wells had concentrations of dissolved solids that exceeded 3,000 mg/L. All these wells are near areas of waste disposal or filled land.

Iron

Detected concentrations of iron, determined for water from 128 wells (table 16, appendix 3), ranged from 0.014 mg/L in water from well B2 (S-048) to 58.4 mg/L in water from well I1 (S-032). The median iron concentration for all samples was 1.26 mg/L (table 17). The median concentration for iron is larger than general concentrations shown for northwestern Indiana by Clark (1980, p. 84), although it is similar to concentrations reported elsewhere in Indiana. Iron was not detected in concentrations larger than 0.155 mg/L in water from four wells: BH1D (S-089), BH14 (S-094), BH12 (S-097), and C2 (S-129). The SMCL for iron is 0.3 mg/L (U.S. Environmental Protection Agency, 1992). This limit was exceeded in 83 samples; in 59 samples, concentrations of iron were larger than five times the SMCL. The SMCL was exceeded in 75 percent of the samples from confined sand aquifers, 70 percent of the samples from the Calumet aquifer, 59 percent of the samples from the confining unit, and 30 percent of the samples from the Silurian-Devonian aquifer.

Magnesium

Concentrations of magnesium determined for water from 128 wells (table 16, appendix 3) ranged from less than 0.046 mg/L in water from well BH31 (S-036) to 794 mg/L in water from well FILO2 (S-127). The median concentration for all samples was 24.4 mg/L. Magnesium was the dominant cation in only 2 of the 125 samples for which percentages of cations and anions were calculated. The concentration of magnesium in well FILO2 was about 2.5 times that of the next largest magne-

Median concentrations of manganese were similar for water from the confining unit and Calumet aquifer (table 17) but were much larger than median concentrations for the Silurian-Devonian and confined sand aquifers; this pattern indicates a decrease in manganese concentrations with an increase in depth. However, comparison of manganese concentrations in water from 17 sets of paired wells indicates no apparent trend. Concentrations of manganese are largest in water from shallow wells at eight sites, largest in water from deep wells at seven sites, and largest in water from intermediate-depth wells at two sites.

Potassium

Concentrations of potassium for samples from 128 wells (table 16, appendix 3) ranged from 0.459 mg/L in water from well LK13 (S-118) to 161 mg/L in water from well B2 (S-048). The median potassium concentration for all samples was 4.58 mg/L. Potassium was not detected in the abundance that other common cations (such as calcium and sodium) were detected, nor was it the dominant cation in any of the 125 samples for which percentages of cations and anions were calculated. Potassium was detected in concentrations larger than 100 mg/L in water from only three wells: B2 (S-048), D25 (S-037), and I13 (S-033). All of these wells are in industrial areas or areas of made or modified land.

Of the four geohydrologic units, the confining unit had the largest median concentration of potassium, and confined sand aquifers had the smallest median concentration (table 17). The largest range of potassium concentrations was in water from the Calumet aquifer, and the smallest range was in water from confined sand aquifers. Comparison of potassium concentrations in water from paired wells indicates a general increase in potassium concentrations with increasing depth. Concentrations of potassium were largest in water from shallow wells at 5 sites, largest in water from deep wells at 10 sites, and largest in water from an intermediate-depth well at 2 sites.

Silica

Concentrations of silica determined for water from 120 wells (table 16, appendix 3) ranged from 3.2 mg/L in water from well B2 (S-048) to 51.8 mg/L in water from well WS7 (S-121); the median concentration was 16.2 mg/L. The largest median concentration of silica was water from the confining unit and the largest range of concentrations were in water from the Calumet aquifer (table 17). The smallest median concentration of silica was in water from the Silurian-Devonian aquifer. The smallest range of silica concentrations was in water from confined sand aquifers. Comparison of silica concentrations in water from 15 sets of paired wells indicates that the largest concentrations were generally in water from shallow wells at these sites. Silica concentrations were largest in water from shallow wells at 10 sites, largest in water from deep wells at 4 sites, and largest in water from an intermediate-depth well at 1 site.

Sodium

Concentrations of sodium determined for samples from 128 wells (table 16, appendix 3) ranged from 1.11 mg/L in water from well MW5 (S-042) to 1,450 mg/L in water from well I3 (S-086). The median concentration for all samples

Sulfate

Concentrations of sulfate determined for water from 125 wells (table 16, appendix 3) ranged from not detected (less than 5 mg/L) in water from 21 wells to 3,850 mg/L in water from well FILO2 (S-127). The median sulfate concentration for all samples was 78 mg/L. Sulfate was the dominant anion in water from 22 of the 125 samples for which percentages of cations and anions were calculated. Sulfate concentrations exceeded the 250-mg/L SMCL in water from 32 wells and exceeded 1,000 mg/L in water from 8 wells. Except for well BH29 (S-038), these wells are in industrial areas, near waste disposal, or in areas of made or modified land.

Among the four geohydrologic units, the median concentration of sulfate and the range of sulfate concentrations were largest for water from the confining unit. Water from confined sand aquifers had the smallest median concentration. Sulfate was not detected in water from any of the wells in confined sand aquifers and was not detected in at least one sample from each of the other three geohydrologic units. Comparison of sulfate concentrations in water from 16 sets of paired wells indicates that sulfate concentrations were largest in water from shallow wells at 12 sites and largest in water from deep wells at 4 sites.

Suspended Solids

Concentrations of suspended solids were determined for 125 water samples (table 16, appendix 3). Suspended solids were not detected in 18 samples. Detected concentrations ranged from 3 mg/L in water from well C4 (S-105) to 5,312 mg/L in water from well I2 (S-102); the median concentration was 18.5 mg/L (table 17). Of the 18 samples in which suspended solids were not detected, 17 were from wells screened in the Calumet aquifer and 1 was from a well screened in a confined sand aquifer. Suspended-solids concentrations may be more indicative of conditions in the immediate vicinity of a well more than they represent a characteristic of ground-water quality. A well having a poorly sized well screen—or in the case of some bedrock wells, no screen—may yield water having larger concentrations of suspended solids than a well that properly has been screened and developed.

Median concentrations of suspended solids were largest for water from the Silurian-Devonian and confined sand aquifers. Comparison of suspended-solids concentrations in water from 16 paired wells also indicates a general increase in suspended solids with an increase in well depth. Concentrations of suspended solids were largest in water from deep wells at 13 sites and were largest in water from shallow wells at 3 sites.

Total Organic Carbon

Concentrations of total organic carbon (TOC) were determined for water from 126 wells (table 16, appendix 3). Detected concentrations ranged from 2.1 mg/L in water from wells BH15 (S-063) and 105 (S-083) to 209 mg/L in water from well BH32 (S-110). TOC was not detected in water from nine wells. The median TOC concentration for all samples was 7.65 mg/L. Water from four wells—I13 (S-033), BH32 (S-110), I20 (S-119), and FILO2 (S-127)—had concentrations of TOC larger than 100 mg/L. These wells are located around Lake Calumet in areas of made or modified land or near waste-disposal sites.

TOC is a measurement of the organic content of the water sample. All natural water contains organic compounds in the form of humic and fulvic acids. Generally, concentrations in ground water are small, 0.1 to 10 mg/L (Freeze and Cherry, 1979, p. 86). Larger concentrations may indicate contamination by organic compounds at waste-disposal sites (Hem, 1985, p. 152). Organic material can affect water chemistry by changing pH and by modifying the adsorption of metals on sediments (Drever, 1982, p. 304–305).

Among the four geohydrologic units, the median concentration of TOC was largest for water from the confining unit and smallest for water from confined sand aquifers. Water from the Silurian-Devonian and Calumet aquifers had similar median concentrations. Concentrations of TOC at 17 sets of paired wells indicate no apparent trend with depth. TOC concentrations were largest in water from shallow wells at 7 sites and largest in water from deep wells at 10 sites.

Trace Elements and Cyanide

Trace elements are natural substances that are present in the earth's crust in varied amounts. In water, they generally are found at much smaller concentrations than are the common ions. Human activities can increase concentrations of trace elements through industrial processes that use these substances and through disposal of waste that contains trace elements. The solubility of trace elements depends on the characteristics of the individual element and on other properties of water, such as pH; however, all are at least somewhat soluble in water and therefore are potential ground-water contaminants. Cyanide is a carbon-nitrogen compound that can occur naturally, although it is commonly associated with various industrial processes and has been used widely as a pesticide. The presence of cyanide in ground water may indicate waste disposal (Hem, 1985, p. 124).

Results of analyses for 17 trace elements and cyanide are listed in table 18 (appendix 3) and are summarized in table 19. All samples contained at least one trace element. Except for silver, each trace element was detected in at least one sample. Arsenic, barium, lead, mercury, and thallium were detected in more than half of the samples. Barium, the most frequently detected trace element, was found in all but one sample. Aluminum, nickel, selenium, vanadium, and zinc were detected in 25 to 50 percent of the samples. Cobalt, copper, and cyanide were detected in 10 to 24 percent of the samples. Antimony, beryllium, cadmium, and chromium were detected in less than 10 percent of the samples.

Although 16 trace elements and cyanide were detected in samples from wells screened in the Calumet aquifer, trace elements were detected in a larger percentage of samples from wells screened in the confining unit than from wells completed in the other three geohydrologic units. The confining unit consists of fine-grained sediments, including clay particles that can attract many trace elements through ion exchange and molecular bonds (Freeze and Cherry, 1979, p. 127). The Calumet aquifer, confined sand aquifers, and Silurian-Devonian aquifer contain a much smaller percentage of clay particles than the confining unit. Therefore, the larger percentage of detections in samples from wells screened in the confining unit probably represents trace elements that are concentrated in these sediments by natural processes.

Detected concentrations for each trace element from all of the wells in the study area were ranked from lowest to highest; the ranks for each sample were summed to allow comparison among samples and provide a means of illustrating the distribution of trace elements in the study area. This method was selected because the trace elements have varied toxicities which make direct comparison misleading. For example, arsenic is more toxic than copper, which is more toxic than zinc. Silver is not included in this analysis because it was not detected in any samples. Thallium is not included because the results for this trace element are incomplete, as explained later in this report.

The distribution of trace elements (fig. 8) indicates that the largest concentrations were in samples from wells in areas south of and between Lake Calumet and Wolf Lake. Water from several wells in residential areas south of the Grand Calumet River and in the northwest part of the study area had moderate concentrations of trace elements. Moderate concentrations also were detected in samples from wells along the Lake Michigan shoreline and along the Grand Calumet River in the central part of the study area. Many of the samples having large concentrations of trace elements were from wells in industrial areas or near areas of waste disposal or fill, an indication that contamination of ground water by trace elements has resulted from human activities.

Table 19. Maximum Contaminant Levels and Secondary Maximum Contaminant Levels for selected trace elements and cyanide and summary of detections in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; --, no regulation; n.d., no data. Source: U.S. Environmental Protection Agency, 1992]

Element	Laboratory quantitation limits (smallest amount detectable) (µg/L)	Number of wells for which element was detected in sample	Range of detected concentrations (µg/L)	Maximum Contaminant Level (µg/L)	Secondary Maximum Contaminant Level (µg/L)	Number exceeding Maximum Contaminant Level	Number exceeding Secondary Maximum Contaminant Level
Aluminum	20.9-23.5	54	21.3 -7,280	--	50	--	29
Antimony	15.7-17.9	2	19.6 - 20.1	5[a]	--	2	--
Arsenic	1.7- 2.7	69	1.7 - 292	50[b]	--	3	--
Barium	5	127	5 - 690	2,000	--	0	--
Beryllium	.5- 1.2	2	.77- 1.5	1[a]	--	1	--
Cadmium	1.5- 1.7	1	n.d.	5	--	0	--
Chromium	5.1- 5.8	11	5.2 - 116	100	--	1	--
Cobalt	2.5- 3.8	14	2.8 - 51.2	--	--	--	--
Copper	4 - 4.2	31	4 -1,660	1,300[c]	1,000	1	1
Cyanide	10	17	10.7 - 230	200[a]	--	2	--
Lead	1.1- 3.8	68	1.1 - 54.2	15[c]	--	2	--
Mercury	.1	69	.1 - 1.1	2	--	0	--
Nickel	4.7- 6.1	36	4.8 - 376	100[a]	--	6	--
Selenium	2.3- 3.7	32	2.3 - 17.2	50	--	0	--
Silver	3.8- 5	0	n.d.	--	100	--	n.d.
Thallium	1.1- 7	71	1.1 - 6	1[a]	--	71	--
Vanadium	2.6- 3.3	41	3 - 52.7	--	--	--	--
Zinc	2.6- 3.7	43	3.8 -1,090	--	5,000	--	0

[a] Proposed.
[b] In review.
[c] U.S. Environmental Protection Agency action level.

fig 8

Aluminum

Aluminum was detected in 54 water samples: 36 from wells completed in the Calumet aquifer, 14 from wells in the confining unit, and 4 from wells in the Silurian-Devonian aquifer. Aluminum was not detected in any of the samples from confined sand aquifers. Detected concentrations of aluminum ranged from 21.3 µg/L for wells BH28 (S-071) and C3 (S-104) to 7,280 µg/L for well I20 (S-119). Small concentrations, less than 50 µg/L, were detected in samples from wells throughout the study area. The largest concentrations of aluminum, more than 500 µg/L, were detected in samples from several wells near and south of Lake Calumet and Wolf Lake and at well B2 (S-048) along the Lake Michigan shoreline in the central part of the study area. Aluminum concentrations ranging from 50 to 500 µg/L were detected in samples from other wells near Lake Calumet and Wolf Lake, from three wells in the central part of the study area, and from five wells in the eastern part of the study area. The SMCL for aluminum, 50 µg/L, (table 19) was exceeded in 29 water samples: 18 from wells in the Calumet aquifer, 8 from wells in the confining unit, and 3 from wells in the Silurian-Devonian aquifer.

Antimony

Antimony was detected in samples from wells B7 (S-069) and D67 (S-072), at concentrations of approximately 20 µg/L. These wells are completed in the Calumet aquifer and are approximately 4.5 mi apart on the south side of the Grand Calumet River in the central part of the study area (fig. 2). Both wells are less than 11 ft deep and are paired with adjacent deep wells that produced samples in which antimony was not detected. The detected concentrations exceeded the proposed MCL of 5 µg/L; however, because the laboratory quantitation limit for antimony is also larger than 5 µg/L, it is not known if concentrations in other samples may have exceeded the proposed MCL (table 19).

Arsenic

Arsenic was detected in samples from 69 wells: 48 completed in the Calumet aquifer, 14 in the confining unit, 4 in confined sand aquifers, and 3 in the Silurian-Devonian aquifer. Detected concentrations ranged from 1.7 µg/L in water from well E6 (S-024) to 292 µg/L in water from well I15 (S-051). Concentrations in 14 of the samples were between the two quantitation limits, 1.7 and 2.7 µg/L, reported by the laboratory. Arsenic was detected in samples from wells throughout the study area; however, two-thirds of these samples were from wells located in industrial and commercial areas between the Indiana Harbor Canal and the area west of Lake Calumet. The three largest concentrations, 73, 127, and 292 µg/L, were detected in samples from wells I16 (S-059), I14 (S-035), and I15 (S-051), all of which are between Lake Calumet and the Calumet River (fig. 2). These wells are less than 15 ft deep and are completed in the Calumet aquifer in an area of fill and near waste disposal. Arsenic concentrations in these samples exceeded the proposed MCL for arsenic (table 19).

Comparison of arsenic concentrations at 14 sites where there are paired wells indicates no consistent trend with depth except at 3 sites in the eastern part of the study area where wells are screened in confined sand aquifers. Samples from wells 230-128 (S-010), 244-125 (S-052), and 105 (S-083) contained arsenic concentrations larger than 10 µg/L. Arsenic was not detected in any samples from the shallow wells at these sites. The sample from well 230-58 (S-003), an intermediate-depth well, contained an arsenic concentration between those of the shallow well and deep well at that site. The detection of arsenic in the confined sand aquifer may indicate upward flow from the underlying shale bedrock in this area.

Barium

Barium was detected in samples from all wells except FILO6 (S-128), a 19-ft-deep well completed in the confining unit. Detected concentrations ranged from 5 µg/L in water from well B7 (S-069) to 690 µg/L in water from well I1 (S-032).

Samples from wells screened in the confining unit generally had larger concentrations of barium than did samples from wells in the Calumet, confined sand, or Silurian-Devonian aquifers. The median detected concentration was 105 µg/L for samples from wells completed in the confining unit, 73.3 µg/L for samples from wells in confined sand aquifers, 56.6 µg/L for samples from wells in the Calumet aquifer, and 24.1 µg/L for samples from wells in the Silurian-Devonian aquifer. The MCL for barium, 2,000 µg/L, was not exceeded in any samples (table 19); only two wells, I1 (S-032) and B2 (S-048), produced samples containing concentrations of barium larger than 500 µg/L, or 25 percent of the MCL. Well I1 is in an area of modified land near waste treatment and disposal south of Lake Calumet. Well B2 is in an industrial area along Lake Michigan in the central part of the study area (fig. 2).

Beryllium

Beryllium was detected in samples from wells 235-45 (S-041) and I20 (S-119). The sample from well 235-45 contained 0.77 µg/L; the sample from well I20 contained 1.5 µg/L. The detected concentrations are similar to the two quantitation limits (0.5 and 1.2 µg/L) reported by the laboratory (table 19). Well 235-45 is screened in the Calumet aquifer at a depth of 42 feet and is in a residential area in the east-central part of the study area. Well I20 is screened in the Calumet aquifer at a depth of 15 ft in an area west of the Calumet River that may be affected by local dumping. The concentration of beryllium detected in the sample from I20 exceeded the proposed MCL of 1 µg/L (table 19). It is not known if other samples may have exceeded the proposed MCL because the quantitation limit was larger than the MCL for some of the samples.

Cadmium

Cadmium was detected in the sample from well BH14 (S-094) at a concentration of 2 µg/L. Well BH14 is screened at a depth of 19 ft in the Calumet aquifer and is in a residential area in the central part of the study area (fig. 2). The detected concentration of cadmium does not exceed the MCL (table 19).

Chromium

Chromium was detected in samples from 11 wells: 5 are completed in the Calumet aquifer and 6 are in the confining unit. Chromium was not detected in any samples from the confined sand or Silurian-Devonian aquifers. Detected concentrations ranged from 5.2 µg/L in water from well C25 (S-075) to 116 µg/L in water from well BH7I (S-061). The smallest detected concentration, 5.2 µg/L, is within the range of the two quantitation limits (5.1 and 5.8 µg/L) reported by the laboratory (table 19). The majority of chromium detections were in samples from wells in industrial areas or near areas of fill or waste disposal; however, samples from wells BH2 (S-092) and D75 (S-116), located in residential areas, had chromium concentrations of 9.7 and 11 µg/L. The MCL for chromium was exceeded in only one sample (table 19).

Cobalt

Cobalt was detected in 14 samples: 6 from wells completed in the Calumet aquifer, 7 from wells in the confining unit, and 1 from a well in the Silurian-Devonian aquifer. All the wells are west of the Indiana Harbor Canal. All but three of the wells are near Lake Calumet. Six of the detected concentrations were between the two quantitation limits reported by the laboratory for cobalt (2.5 and 3.8 µg/L). The largest concentration, 51.2 µg/L, was detected in the sample from well FILO2 (S-127), a 29-ft-deep well screened in the confining unit near an area of waste disposal. The smallest detected concentration was 2.8 µg/L in the samples from well D75 (S-116) located in a residential area south of the Grand Calumet River in the west-central part of the study area (fig. 2).

Copper

Copper was detected in 31 samples: 17 from wells completed in the Calumet aquifer, 13 from wells in the confining unit, and 1 from a well in the Silurian-Devonian aquifer. Copper was detected at concentrations of less than 20 µg/L in 23 of the samples. Most samples in which copper was detected were from wells in industrial areas or in areas of made or modified land including waste disposal around Lake Calumet, along the Calumet River, and west of Wolf Lake. The largest concentration, 1,660 µg/L, was detected in the sample from well I8 (S-068), a 14-ft-deep well completed in the confining unit in a filled area near industry and a wastewater-treatment facility southwest of Lake Calumet. Copper was not detected in the sample from well I9 (S-067), an 11-ft-deep well near I8. The copper concentration in the sample from well I8 exceeded the SMCL and the USEPA action level for copper (table 19). No other samples exceeded these concentrations, although samples from four wells—BH13 (S-096), BH16S (S-115), I22 (S-087), and I3 (S-086)—contained concentrations of 100, 106, 268, and 907 µg/L. Well I3 is southwest of Lake Calumet near an area of wastewater treatment. Wells BH13 and I22 are in residential areas, and well BH16S is in an area that was formerly a rail yard. Samples from wells BH12 (S-097), BH13 (S-096), and BH19 (S-095), located in a residential area south of the Grand Calumet River and west of Gary Harbor, contained concentrations of 61.4, 100, and 40.1 µg/L.

Cyanide

Cyanide was detected in 17 samples: 15 from wells completed in the Calumet aquifer, 1 from a well in the confining unit, and 1 from a well in the Silurian-Devonian aquifer. Detected concentrations ranged from 10.7 µg/L in water from well I20 (S-119) to 230 µg/L in water from well E6 (S-024). Cyanide was detected in water from wells in industrial and commercial areas or near areas of waste disposal in the central and western parts of the study area. Concentrations in two samples, E6 (S-024) and BH33 (S-013), exceeded the proposed MCL for cyanide of 200 µg/L (table 19). These wells are south and north of Wolf Lake in areas of modified land (fig. 2). The presence of cyanide in the water samples indicates contamination.

Lead

Lead was detected in samples from 65 wells: 44 completed in the Calumet aquifer, 14 in the confining unit, and 7 in the Silurian-Devonian aquifer. Detected concentrations ranged from 1.1 µg/L in water from wells W-3 (S-080) and E5 (S-107) to 54.2 µg/L in water from well I20 (S-119). Lead was detected in water from wells throughout the study area. The largest concentrations (greater than 10 µg/L) were detected in samples from wells near areas of waste disposal around Lake Calumet; however, a relatively large concentration, 17.7 µg/L, was detected in water from well BH6 (S-054), a 21-ft-deep well completed in the Silurian-Devonian aquifer and located in a residential area. Lead concentrations in water from two wells, BH6 (S-054) and I20 (S-119), exceeded the USEPA action level of 15 µg/L.

Comparison of detected concentrations of lead for samples from 14 sites having paired wells indicates no apparent trend in concentrations with depth. At seven sites, concentrations were largest in samples from the shallow well; at six sites, concentrations were largest in samples from the deep well; and at one site (BH18), concentrations were the same, 1.9 µg/L, in samples from the shallow, intermediate, and deep wells.

Mercury

Mercury was detected in 69 samples: 46 from wells completed in the Calumet aquifer, 13 from wells in the confining unit, 3 from wells in confined sand aquifers, and 7 from wells in the Silurian-Devonian aquifer. Fifty two samples contained mercury concentrations less than 0.2 µg/L.

Detected concentrations ranged from the quantitation limit, 0.1 µg/L, in samples from wells 230-128 (S-010), 230-24 (S-017), and E6 (S-024) to 1.1 µg/L in samples from wells B2 (S-048) and I2 (S-102). Well B2 is on the Lake Michigan shoreline in an industrial area in the central part of the study area (fig. 2). Well I2 is in an area of modified land southwest of Lake Calumet. Two other samples contained concentrations of mercury larger than 0.5 µg/L: the sample from well C25 (S-075) contained 0.71 µg/L and the sample from well I20 (S119) contained 0.59 µg/L. Both wells are near areas of waste disposal. The largest concentration detected in water from wells completed in confined sand aquifers was 0.15 µg/L for well 244-125 (S-052). The largest detected concentration in water from wells in the Silurian-Devonian aquifer was 0.24 µg/L for well FILO1 (S-123). Mercury concentrations did not exceed the MCL of 2 µg/L (table 19).

Many of the detections of mercury in the samples were flagged as estimated by the USEPA quality-assurance audit as a result of potential contamination. The laboratory reported detections of mercury in calibration blanks at concentrations ranging from 0.1 to 1 µg/L; therefore, the reported detections of less than 1 µg/L of mercury may represent nondetection.

Mercury was detected in at least one sample at 11 sites having paired wells. Concentrations at three sites were largest in the sample from the shallow well, concentrations at five sites were largest in the sample from the deep well, and concentrations at one site were the same in samples from the shallow and deep wells. At two sites, the largest mercury concentration was in the sample from the wells completed at an intermediate depth.

Nickel

Nickel was detected in 36 samples: 21 from wells completed in the Calumet aquifer, 14 from wells in the confining unit, and 1 from a well in the Silurian-Devonian aquifer. Detected concentrations ranged from 4.8 µg/L in the sample from well BH18I (S-109) to 376 µg/L in the sample from well FILO4 (S-125). Except for the lowest detection, all samples in which nickel was detected had concentrations larger than the largest quantitation limit, 6.1 µg/L, reported by the laboratory (table 19). The proposed MCL, 100 µg/L, was exceeded in samples from wells A1 (S-049), BH7I (S-061), BH13 (S-096), FILO2 (S-127), FILO4 (S-125), and FILO5 (S-126). Wells FILO2, FILO4, and FILO5 are in an area of waste disposal southwest of Lake Calumet. Well A1 is in an industrial area near Gary Harbor. Well BH13 is in a residential area south of the Grand Calumet River near Gary Harbor, and well BH7I is in a natural area along and east of the Calumet River (fig. 2).

At 10 sites having paired wells, nickel was detected in a sample from at least one well. At five of the sites, the largest concentrations were detected in water from the shallow well, whereas concentrations at three sites were larger in water from the deep wells. At two sites, nickel concentrations were detected in the sample from the well completed at an intermediate depth but not in samples from the shallow or the deep well.

Selenium

Selenium was detected in 32 samples: 22 from wells completed in the Calumet aquifer, 9 from wells in the confining unit, and 1 from a

Silver

Silver was not detected in samples from any of the wells. The quantitation limits reported by the laboratory for silver are 3.8 and 5 µg/L. In all, 46 samples were analyzed at the lower limit, and 82 were analyzed at the higher limit.

Thallium

Thallium was detected in 71 samples: 51 from wells completed in the Calumet aquifer, 14 from wells in the confining unit, and 3 each from wells in confined sand and the Silurian-Devonian aquifers. All detected concentrations are between the range of laboratory quantitation limits, 1.1 to 7 µg/L, reported for thallium. The laboratory reported having difficulties with the thallium analyses. The laboratory calibration blanks contained concentrations of thallium ranging from 1.5 to 2.5 µg/L. Of the 71 samples in which thallium was from the shallow well at this site. The largest concentration in samples from wells in the Silurian-Devonian aquifer was 58.8 µg/L for well FILO1 (S-123), located in an area of waste disposal. The detected concentrations of zinc do not exceed the SMCL (table 19).

Volatile Organic Compounds

Water samples were analyzed for the presence of 33 VOC's on the USEPA's target compound list (table 20, appendix 3). Additionally, several tentatively identified VOC's that are not on the target compound list were detected during the laboratory analysis (table 21, appendix 3). The quantitation limit was 10 µg/L for most samples; however, samples from wells D20 (S-022), A3 (S-044), and I2 (S-102) were diluted by the laboratory and have quantitation limits ranging from 33 to 120 µg/L. Samples from wells I3 (S-086), I20 (S-119) and WS5 (S-1240) were diluted and re-analyzed after the initial analyses because concentrations of one or more compounds in the sample exceeded the laboratory calibration range for that specific compound. Results reported for these analyses are concentrations of VOC's detected within the calibration range on the initial analysis and concentrations determined from analysis of the diluted sample for the compounds that exceeded the calibration range on the initial sample.

Results of the analyses for VOC's are summarized in table 22. Target VOC's were detected in water from 20 of the 128 wells sampled. A total of 14 target VOC's was detected. The number of VOC's detected in each sample ranges from one compound in water from 11 wells to 5 compounds in water from 2 wells. Target VOC's were detected in water from 14 wells completed in the Calumet aquifer, 5 wells in the confining unit, and 1 well in the Silurian-Devonian aquifer. Of the 20 wells having water in which VOC's were detected, 18 are in or near industrial areas or in areas of made or modified land or waste disposal. The other two wells are in residential areas. Target VOC's were detected near industrial and waste-disposal sites around Lake Calumet and in industrial areas along the Calumet River, between Lake George and the Indiana Harbor Canal, near Gary Harbor, and at two locations south of the Grand Calumet River in the central part of the study area (fig. 9).

The detected VOC's are primarily solvents and degreasers that are used in a variety of industrial and manufacturing processes (Lucius and others, 1990). Many of the detected compounds, including benzene, toluene, and xylenes, are associated with petroleum refining and coal coking (Burdick and Leffler, 1983). Benzene, toluene, and xylenes were among the VOC's most frequently detected during this study and were the most frequently detected VOC's reported by Fenelon and Watson (1993). Because these compounds do not occur naturally, their presence in the samples indicates contamination of ground water.

Water from wells, BH21 (S-002), D40 (S-006), D10 (S-019), D20 (S-022), D21 (S-023), and C19 (S-074)—all near areas where petroleum is refined or stored—have measurable concentrations of VOC's. Benzene was the most frequently detected VOC in water from these wells; concentrations ranged from 8 µg/L in water from well BH21 to 1800 µg/L in water from well D20. Concentrations of benzene in water from these wells exceeded the MCL established by USEPA for this compound (table 22). Acetone and xylenes were detected in water from two of these wells. Water from well C19, near a petroleum storage facility, contained five detected target VOC's: acetone, benzene, toluene, ethylbenzene, and xylene. All the target VOC's detected in water from these wells are components of gasoline and are associated with petroleum refining (Burdick and Leffler, 1983).

The laboratory reported a quantitation limit of 120 µg/L for the sample from well D20 (S-022) as a result of sample dilution; therefore, it is not known if other VOC's are present in water from this well at concentrations less than the quantitation

Table 22. Maximum Contaminant Levels for volatile organic compounds and summary of detections in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[CAS, Chemical Abstract Service; USEPA, U.S. Environmental Protection Agency; µg/L, microgram per liter; MCL, Maximum Contaminant Level; n.r., no regulation; n.a., not applicable. Source: U.S. Environmental Protection Agency, 1992]

Compound name	CAS registry number	USEPA MCL (µg/L)	Number of wells with compound	Number of wells exceeding MCL
Target compounds:				
Acetone	67-64-1	n.r.	4	n.a.
Benzene	71-43-2	5	11	11
Chloroform	67-66-3	100[a]	1	0
1,1-Dichloroethylene	75-35-4	7	1	1
1,1-Dichloroethane	75-34-3	n.r.	1	n.a.
1,2-Dichloroethene	540-59-0	n.r.	3	n.a.
Ethylbenzene	100-41-4	700	3	0
2-Hexanone	591-78-6	n.r.	1	n.a.
Methylisobutyl ketone	108-10-1	n.r.	1	n.a.
Styrene	100-42-5	100	1	0
1,1,2,2-Tetrachloroethane	79-34-5	n.r.	1	n.a.
Toluene	108-88-3	1,000	4	0
Vinyl chloride	75-01-4	2	2	2
Xylenes	1330-20-7	10,000	7	0
Tentatively identified compounds:				
Unknown aliphatic hydrocarbon	n.a.	n.r.	8	n.a.
Unknown aromatic hydrocarbon	n.a.	n.r.	2	n.a.
Unknown	n.a.	n.r.	7	n.a.

[a] Listed for regulation.

fig 9

limit. Fenelon and Watson (1993) reported detections of benzene in water from well D20 collected during 1987 and 1988. They also reported detections of ethylbenzene, toluene, and xylenes in water from this well. The concentration of benzene reported for the sample collected in 1987 was similar to that detected for this study; however, the concentration reported for the sample collected during 1988 was much smaller (Fenelon and Watson, 1993).

A total of nine different VOC's was detected in water from five wells—I14 (S-035), B7 (S-069), BH32 (S-110), I20 (S-119), and FILO4 (S-125)—all near areas of waste disposal. The VOC's detected in water from these wells are acetone, benzene, chloroform, 1,1-dichloroethylene, 1,2-dichloroethene, 2-hexanone, methylisobutyl ketone, toluene, and vinyl chloride. Water from two of these wells contains one detected VOC, water from two wells contains three detected VOC's, and water from one well contains four detected VOC's. Acetone, benzene, and toluene were each detected in water from at least one well but were detected at generally smaller concentrations than those in water from wells near petroleum industry. Concentrations of benzene in water from wells near areas of waste disposal exceeded the MCL for this compound (table 22). The presence of these compounds in ground water indicates that dissolved waste material is entering the ground water in these areas.

Vinyl chloride was detected in water from wells I20 (S-119) and FILO4 (S-125). The detected

Two wells located in residential areas, IP (S-058) and BH1D (S-089), produced water that contained one target VOC. Water from BH1D contained 37 μg/L of acetone, and water from IP contains an estimated 3 μg/L of xylenes. In addition to being in residential areas, these wells are completed much deeper than the other wells in which target VOC's were detected. Well IP is the only well in the Silurian-Devonian aquifer that produced water in which target VOC's were detected. Large concentrations of acetone and xylenes have been reported to increase the hydraulic conductivity of clay liners used to contain landfill leachate (Anderson and Brown, 1981; Brown and others, 1983, 1986). If the detected concentrations of VOC's in water from these wells are representative of the ground water at these locations, then the potential for VOC's to move into relatively deep ground water is demonstrated.

Several tentatively identified VOC's were detected in the samples during analysis for the target compounds. The laboratory reported some of the tentatively identified VOC's by compound name and others as "unknown"; all concentrations reported by the laboratory are considered to be estimates. In this report, the tentatively identified VOC's are grouped into three categories: aliphatic and alicylic hydrocarbon compounds, aromatic hydrocarbon compounds, and unknown compounds. Aliphatic compounds are open-chain compounds and alicyclic compounds contain one or several rings (Schwarzenbach and others, 1993, p. 32). Aromatic compounds are benzene and compounds that resemble benzene in their chemical behavior (Morrison and Boyd, 1980, p. 318). Concentrations reported are totals of all tentatively identified compounds in the samples for each category.

Tentatively identified VOC's were detected in water from 13 wells (table 21, appendix 3). Seven of the wells produced water in which target VOC's also were detected; six wells produced water in which target VOC's were not detected. The number of tentatively identified VOC's detected in samples from these wells ranged from 1 compound in water from 9 wells to 10 compounds in water from 2 wells. Tentatively identified VOC's were detected in water from nine wells completed in the Calumet aquifer, three wells in the confining unit, and one well in the Silurian-Devonian aquifer. Eleven of the 13 wells are in industrial areas or in areas of waste disposal or modified land. Two of the wells are in residential areas.

The tentatively identified VOC's are primarily aliphatic hydrocarbon compounds, which were detected in water from 8 of the 13 wells. Tentatively identified compounds reported as unknown were detected in water from seven wells. Aromatic hydrocarbon compounds were detected in water from two wells. The tentatively identified VOC's detected during this study are primarily solvents (Lucius and others, 1990). Several detected compounds are components of petroleum and coal tar. Tentatively identified VOC's reported by the laboratory include cyclohexane, cyclopentane, and propylbenzene. The presence of these compounds indicates ground-water contamination.

Of the 13 wells that produced water containing tentatively identified VOC's, 5 wells—C19 (S-074), D10 (S-019), D20 (S-022), D21 (S-023), and D40 (S-006)—are near areas where petroleum is refined or stored. Water from these wells generally contained larger concentrations of tentatively identified VOC's than water from the other wells in which tentatively identified VOC's were detected. Water from three of these wells had the largest concentrations of tentatively identified VOC's detected during this study. The average concentration of tentatively identified VOC's in water from these wells is about 500 μg/L. The number of tentatively identified VOC's in water from these wells ranges from 3 to 10 compounds.

Five wells that produced water in which tentatively identified VOC's were detected are near areas of waste disposal. The wells are C18 (S-076), FILO4 (S-125), FILO5 (S-126), I10 (S-064), and I15 (S-051). Concentrations of tentatively identified VOC's in water from these wells ranged from 6 to 186 μg/L. The presence of tentatively identified VOC's in water from well FILO5, a bedrock well, indicates that VOC's have moved relatively deep in the ground-water-flow system. VOC's were not detected in water from a shallow well at this site, so it is unlikely that VOC's have migrated vertically down the well bore.

Of the three other wells that produced water containing tentatively identified VOC's, one well, WS5 (S124), is near steel industry and two wells, BH5D (S-108) and BH12 (S-097), are in residential areas. Water from the well near steel industry contained one tentatively identified VOC at a concentration of 26 μg/L. Water from each of the two wells in residential areas contained one tentatively identified VOC at a relatively small concentration (5 and 14 μg/L).

Semivolatile Organic Compounds

Water samples were analyzed for the presence of 64 SVOC's on the USEPA's target compound list (table 23, appendix 3). The laboratory also reported the presence of a number of tentatively identified SVOC's and molecular sulfur in some of the samples (table 24, appendix 3). The sample quantitation limit was 10 μg/L for 56 of the target compounds and 25 μg/L for 8 of the target compounds. One sample, S-019 (D10), was diluted by the laboratory and has quantitation limits of 100 and 250 μg/L. Samples from wells I3 (S-086), I2 (S-102), and WS5 (S-124) were diluted and re-analyzed after the initial analyses because concentrations of one or more compounds in the sample exceeded the laboratory calibration range for that specific compound. Results reported for these analyses are concentrations of SVOC's detected within the calibration range on the initial analysis and concentrations determined from analysis of the diluted sample for the compounds that exceeded the calibration range on the initial sample.

Target SVOC's were detected in water from 56 of the 128 wells that were sampled. A total of 23 target SVOC's was detected (table 25). The number of SVOC's detected in each of the 56 samples ranged from 1 compound in water from 41 wells to 14 compounds in water from 1 well. No MCL's have been established for 21 of the 23 target SVOC's detected. The MCL for benzo[*b*]fluoranthene was exceeded in one sample.

Di-*n*-butylphthalate and bis(2-ethylhexyl) phthalate were the most frequently detected compounds reported by the laboratory; however, these compounds also were detected at similar concentrations in laboratory and field-blank samples. The quality-assurance review determined that some reported detections of these compounds should be considered as not detected, although not all of the detections were qualified in this manner. The reported detections of these two compounds that were not qualified by the review are listed in the tables but are not included in further discussion because concentrations of these compounds are probably not representative of ground-water quality. If the samples that contain only these two compounds are not included, then SVOC's were detected in water from 23 wells.

SVOC's were detected in samples from 16 wells completed in the Calumet aquifer, 6 wells in the confining unit, and 1 well in the Silurian-Devonian aquifer (fig. 10). SVOC's were detected in water from 9 wells near industrial facilities, 8 wells in areas of modified land or near waste-disposal sites, 5 wells in residential areas, and 1 well in a natural area.

The detected SVOC's comprise a variety of industrial compounds including disinfectants, insecticides, deodorants, and plasticizers (Lucius and others, 1990). Many of the compounds are components or byproducts of coal tar and petroleum processing or combustion. Phenol,

Table 25. Maximum Contaminant Levels for semivolatile organic compounds and summary of detections in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[CAS, Chemical Abstract Service; USEPA, U.S. Environmental Protection Agency; µg/L, microgram per liter; MCL, Maximum Contaminant Level; n.r., no regulation; n.a., not applicable. Source: U.S. Environmental Protection Agency, 1992]

Compound name	CAS registry number	USEPA MCL (µg/L)	Number of wells with compound	Number of wells exceeding MCL
Target compounds				
Phenol	108-95-2	n.r.	8	n.a.
1,4-Dichlorobenzene	106-46-7	75	1	0
Orthocresol (2-methylphenol)	95-48-7	n.r.	2	n.a.
Paracresol (4-methylphenol)	106-44-5	n.r.	4	n.a.
2,4-Dimethylphenol	105-67-9	n.r.	4	n.a.
Naphthalene	91-20-3	n.r.	7	n.a.
2-Methylnaphthalene	91-57-6	n.r.	4	n.a.
Dimethylphthalate	131-11-3	n.r.	2	n.a.
Acenaphthylene	208-96-8	n.r.	4	n.a.
2,6-Dinitrotoluene	606-20-2	n.r.	1	n.a.
Acenaphthene	83-32-9	n.r.	3	n.a.
Dibenzofuran	132-64-9	n.r.	3	n.a.
Fluorene	86-73-7	n.r.	6	n.a.
Phenanthrene	85-01-8	n.r.	8	n.a.
Carbazole	86-74-8	n.r.	3	n.a.
Di-n-butylphthalate	84-74-2	n.r.	15	n.a.
Fluoranthene	206-44-0	n.r.	4	n.a.
Pyrene	129-00-0	n.r.	4	n.a.
bis(2-ethylhexyl)phthalate	117-81-7	n.r.	28	n.a.
Diethylphthalate	84-66-2	n.r.	3	n.a.
Anthracene	120-12-7	n.r.	2	n.a.
Di-*n*-octylphthalate	117-84-0	n.r.	4	n.a.
Benzo[*b*]fluoranthene	205-99-2	.2[a]	1	1
Tentatively identified compounds				
Unknown aliphatic hydrocarbon	n.a.	n.r.	23	n.a.
Unknown aromatic hydrocarbon	n.a.	n.r.	19	n.a.
Unknown	n.a.	n.r.	61	n.a.
Molecular sulfur	10544-50-0	n.r.	15	n.a.

[a] Proposed.

fig 10

0.5 µg/L in water from wells I10 and WS7 to 99.8 µg/L in water from well WS5. The number of SVOC's detected in water from each well ranged from one compound in water from wells A1, A4, I10, C19, and WS7 to 11 compounds in water from wells B2 and WS5.

Naphthalene was detected in water from five wells near industrial facilities at concentrations ranging from 0.5 µg/L in water from well I10 to 12 µg/L in water from well D20. Phenol, flourene, and phenanthrene were detected in water from three wells near industrial facilities. Water from well WS5 contained 73 µg/L, and water from well D20 contained 33 µg/L of phenol. Other SVOC's detected in water from at least two wells near industrial facilities were dimethylphthalate, 2,4-dimethylphenol, acenapthene, dibenzofuran, fluoranthene, and pyrene. The presence of these compounds indicates contamination of ground water.

Eight wells in areas of modified land or near waste disposal sites produced water in which target SVOC's were detected: I13 (S-033), BH31 (S-036), C18 (S-076), I3 (S-086), I2 (S-102), BH32 (S-110), FILO1 (S-123), and FILO2 (S-127). Total concentrations of SVOC's in samples from these wells ranged from 0.6 µg/L in water from well FILO1 to 5,234 µg/L in water from well I2. The number of SVOC's detected in each sample ranged from 1 compound in water from wells C18, FILO1, and FILO2 to 14 compounds in water from well I2.

Phenol and phenanthrene were the most frequently detected SVOC's in water from wells in areas of made or modified land or near waste disposal. Concentrations of phenol ranged from 0.8 µg/L in water from well C18 to 1,600 µg/L in water from well I2. Detected concentrations of phenanthrene ranged from 0.8 µg/L in water from well I3 to 14 µg/L in water from well I2. Other SVOC's that were detected in water from three of these wells were paracresol, di-*n*-octylphthalate, 2-methylnaphthalene, and acenapthylene.

Water from wells I3 and I2, near the southwestern edge of Lake Calumet and along an interstate highway (fig. 2), had very large total concentrations of SVOC's—306.2 and 5,234 µg/L. Roadcap and Kelly (1994, p. 41) reported detecting similar compounds and concentrations in water samples from these wells. They attributed ground-water quality at these wells to various potential contaminant sources including road salting, petroleum, and steel making.

One target SVOC was detected in each sample from wells BH23 (S-081), BH1D (S-089), A20 (S-079), BH25 (S-093), and BH13 (S-096) (table 23, appendix 3). These wells are in residential or commercial areas. The reported concentrations were less than the laboratory quantitation limit and ranged from 0.6 to 4 µg/L. Only two target SVOC's were reported at concentrations larger than 1 µg/L in water from these wells. Water from well BH13 contained 4 µg/L of 1,4-dichlorobenzene, a common insecticide (Budavari, 1989, p. 482). Water from well BH1D contained 2 µg/L of phenol. Well BH1D is 90 ft deep and completed in the confining unit. VOC's also were detected in water from this well; however, no organic compounds were detected in water from a 15-ft-deep well at this site. The presence of organic compounds in the deep well may result from horizontal flow of ground water through the base of the moraine rather than downward flow through the confining unit.

A concentration of 1 µg/L of di-*n*-octylphthalate was reported for water from well 232 (S-082), located in a natural area along Lake Michigan. Well 232 is screened at a depth of 43 ft in the Calumet aquifer. The detected compound, di-*n*-octylphthalate, is a plasticizer and is documented to be distributed widely in the environment (Callahan and others, 1979, p. 94-1a). The presence of this compound in water from well 232 may indicate the persistence of some organic compounds and their capability to move in ground water. On the other hand, di-*n*-octylphthalate is closely related to bis(2-ethylhexyl)phthalate (Callahan and others, 1979, p. 94–3), a laboratory contaminant commonly detected during this study.

More than 50 tentatively identified SVOC’s were detected in the samples during analysis for the target compounds (table 24, appendix 3). The laboratory reported some of the tentatively identified SVOC’s by compound name and others as “unknown”; all concentrations reported by the laboratory are considered estimates. The tentatively identified SVOC’s are grouped into three categories: aliphatic hydrocarbon compounds, aromatic hydrocarbon compounds, and unknown compounds. Concentrations reported are totals of all tentatively identified compounds in the samples for each category. The tentatively identified SVOC’s that were detected are primarily classified as unknown compounds, which were detected in water from 61 wells. Aliphatic hydrocarbon compounds were detected in water from 23 wells, and aromatic hydrocarbon compounds were detected in water from 19 wells.

Tentatively identified SVOC’s were detected in water from 73 wells (table 24, appendix 3). Tentatively identified SVOC’s were detected in water from 17 of the 23 wells producing water in which target SVOC’s were detected. More than one-half of the samples in which tentatively identified SVOC’s were detected contained only one or two compounds; water from 25 wells contained one tentatively identified SVOC, and water from 12 wells contained two tentatively identified SVOC’s. Water from five wells, D10 (S-019), A1 (S-049), C19 (S-074), I2 (S-102), and FILO4 (S-125), contained 20 tentatively identified SVOC’s. Tentatively identified SVOC’s were detected in water from 48 wells completed in the Calumet aquifer, 16 wells in the confining unit, 2 wells in confined sand aquifers, and 7 wells in the Silurian-Devonian aquifer. Thirty-four of the wells are in residential or commercial areas, 17 are in industrial areas, 17 are in areas of waste disposal or made or modified land, and 5 wells are in natural areas.

Water from 17 wells near industrial facilities contained concentrations of tentatively identified SVOC’s ranging from 2 to 22,864 µg/L. The average concentration in water from these wells was 1,790 µg/L. The number of tentatively identified SVOC’s in each sample ranged from one compound in water from D11 (S-018), D21 (S-023), I21 (S-060), and I10 (S-064) to 20 compounds in water from D10 (S-019), A1 (S-049), and C19 (S-074). Unknown compounds were detected in water from 16 of the wells in this group. Water from seven wells contained aromatic compounds, and water from four wells contained aliphatic compounds. Six of the wells near industrial facilities and producing water in which tentatively identified SVOC’s were detected also produced water containing target SVOC’s.

Fourteen wells near industry produced water containing more than 10 µg/L of tentatively identified SVOC’s. Seven wells produced water in which concentrations of these compounds exceeded 100 µg/L. Three wells—D10 (S-019), C19 (S-074), and WS5 (S-124)—produced water containing more than 1,000 mg/L of tentatively identified SVOC’s. Wells D10 and C19 are near petroleum industry and produced water containing 4,680 and 1,297 µg/L of unknown and aromatic compounds. Water from well WS5, near steel industry, contained 22,864 µg/L of unknown and aliphatic compounds.

Seventeen wells in areas of made or modified land or near waste disposal produced water in which tentatively identified SVOC’s were detected. Concentrations of these compounds ranged from 2 to 16,543 µg/L and averaged 2,030 µg/L. The and FILO2 (S-127) were 3,545, 16,543, and 13,035 µg/L. Wells FILO2 and FILO4 are near a waste-disposal site southwest of Lake Calumet (fig. 2) and produced water containing unknown and aromatic compounds. Well BH32 is near a waste-disposal site on the north side of Lake Calumet and produced water containing unknown, aliphatic, and aromatic compounds.

Tentatively identified SVOC's were detected in water from 34 wells in residential or commercial areas. Concentrations ranged from 2 µg/L in water from nine wells to 911 µg/L in water from BH23 (S-081). The average concentration in water from these wells was about 40 µg/L. Although tentatively identified SVOC's were detected in water from more wells in residential or commercial areas than wells in industrial areas or in areas of waste disposal, the number of compounds detected and the concentrations are generally small in residential or commercial areas. Of the 34 wells, 18 produced water in which only one compound was detected, and 9 produced water in which only two compounds were detected.

Well BH23 produced water containing the largest concentration and number of tentatively identified SVOC's detected at any well in a residential or commercial area; however, none of these compounds was detected in a duplicate sample from this well. The detection of these compounds was not qualified during the USEPA review, and the cause for the discrepancy between the analyses is not clear. Visual inspection of cuttings and water samples during drilling and development of BH23 indicated the presence of contaminants. The lack of reproducible results and the tentative nature of the identification indicate that the reported detections may not be representative of water quality at this site.

Concentrations of tentatively identified SVOC's detected in water from five wells in natural areas ranged from 2 to 81 µg/L. The average concentration in water from these wells was 24 µg/L. The number of tentatively identified SVOC's detected in each sample ranged from 1 compound in water from WP1 (S-007) and D-5A (S-020) to 11 compounds in water from W-3 (S-080).

Only two wells in natural areas produced water containing more than 10 µg/L of tentatively identified SVOC's: BH7D produced water containing 32 µg/L, and W-3 produced water containing

sulfur is present naturally in earth materials,
elemental sulfur usually is found in sediments
that are several hundred feet below land surface,

fig 11

9 wells (table 27). Although the laboratory reported 59 individual detections of pesticide compounds, only 8 of the reported concentrations are larger than the quantitation limit required by the USEPA Contract Laboratory Program. Concentrations of *p,p′*-DDT exceeded the quantitation limit in water from wells BH7S (S-065), BH7I (S-061), BH18I (S-109), and FILO1 (S-123). Concentrations of *p,p′*-DDD exceeded the quantitation limit in water from wells D10 (S-019) and BH7I (S-061). Water from well I2 (S-102) contained concentrations of beta benzene hexachloride and heptachlor that exceeded the quantitation limit.

Water from well I2 (S-102) contained the largest number (14) and largest total concentration (1.78 µg/L) of pesticide compounds. This well is southwest of Lake Calumet in an area of modified land near a waste-disposal site. The pesticide compounds detected in water from well I2 may be

Table 27. Maximum Contaminant Levels for compounds containing pesticides or polychlorinated biphenyls and summary of detections in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[CAS, Chemical Abstract Service; USEPA, U.S. Environmental Protection Agency; µg/L, microgram per liter; MCL, Maximum Contaminant Level; n.r., no regulation; n.a., not applicable; PCB, polychlorinated biphenyl. Source: U.S. Environmental Protection Agency]

Compound name	CAS registry number	USEPA MCL (µg/L)	Number of wells with compound	Number of wells exceeding MCL
alpha-BHC	319-84-6	n.r.	1	n.a.
beta-BHC	319-85-7	n.r.	1	n.a.
delta-BHC	319-86-8	n.r.	1	n.a.
Aldrin	309-00-2	n.r.	4	n.a.
alpha-Chlordane	5103-71-9	n.r.	2	n.a.
gamma-Chlordane	5103-74-2	n.r.	3	n.a.
p,p'-DDD	72-54-8	n.r.	4	n.a.
p,p'-DDE	72-55-9	n.r.	3	n.a.
p,p'-DDT	50-29-3	n.r.	9	n.a.
Dieldrin	60-57-1	n.r.	4	n.a.
Endosulfan I	959-98-8	n.r.	1	n.a.
Endosulfan II	33213-65-9	n.r.	4	n.a.
Endosulfan sulfate	1031-07-8	n.r.	4	n.a.
Endrin	72-20-8	2[a]	2	0
Endrin ketone	53494-70-5	n.r.	1	n.a.
Endrin aldehyde	7421-36-3	n.r.	14	n.a.
Heptachlor	76-44-8	.4	2	0
Methoxychlor	72-43-5	40	2	0
Aroclor 1242, PCB	53469-21-9	.5	1	1
Aroclor 1248, PCB	12672-29-6	.5	1	0
Aroclor 1254, PCB	11097-69-1	.5	1	1

[a] Proposed.

wells having water that most likely represents natural water quality are in Porter County in the eastern part of the study area (fig. 2). Shallow wells at the 10 sites in Porter County were selected to provide the best description of natural water quality in the Calumet aquifer. These wells range in depth from 9 to 62 ft.

Water from the shallow wells in Porter County is typically a calcium bicarbonate type having a median pH of 7.2 and small to moderate concentrations of dissolved solids (table 28). Comparison of

Table 28. Statistical summary of water quality for 10 shallow wells in Porter County selected to represent natural ground-water quality in the Calumet Region, Indiana and Illinois, June 1993

[mv, millivolts; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25^{o}C; µg/L, microgram per liter. Wells and corresponding sample-identification numbers included in this analysis are G-1(S-009), 230-24(S-017), D-5A(S-020), 225(S-021), 24(S-026), 25(S-027), W-1A(S-028), 244-65(S-053), 232-45(S-082), and 106(S-084)]

Water-quality measurement, property, or constituent	Units	Median	Minimum	Maximum
Onsite measurements				
pH	pH units	7.2	6.0	7.5
Oxidation-reduction potential	mv	-105	-167	89
Dissolved oxygen	mg/L	.15	0	6.1
Specific conductance	µS/cm	493	164	1,190
Water-quality properties and common ions				
Calcium	mg/L	57.1	10.7	301
Magnesium	mg/L	18.4	5.03	50.6
Sodium	mg/L	15.0	1.14	103
Potassium	mg/L	1.94	.52	26.2
Alkalinity	mg/L	174.5	41.8	289
Sulfate	mg/L	41.0	<5.0	660
Chloride	mg/L	16.8	6.2	138
Silica	mg/L	12.3	6.03	29.7
Dissolved solids	mg/L	308	95	1,324
Suspended solids	mg/L	6.75	<3	15.5
Ammonia nitrogen	mg/L	.55	<.1	2.6
Iron	mg/L	3.33	.024	29.6
Manganese	mg/L	.185	<.0016	1.23
Total organic carbon	mg/L	8.5	<2.0	26.9
Trace elements and cyanide				
Aluminum	µg/L	<25.9	<20.9	383
Antimony	µg/L	<17.9	< 15.7	<17.9
Arsenic	µg/L	<1.7	<1.7	15.3
Barium	µg/L	36.6	14.7	229
Beryllium	µg/L	<.5	<.5	<1.2
Cadmium	µg/L	<1.7	<1.5	<1.7
Chromium	µ			

extremely large concentrations. Target and tentatively identified VOC's were detected more frequently and in larger concentrations in water from wells in industrial areas or near areas of fill or waste disposal than in residential or natural areas. No target or tentatively identified VOC's were detected in water from shallow wells in Porter County.

Tentatively identified SVOC's were detected more frequently than other organic compounds and were detected most frequently in water from wells in residential and commercial areas. Tentatively identified SVOC's were detected in water from more than half of the wells and from wells screened in all four geohydrologic units. The largest concentrations and numbers of detected compounds, however, were reported for water from wells completed in the Calumet aquifer or confining unit and near industrial areas and areas of waste disposal. Phenol, phenanthrene, and naphthalene, which are components of coal tar and have a variety of industrial uses, were the most frequently detected SVOC's. Although all ground water contains organic matter (Freeze and Cherry, 1979, p. 86), the types of organic compounds detected during this study and the pattern of detection indicate that the presence of these compounds in ground water most likely is the result of industrial and waste-disposal activities.

Except for 1 mg/L of di-*n*-octylphthalate in water from 232 (S-082), target SVOC's that were not qualified by the quality-assurance audit were not detected in water from wells in Porter County. As previously discussed, the detection of this compound may have resulted from contamination in the field or laboratory and may not be representative of ground-water quality. Tentatively identified SVOC's were detected in water from 4 of the 10 shallow wells in Porter County that were used to illustrate natural water quality.

Pesticide compounds were detected in water from wells completed in the Calumet aquifer, confining unit, and Silurian-Devonian aquifer. Most of these wells are near areas of waste disposal. The detected pesticide compounds are primarily insecticides and degradation products of insecticides (Briggs and others, 1992, p. 81–196). Most of the detected pesticides are chlorinated hydrocarbon compounds that tend to bioaccumulate and are persistent once they are released into the environment (Briggs and others, 1992, p. 212). The use of several pesticides detected during this study—including endrin, dieldrin, and *p,p′*-DDT—was banned in the United States during the 1970's (Briggs and others, 1992, p. 81–196). The presence of pesticide compounds in water from the Silurian-Devonian aquifer is indicative of the mobility and persistence of these compounds. Compounds containing PCB's generally were not detected during this study, although two of the three detected concentrations of these compounds exceeded the USEPA MCL for total polychlorinated biphenyls. Compounds containing pesticides and PCB's were not detected in water from shallow wells in Porter County.

Water from 15 wells, or about 12 percent of the sampled wells, had concentrations of one or more substances that exceeded an established USEPA MCL (fig. 12). MCL's for trace elements were exceeded in water from four wells. The MCL for chromium was exceeded in one sample. USEPA action levels for copper and lead, which are basically MCL's applied at the point of use, were exceeded in one and two samples. Volatile organic compounds were detected in water from 12 wells at concentrations larger than established MCL's. Concentrations of benzene exceeded the MCL in 11 samples. Concentrations of 1,1-dichloroethylene exceeded the MCL in one sample and concentrations of vinyl chloride exceeded the MCL in two samples. Compounds containing PCB's exceeded the MCL in two samples. Semivolatile organic compounds and pesticide compounds were not detected in concentrations that exceeded established MCL's (U.S. Environmental Protection Agency, 1992).

Figure 12 and most of the figures showing distribution of water-quality constituents in this report indicate that the frequency of detection and the concentration of many constituents in ground water increases from east to west across the study area. An increase from south to north is less obvious. This observed pattern of water quality corresponds to the pattern of industrialization and urbaniza-

fig 12

tion, which also increases from east to west and south to north in the study area. Moreover, the confining unit is at land surface in much of the Illinois part of the study area. Ground water in the confining unit would contain, through natural processes of ion exchange, larger amounts of dissolved inorganic substances than would water in the Calumet aquifer, owing to the abundance of clay minerals and slow rate of flow in the confining unit. This effect is shown by the median concentration of dissolved solids for water from the confining unit, which is more than twice those of the other geohydrologic units.

A third factor that affects the distribution of ground-water quality shown on figure 12 and other figures in this report is the selection of wells that were sampled. Most wells sampled during this study were installed for previous studies. Most of the wells in Indiana intentionally were placed away from areas of known ground-water contamination (Fenelon and Watson, 1993, p. 7); in contrast, many of the wells in Illinois were installed in locations where ground-water contamination was expected (George Roadcap, Illinois State Water Survey, oral commun., 1994).

In contrast to MCL’s, SMCL’s were exceeded more frequently in the water samples collected for this study. SMCL’s for dissolved solids, iron, and manganese were exceeded in more than half of the samples. Concentrations of aluminum and sulfate raising pH. The consequence of extremely high pH is not understood completely. The variety of compounds detected in water from wells near areas of slag disposal probably reflects the variety of materials that were disposed of along with the slag.

SUMMARY

During June 1993, the USGS, in cooperation with the USEPA, collected water samples from 128 wells in a large industrial and urban area in northwestern Indiana and northeastern Illinois. Samples were collected from wells screened in one of four geohydrologic units: a surficial sand aquifer (Calumet aquifer), a clay confining unit, confined sand aquifers, and a carbonate-bedrock aquifer (Silurian-Devonian aquifer). Samples were analyzed by U.S. Environmental Protection Agency contract laboratories for selected water-quality properties, common ions, trace elements, volatile and semivolatile organic compounds, and compounds containing pesticides or PCB's. Onsite measurements of water temperature, pH, oxidation-reduction potential, dissolved oxygen, and specific conductance were made during sample collection.

The Silurian-Devonian aquifer and clay confining unit underlie the entire study area. Confined sand aquifers are present within the confining unit in the eastern part of the study area. The Calumet aquifer is at land surface in the eastern two-thirds of the study area; the confining unit is at land surface in the western third of the study area.

Measured pH of ground water in the study area ranged from 5.3 to 12.1; the median was 7.2. Median values of pH are larger in water from the Silurian-Devonian and confined sand aquifers than in water from the other geohydrologic units. Values of pH larger than 8.5 were associated with water from bedrock wells or from wells in areas of filled or modified land. The largest values of pH were measured in water from wells located near areas used to dispose of slag from local steel industry.

Specific conductance ranged from 106 to 5,980 μS/cm; the median was 828 μS/cm. Concentrations of dissolved solids ranged from 95 mg/L to 6,780 mg/L; the median was 674 mg/L. Median values of specific conductance and dissolved solids were largest for water from the confining unit and smallest for water from the Silurian-Devonian aquifer.

Water from wells in the Silurian-Devonian aquifer is predominantly a sodium bicarbonate type. Water types in confined sand aquifers and the confining unit are varied. Water types from wells in the Calumet aquifer also are varied, although approximately 42 percent of the wells in this geohydrologic unit produced water in which calcium and bicarbonate are the dominant cation-anion pair. Samples from several shallow wells in the confining unit and the Calumet aquifer, and one well in a confined sand aquifer, were classified as sodium chloride-type water. Except for the well in a confined sand aquifer, the occurrence of sodium chloride may indicate the effect of deicing salts that have washed from the roadway and entered the shallow ground water. The presence of sodium chloride in water from a confined sand aquifer may result from upward flow of water from shale bedrock that underlies the unconsolidated sediments in the extreme eastern part of the study area.

The largest concentrations of trace elements were in samples from wells located in or near industrial areas or areas of waste disposal; however, water from several wells located in residential areas had relatively large concentrations of trace elements. Barium, the most frequently detected trace element in this study, was detected in all but one sample. Arsenic, lead, and mercury were detected in more than half of the samples. The MCL established by the USEPA for chromium was exceeded in one sample. SMCL's were exceeded in 29 samples for aluminum and in 1 sample for copper.

A total of 14 volatile organic compounds on the USEPA's target compound list was detected in samples from 20 wells. Volatile organic compounds were detected in water from the Calumet and Silurian-Devonian aquifers and from the confining unit. Volatile organic compounds were detected in water from wells located near industrial and waste-disposal sites and in areas of filled or modified land containing sand, slag, construction debris, and other materials. Acetone, benzene, toluene, and xylene were the most frequently detected volatile organic compounds. Concentrations of benzene exceed the MCL in 11 samples. The MCL for vinyl chloride was exceeded in two samples.

A total of 23 semivolatile organic compounds on the USEPA's target compound list was detected in samples from 56 wells. Semivolatile organic compounds were detected in water from the Calumet and Silurian-Devonian aquifers and from the confining unit. The largest concentrations of semivolatile organic compounds were detected in water from wells located near waste-disposal sites. Phenol, phenanthrene, and naphthalene are among the compounds detected most frequently during this study. These compounds, along with orthocresol and paracresol, were detected in relatively large concentrations compared to the other semivolatile organic compounds. The MCL for benzo[b]fluoranthene was exceeded in one sample.

A total of 18 pesticide compounds was detected in water from 29 wells. Pesticides were detected in water from the Calumet and Silurian-Devonian aquifers and from the confining unit. Pesticide compounds were detected in water from wells near industrial and waste-disposal facilities and from five wells in residential areas. The compounds most frequently detected during this study were endrin aldehyde, which was detected in water from 14 wells, and *p,p′*-DDT, which was detected in water from 9 wells. Pesticides were not detected in water from any wells in the eastern part of the study area.

Compounds that contain PCB's were detected in water from only three of the wells that were sampled. PCB's were detected in water from the Calumet aquifer and the confining unit; one well is near industry, and two wells are in areas of modified land near waste disposal. Two of the detected concentrations of PCB's exceed the MCL.

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APPENDIX 1

SELECTED CHARACTERISTICS OF WELLS

Table 1. Selected characteristics of wells from which water samples were collected in the Calumet Region, Indiana and Illinois, June 1993

[USGS, U.S. Geological Survey; °, degrees; ′, minutes; ″, seconds; SS, stainless steel; PVC, polyvinyl chloride; Galv, galvanized steel; BI, black iron; CA, Calumet aquifer; COMM, commercial; IND, industrial; NAT, natural; RES, residential; CS, confined sand aquifer; BR, carbonate-bedrock aquifer; WASTE, waste disposal; CU, confining unit; --, no data]

Sample number	Well name	Latitude	Longitude	USGS site identification number	Land-surface altitude (feet above sea level)	Screened interval (feet below ground level)	Casing/ screen material[1]	Hydrologic unit	Primary land use
S-001	E10	41° 37′ 22″	87° 30′ 41″	413722087304101	586	6-9	SS	CA	COMM
S-002	BH21	41° 38′ 32″	87° 32′ 36″	413832087323601	587	3-13	PVC/SS	CA	IND
S-003	230-58	41° 37′ 01″	87° 11′ 09″	413651087110502	611	49-55	PVC	CA	NAT
S-004	E20	41° 36′ 27″	87° 31′ 05″	413627087310500	592	5-8	SS	CA	RES
S-005	234-142	41° 35′ 47″	87° 14′ 58″	413515087145501	613	130-135	PVC	CS	COMM
S-006	D40	41° 38′ 35″	87° 28′ 51″	413835087245101	584	4-7	SS	CA	IND
S-007	WP1	41° 39′ 37″	87° 32′ 19″	413937087321901	587	15-20	PVC	CA	NAT
S-008	IC	41° 35′ 11″	87° 30′ 03″	413511087300302	590	53-58	PVC	BR	RES
S-009	G1	41° 38′ 21″	87° 07′ 09″	413821087070901	623	40-45	BI	CA	IND
S-010	230-138	41° 36′ 51″	87° 11′ 05″	413651087110501	611	114-119	PVC	CS	NAT
S-011	BH8	41° 39′ 32″	87° 31′ 31″	413932087313101	584	15-30	PVC/SS	CA	WASTE
S-012	BH22	41° 39′ 48″	87° 32′ 18″	413948087321801	589	13-23	PVC/SS	CA	NAT
S-013	BH33	41° 40′ 34″	87° 31′ 47″						

Table 1. Selected characteristics of wells from which water samples were collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Latitude	Longitude	USGS site identification number	Land-surface altitude (feet above sea level)	Screened interval (feet below ground level)	Casing/ screen material[1]	Hydrologic unit	Primary land use
S-027	25	41° 38′ 42″	87° 05′ 12″	413842087051201	606	11-14	BI/Galv	CA	NAT
S-028	W-1A	41° 36′ 25″	87° 13′ 20″	413625087132001	606	6-9	SS	CA	NAT
S-029	BH30	41° 39′ 30″	87° 36′ 25″	413930087362501	587	10-20	PVC/SS	CU	RES
S-030	IT	41° 42′ 17″	87° 33′ 50″	414217087335001	585	79-84	PVC	BR	RES
S-031	BH31	(see S-036)							
S-032	I1	41° 39′ 38″	87° 35′ 07″	413938087350701	586	7-11	PVC	CU	WASTE
S-033	I13	41° 42′ 10″	87° 35′ 25″	414210087352501	587	4-14	PVC	CU	WASTE
S-034	I12	41° 41′ 38″	87° 35′ 48″	414138087354801	586	5-10	PVC	CU	WASTE
S-035	I14	41° 39′ 50″	87° 34′ 30″	413950087343001	589	10-15	PVC	CA	WASTE
S-036	BH31	41° 39′ 47″	87° 30′ 25″	413947087302501	600	18-28	PVC/SS	CA	WASTE
S-037	D25	41° 39′ 09″	87° 28′ 03″	413804087291102	588	5-8	SS	CA	IND
S-038	BH29	41° 39′ 16″	87° 36′ 54″	413916087365901	590	5-15	PVC/SS	CU	RES
S-039	BH26	41° 41′ 09″	87° 35′ 25″	414109087352501	592	8-18	PVC/SS	CU	RES
S-040	237-45	41° 35′ 50″	87° 16′ 38″	413550087163800	608	34-39	PVC	CA	COMM
S-041	235-45	41° 36′ 29″	87° 14′ 26″	413629087142600	606	37-42	PVC	CA	RES
S-042	MW-5	41° 36′ 22″	87° 16′ 13″	413622087161301	602	4-7	SS	CA	NAT
S-043	MW-15	41° 36′ 52″	87° 16′ 54″	413652087165401	588	2-5	SS	CA	WASTE
S-044	A3	41° 36′ 31″	87° 18′ 20″	413631087182000	590	3-6	SS	CA	IND
S-045	E1	41° 38′ 44″	87° 31′ 04″	413844087310401	582	5-8	SS	CA	COMM
S-046	A2	41° 37′ 06″	87° 18′ 18″	413706087181800	603	34-39	SS	CA	IND
S-047	BH27	41° 41′ 15″	87° 36′ 31″	414115087363101	589	11-21	PVC/SS	CU	RES
S-048	B2	41° 37′ 52″	87° 22′ 35″	413752087223500	608	43-48	SS	CA	IND
S-049	A1	41° 36′ 47″	87° 19′ 19″	413647087191901	604	18-21	SS	CA	IND
S-050	A4	41° 36′ 30″	87° 18′ 21″	413630087182100	603	18-23	SS	CA	IND
S-051	I15	41° 40′ 11″	87° 34′ 30″	414011087343001	590	10-15	PVC	CA	WASTE
S-052	244-125	41° 37′ 32″	87° 10′ 57″	413732087105701	629	115-120	PVC	CS	RES
S-053	244-65	41° 37′ 32″	87° 10′ 57″	413732087105702	629	57-62	PVC	CA	RES
S-054	BH6	41° 43′ 40″	87° 34′ 32″	414340087343291	503	11-21	PVC/SS	BR	RES

S-055	BH4D	41° 44′ 42″	87° 32′ 57″	414442087325702	587	23-33	PVC/SS	BR	RES
S-056	BH4S	41° 44′ 42″	87° 32′ 57″	414442087325701	586	8-13	PVC/SS	CA	RES
S-057	BH24	41° 41′ 13″	87° 32′ 22″	414113087322201	587	6-16	PVC/SS	CA	RES
S-058	IP	41° 41′ 32″	87° 36′ 59″	414132087365901	591	72-77	PVC	BR	RES
S-059	I16	41° 40′ 23″	87° 34′ 30″	414023087343001	588	9-14	PVC	CA	WASTE
S-060	I21	41° 39′ 32″	87° 33′ 38″	413932087333801	590	7-12	PVC	CA	IND
S-061	BH7I	41° 39′ 10″	87° 33′ 58″	413910087335802	589	19-29	PVC/SS	CU	NAT
S-062	BH9S	41° 39′ 29″	87° 31′ 58″	413929087315801	585	13-23	PVC/SS	CA	NAT
S-063	BH15	41° 41′ 20″	87° 30′ 47″	414120087304701	585	10-15	PVC/SS	CA	COMM
S-064	I10	41° 40′ 37″	87° 36′ 07″	414037087360701	586	5-10	PVC	CU	IND
S-065	BH7S	41° 39′ 10″	87° 33′ 58″	413910087335801	588	7-17	PVC/SS	CA	NAT
S-066	BH7D	41° 39′ 10″	87° 33′ 58″	413910087335803	589	69-79	PVC/SS	BR	NAT
S-067	I9	41° 40′ 04″	87° 35′ 52″	414004087355201	586	6-11	PVC	CU	WASTE

S-083	105	41° 37′ 44″	87° 06′ 37″	413744087063702	608	71-76	PVC	CS	IND
S-084	106	41°							

S-111	BH11	41° 39′ 52″	87° 32′ 59″	413952087325901	586	18-28	PVC/SS	CA	NAT
S-112	BH18D	41° 43′ 16″	87° 31′ 31″	414316087313103	593	58-68	PVC/SS	BR	WASTE
S-113	D70	41° 35′ 15″	87° 29′						

[1] One material listed indicates casing and screen are both constructed of that material.

APPENDIX 2

QUALITY-ASSURANCE DATA

Table 3. Water-quality properties and concentrations of common ions in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993

[mg/L, milligram per liter; $CaCO_3$, calcium carbonate; µg/L, microgram per liter; e, estimated; b, constituent also detected in laboratory calibration blanks; <, less than; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Sample name	Acidity, (mg/L as $CaCO_3$) (00435)	Calcium, dissolved (µg/L) (91051)	Magnesium, dissolved (µg/L) (91052)	Sodium, dissolved (µg/L) (91053)	Potassium, dissolved (µg/L) (91054)	Alkalinity (mg/L as $CaCO_3$) (00417)	Sulfate, dissolved (mg/L) (00945)	Chloride, dissolved (mg/L) (00940)	Silica, dissolved (mg/L) (00955)
R-001	MB-1	0e	82.2b	47.1b	<66.2	<188	20.8e	<5e	<0.5	<0.04e
R-002	MB-2	0e	<42.3	55b	511b	<188	2.72e	<5e	<.5	<.04e
R-003	MB-3	0e	<42.3	<46.4	<66.2	<188	20.3e	<5e	<.5	<.04e
R-004	MB-4	0e	65.1b	47.2b	454b	<188	31.7e	<5e	<.5	<.04e
R-005	MB-5	15.4e	93.8b	<46.4	<66.2	<188	4.95e	<5e	<.5e	<.107e
R-009	MB-6	0	<42.3	<46.4	<66.2	<188	1.24e	<5e	<.5e	<.04
R-013	MB-7	0	323b	193b	279b	252b	41.8e	<5e	<.5	<.04

Sample number	Sample name	Dissolved solids (mg/L) (70301)	Suspended solids (mg/L) (70299)	Ammonia (mg/L) (00610)	Iron, dissolved (µg/L) (01046)	Magnesium, dissolved (µg/L) (01056)	Total organic carbon (mg/L) (00680)
R-001	MB-1	<20	<3e	<0.1	<4.8	<1.8	<2e
R-002	MB-2	<20	<3	<.1	27.3b	<1.8	<2e
R-003	MB-3	<20	<3	<.1	11.7b	<1.8	<2e
R-004	MB-4	<20	<3e	<.1	19b	<1.8	<2e
R-005	MB-5	<20	4.5	.3e	<4.8	<1.8	<2e
R-009	MB-6	<20	<3	.2	6.8b	<1.8	<2e
R-013	MB-7	<20	<3	.4e	56.3b	12.2b	<2

Table 4. Concentrations of trace elements and cyanide in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated value; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Sample name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
R-001	MB-1	<23.5	<17.9	<1.7	<2.5	<0.5	<1.7	<5.8	<3.8	<4.2	3.8
R-002	MB-2	<23.5	<17.9	<1.7	2.5e	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
R-003	MB-3	<23.5	<17.9	<1.7	<2.5	<.5	<1.7	<5.8	<3.8	10.8	<1.1
R-004	MB-4	<23.5	<17.9	<1.7	<2.5	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
R-005	MB-5	<23.5	<17.9	<1.7	<2.5	<.5	<1.7	<5.8	<3.8	<4.2	1.9
R-009	MB-6	52.1e	<17.9	2.5	<2.5	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
R-013	MB-7	390	<17.9	<1.7	4e	<.5	<1.7	<5.8	<3.8	<4.2	<1.1

Sample number	Sample name	Mercury, dissolved (µg/L) (71890)	Nickel, dissolved (µg/L) (01065)	Selenium, dissolved (µg/L) (01145)	Silver, dissolved (µg/L) (01075)	Thallium, dissolved (µg/L) (01057)	Vanadium, dissolved (µg/L) (01085)	Zinc, dissolved (µg/L) (01090)	Cyanide, dissolved (µg/L) (00723)
R-001	MB-1	<0.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
R-002	MB-2	<.1e	<6.1	<2.3	<3.8	2.8	<3.3	<3.4	<10
R-003	MB-3	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
R-004	MB-4	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
R-005	MB-5	<.1	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
R-009	MB-6	<.1	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
R-013	MB-7	<.1	<6.1	<2.3	<3.8	1.4	<3.3	<3.4	<10

Table 5. Concentrations of target volatile organic compounds in sampling-device blanks and trip blanks collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated value; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Sample name	Chloro-methane (µg/L) (30201)	Bromo-methane (µg/L) (30202)	Vinyl chloride, total (µg/L) (39175)	Chloro-ethane, total (µg/L) (34311)	Methylene chloride, total (µg/L) (34423)	Acetone, total (µg/L) (81552)	Carbon di-sulfide, total (µg/L) (77041)	1,1-Di-chloro-ethylene, total (µg/L) (34501)	1,1-Di-chloro-ethane, total (µg/L) (34496)	1,2-Di-chloro-ethene, total (µg/L) (45617)	Chloroform, total (µg/L) (32106)
R-001	MB1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-002	MB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-003	MB3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-004	MB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-005	MB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-006	TB1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-007	TB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-008	TB3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-009	MB6	<10	<10	<10	<10	<10	4e	<10	<10	<10	<10	<10
R-010	TB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-011	TB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-012	TB6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-013	MB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-014	TB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-015	TB8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-016	TB9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-017	TB10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-018	TB11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-019	TB12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-020	TB15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 5. Concentrations of target volatile organic compounds in sampling-device blanks and trip blanks collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Sample name	1,2-Di-chloro-ethane (μg/L) (32103)	Methyl-ethyl-ketone, total (μg/L) (81595)	1,1,1-Tri-chloro-ethane, total (μg/L) (34506)	Carbon tetra-chloride, total (μg/L) (32102)	Di-chloro-bromo-methane, total (μg/L) (32101)	1,2-Di-chloro-propane, total (μg/L) (34541)	cis-1,3-Di-chloro-propene, total (μg/L) (34704)	Tri-chloro-ethlyene, total (μg/L) (39180)	Chloro-di-bromo-methane, total (μg/L) (32105)	1,1,2-Tri-chloro-ethane, total (μg/L) (34511)	Benzene, total (μg/L) (34030)
R-001	MB1	<10	5e	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-002	MB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-003	MB3	<10	5e	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-004	MB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-005	MB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-006	TB1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-007	TB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-008	TB3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-009	MB6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-010	TB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-011	TB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-012	TB6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-013	MB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-014	TB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-015	TB8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-016	TB9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-017	TB10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-018	TB11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-019	TB12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-020	TB15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 5. Concentrations of target volatile organic compounds in sampling-device blanks and trip blanks collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Sample name	trans-1,3-Di-chloro-propane, total (µg/L) (34699)	Bromo-form, total (µg/L) (32104)	Methyl-isobutyl ketone, total (µg/L) (78133)	2-Hexa-none, total (µg/L) (77103)	Tetra-chloro-ethylene, total (µg/L) (34475)	1,1,2,2-Tetra-chloro-ethane, total (µg/L) (34516)	Toluene, total (µg/L) (34010)	Chloro-benzene, total (µg/L) (34301)	Ethyl-benzene, total (µg/L) (34371)	Styrene, total (µg/L) (77128)	Xylene, total (µg/L) (81551)
R-001	MB1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-002	MB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-003	MB3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-004	MB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-005	MB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-006	TB1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-007	TB2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-008	TB3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-009	MB6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-010	TB4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-011	TB5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-012	TB9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-013	MB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-014	TB7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-015	TB8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-016	TB9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-017	TB10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-018	TB11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-019	TB12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-020	TB15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6. Concentrations of target semivolatile organic compounds in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Sample name	Phenols, total (µg/L) (32730)	Bis(2-Chloro-ethyl) ether, total (µg/L) (34273)	2-phenol, (µg/L) (34586)	1,3-Di-chloro-benzene (µg/L) (34566)	1,4-Di-chloro-benzene (µg/L) (34571)	o-Chloro-benzene (µg/L) (34536)	Ortho cresol, total (µg/L) (77152)	2-2′-oxybis 1-Chloro-propane (µg/L) (-----)[1]	Para cresol, total (µg/L) (77146)	N-Nitro sodi-N-propyl-amine, total (µg/L) (34428)	Hexa-chloro-ethane, total (µg/L) (34396)	Nitro-benzene, total (µg/L) (34447)	Iso-phorone, total (µg/L) (34408)	Nitro-phenol, total (µg/L) (34591)
R-001	MB01	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-002	MB02	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-003	MB03	2e	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.6e	<10
R-004	MB04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-005	MB05	<10	<10	<10	<10	.5e	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-009	MB06	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R-013	MB07	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Sample number	Sample name	2,4-Di-methyl-phenol, total (µg/L) (34606)	Bis(2-chloro-ethoxy) methane, total (µg/L) (34278)	2,4-Di-chloro-phenol, total (µg/L) (34601)	1,2,4-Tri-chloro-benzene, total (µg/L) (34551)	Naphth-alene, total (µg/L) (34696)	4-Chloro-aniline (µg/L) (30343)	Hexa-chloro-buta-diene (µg/L) (34391)	Para-chloro-meta cresol, total (µg/L) (34452)	2-Methyl naph-thalene, total (µg/L) (30194)	Hexa-chloro-cyclo-pent-adiene, total (µg/L) (34386)	2,4,6-Tri-chloro-phenol, total (µg/L) (34621)	2,4,5-Tri-chloro-phenol, total (µg/L) (77687)	2-Chloro-naph-thalene, total (µg/L) (34581)	2-Nitro-aniline (µg/L) (30195)
R-001	MB01	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-002	MB02	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-003	MB03	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-004	MB04	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-005	MB05	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-009	MB06	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
R-013	MB07	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25

Table 6. Concentrations of target semivolatile organic compounds in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Sample name	Dimethyl phthalate, total (µg/L) (34341)	Acenapthylene, total (µg/L) (34200)	2,6-Dinitrotoluene, total (µg/L) (34626)	3-Nitro niline, total (µg/L) (78300)	Acenaphthene, total (µg/L) (34205)	2,4-Dinitrophenol, total (µg/L) (34616)	4-Nitrophenol, total (µg/L) (34646)	Dibenzofuran, total (µg/L) (81302)	2,4-Dinitrotoluene, total (µg/L) (34611)	Diethyl phthalate, total (µg/L) (34336)	4-Chlorophenyl phenyl ether, total (µg/L) (34641)	Fluorene, total (µg/L) (34381)	4-Nitroaniline (µg/L) (30196)	2-Methyl 4,6-Dinitrophenol (µg/L) (30204)
R-001	MB01	<10	<10	<10	<25	<10	<25	<25	<10	<10	0.5e	<10	<10	<25	<25
R-002	MB02	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
R-003	MB03	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
R-004	MB04	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
R-005	MB05	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
R-009	MB06	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
R-013	MB07	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25

Sample number	Sample name	N-Nitrosodiphenylamine, total (µg/L) (34433)	4-Bromophenyl phenyl ether, total (µg/L) (34636)	Hexachlorobenzene, total (µg/L) (39700)	Pentachlorophenol, total (µg/L) (39032)	Phenanthrene, total (µg/L) (34461)	Anthracene, total (µg/L) (34220)	Carbazole (µg/L) (-----)[1]	Di-N-butyl phthalate, total (µg/L) (39110)	Fluoranthene, total (µg/L) (34376)	Pyrene, total (µg/L) (34469)	N-Butyl benzyl phthalate, total (µg/L) (34292)	3-3′-Dichlorobenzidine, total (µg/L) (34631)	Benzo(a) anthracene, total (µg/L) (34526)

Table 6. Concentrations of target semivolatile organic compounds in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Sample name	Chrysene, total (μg/L)

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[1] No available WATSTORE or STORET parameter code for this compound.

Table 7. Concentrations of compounds containing pesticides or polychlorinated biphenyls in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Sample name	Alpha benzene hexachloride, total (µg/L) (39337)	Beta benzene hexachloride, total (µg/L) (39338)	Delta benzene hexachloride, total (µg/L) (34259)	Lindane, total (µg/L) (39340)	Heptachlor, total (µg/L) (39410)	Aldrin, total (µg/L) (39330)	Heptachlor epoxide, total (µg/L) (39420)	Endosulfan I, total (µg/L) (34361)	Dieldrin, total (µg/L) (39380)	p, p′ DDE, total (µg/L) (39320)
R-001	MB-1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1
R-002	MB-2	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1
R-003	MB-3	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1
R-004	MB-4	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1
R-005	MB-5	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1
R-009	MB-6	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1
R-013	MB-7	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1

Sample number	Sample name	Endrin, total (µg/L) (39390)	Endosulfan II, total (µg/L) (34356)	p, p′ DDD, total (µg/L) (39310)	Endosulfan sulfate, total (µg/L) (82623)	p, p′ DDT, total (µg/L) (39300)	Methoxychlor, total (µg/L) (39480)	Endrin ketone, total (µg/L) (78008)	Endrin aldehyde, total (µg/L) (82622)	Alpha-Chlordane, total (µg/L) (39348)	Gamma-Chlordane, total (µg/L) (39810)

Table 7. Concentrations of compounds containing pesticides or polychlorinated biphenyls in sampling-device blanks collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Sample name	Aroclor 1016 PCB, total (μg/L) (34671)	Aroclor 1221 PCB, total (μg/L) (34988)	Aroclor 1232 PCB, total (μg/L) (39492)	Aroclor 1242 PCB, total (μg/L) (39496)	Aroclor 1248 PCB, total (μg/L) (39500)	Aroclor 1254

Table 8. Water-quality properties and concentrations of common ions in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993

Sample number	Sample name	Silica, dissolved (mg/L) (00955)	Dissolved solids (mg/L) (70301)	Suspended solids (mg/L) (70299)	Ammonia (mg/L as N) (00610)	Iron, dissolved (µg/L) (01046)	Manganese, dissolved (µg/L) (01056)	Total organic carbon (mg/L) (00680)
S-001	E10	20.5e	523	18.5e	1.94	3,480	631	9.1e
D-001	E10	19.3e	542	9.5e	1.93	3,440	622	9.4e
S-011	BH8	25.9e	322	6.5e	4.2e	1,710	86.5	3.7e
D-011	BH8	25.4e	306	3.0e	4.88	1,610	85.3	5.5e
S-021	225	11.2e	172	8.5e	.30e	1,430	311	5.7e
D-021	225	10.6e	181	6.5e	.30e	1,410	306	6.4e
S-031	BH31	10.1e	776	6.5e	2.7e	883	<1.8	8.6e
D-031	BH31	9.48e	782	6.5e	3.0e	910	<1.8	9.3e
S-036	BH31	10.8e	704	27.5	3.5e	846	<1.8	7.9e
S-041	235-45	18.4	224	<3.0	.30e	2,030	86.7	6.9e
D-041	235-45	--	--	--	--	2,050	86.0	--
S-051	I15	--	--	--	--	25,600	462	--
D-051	I15	22.7	2,380	93.0	<.10	25,900	478	61.9
S-071	BH28	21.8	1,654	12.75	.30e	3,600	485	4.0e
D-071	BH28	22.5	1,681	12.5	.50e	3,250	468	3.6e
S-081	BH23	11.8	652	5.0	<.10e	1,360	361	<2.0e
D-081	BH23	13.1	660	8.5	<.10	717	367	2.7e
S-082	232-45	18.6	367	14.0	.60e	6,160		
D-082	232-45	19.1e	359	14.0	.8e			

Table 9. Concentrations of trace elements and cyanide in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated value; --, no data; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
S-001	E-10	<23.5	<17.9	<1.7	47.1	<0.5	<1.7	<5.8	<3.8	<4.2	<1.1
D-001	E-10	<23.5	<17.9	<1.7	49.6	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-011	BH-8	<23.5	<17.9	22.6	128	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
D-011	BH-8	<23.5	<17.9	22.6	126	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-021	225	<23.5	<17.9	1.9	16.1	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
D-021	225	<23.5	<17.9	2.5	16.1	<.5	<1.7	<5.8	<3.8	<4.2	3.1
S-031	BH-31	508	<17.9	1.8	134	<.5	<1.7	<5.8	<3.8	<4.2	1.5
D-031	BH-31	525	<17.9	3.7	137	<.5	<1.7	<5.8	<3.8	<4.2	<1.1

Table 9. Concentrations of trace elements and cyanide in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Mercury, dissolved (µg/L) (71890)	Nickel, dissolved (µg/L) (01065)	Selenium, dissolved (µg/L) (01145)	Silver, dissolved (µg/L) (01075)	Thallium, dissolved (µg/L) (01057)	Vanadium, dissolved (µg/L) (01085)	Zinc, dissolved (µg/L) (01090)	Cyanide, dissolved (µg/L) (00723)
S-001	E-10	0.15e	<6.1	<2.3	<3.8	2.3e	3.7	<3.4	<10
D-001	E-10	<.1e	<6.1	<2.3	<3.8	2.0e	<3.3	<3.4	<10
S-011	BH-8	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
D-011	BH-8	<.1e	<6.1	<2.3	<3.8	<1.1	3.8	<3.4	<10
S-021	225	.12e	<6.1	<2.3	<3.8	<1.1	<3.3	3.5e	<10
D-021	225	<.1e	<6.1	<2.3	<3.8	2.8e	<3.3	5.3e	<10
S-031	BH-31	.54e	<6.1	3.8	<3.8	<1.1	12.4	<3.4	<10
D-031	BH-31	.28e	<6.1	3.7	<3.8	2.7e	13	<3.4	<10
S-036	BH-31	.2e	<6.1	4.9	<3.8	2.1e	14	<3.4	<10
S-041	235-45	<.1	<6.1	<2.3	<3.8	2.2e	<3.3	<3.4	<10
D-041	235-45	<.1	<6.1	<2.3	<3.8	2.2e	<3.3	<3.4	<10
S-051	I15	<.1	<4.7	<3.5	<5	--	8.1	3.8	21.9e
D-051	I15	.13	<4.7	<3.5	<5	--	7.7	<3.7	21.8e
S-071	BH-28	<.1	12	<3.7e	<5	--	<2.6	<3.7	<10e
D-071	BH-28	<.1	14.5	<3.7e	<5	--	<2.6	<3.7	<10e
S-081	BH-23	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
D-081	BH-23	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-082	232-45	.11	<4.7	<2.3	<5	2.5e	<2.6	<3.7	<10
D-082	232-45	.13	<4.7	<2.3	<5	1.2e	<2.6	<3.7	<10
S-091	BH-18S	<.1	<4.7	3.4e	<5	<1.1	52.7	<3.7	14
D-091	BH-18S	.22e	<4.7	<2.3	<5	<1.1	51.6	<3.7	15.5
S-101	MW-1	.18e	<4.7	<2.3	<5	1.1	<2.6	<3.7	<10
D-101	MW-1	.45e	<4.7	<2.3	<5	<1.1	3	<3.7	<10
S-111	BH-11	.12e	<4.7	4	<5	<1.1	<2.6	40.2	<10
D-111	BH-11	.13e	<4.7	4.4	<5	1.4	<2.6	25.6	<10
S-121	WS7	.14e	<4.7	<2.3	<5	2.1	<2.6	<3.7	<10
D-121	WS7	.13e	<4.7	<2.3	<5	2	<2.6	<3.7	<10

Table 10. Concentrations of target volatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated value; --, no data; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Chloro-methane (µg/L) (30201)	Bromo-methane (µg/L) (30202)	Vinyl chloride, total (µg/L) (39175)	Chloro-ethane, total (µg/L) (34311)	Methylene chloride, total (µg/L) (34423)	Acetone, total (µg/L) (81552)	Carbon, di-sulfide, total (µg/L) (77041)	1,1-Di-chloro-ethylene, total (µg/L) (34501)	1,1-Di-chloro-ethane, total (µg/L) (34496)	1,2-Di-chloro-ethene (µg/L) (45617)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-031	BH31	<10	<10	<10	<10	<10	19	<10	<10	<10	<10
D-031	BH31	<10	<10	<10	<10	<10	8e	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	19	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-051	I15	--	--	--	--	--	--	--	--	--	--
S-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 10. Concentrations of target volatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Chloroform, total (µg/L) (32106)	1,2-Di-chloro-ethane (µg/L) (32103)	Methyl-ethyl-ketone, total (µg/L) (81595)	1,1,1-Tri-chloro-ethane, total (µg/L) (34506)	Carbon tetra-chloride, total (µg/L) (32102))	Di-chloro-bromo-methane, total (µg/L) (32101)	1,2-Di-chloro-propane, total (µg/L) (34541)	cis-1,3-Di-chloro-propene, total (µg/L) (34704)	Tri-chloro-ethlyene, total (µg/L) (39180)	Chloro-di-bromo-methane, total (µg/L) (32105)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-031	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-031	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 10. Concentrations of target volatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,2-Trichloroethane, total (µg/L) (34511)	Benzene, total (µg/L) (34030)	trans-1,3-Dichloropropane, total (µg/L) (34699)	Bromoform, total (µg/L) (32104)	Methyl isobutyl ketone, total (µg/L) (78133)	2-Hexanone, total (µg/L) (77103)	Tetrachloroethylene, total (µg/L) (34475)	1,1,2,2-Tetrachloroethane, (µg/L) (34516)	Toluene, total (µg/L) (34010)	Chlorobenzene, total (µg/L) (34301)

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Phenols, total (µg/L) (32730)

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Iso-phorone, total (µg/L) (34408)	2-Nitro-phenol, total (µg/L) (34591)	2,4-Di-methyl-phenol, total (µg/L) (34606)	Bis(2-chloro-ethoxy) methane, total (µg/L) (34278)	2,4-Di-chloro-phenol, total (µg/L) (34601)	1,2,4-Tri-chloro-benzene (µg/L) (34551)	Naph-thalene, total (µg/L) (34696)	4-Chloro-aniline (µg/L) (30343)	Hexa-chloro-butadiene (µg/L) (34391)	Para-chloro-meta cresol, total (µg/L) (34452)	2-Methyl naph-thalene (µg/L) (30194)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-031	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-031	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Hexachlorocyclopentadiene, total (µg/L) (34386)	2,4,6-Trichlorophenol, total (µg/L) (34621)	2,4,5-Trichlorophenol, total (µg/L) (77687)	2-Chloro-

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	4-Nitrophenol, total (μg/L) (34646)	Di-benzofuran, total (μg/L) (81302)	2,4-Dinitrotoluene, total (μg/L) (34611)	Diethyl phthalate, total (μg/L) (34336)	4-Chlorophenyl phenyl ether, total (μg/L) (34641)	Fluorene, total (μg/L) (34381)	4-Nitroaniline (μg/L) (30196)	2-Methyl 4,6-Dinitrophenol (μg/L) (30204)	N-Nitrosodiphenylamine, total (μg/L) (34433)	4-Bromophenyl phenyl ether, total (μg/L) (34636)	Hexachlorobenzene, total (μg/L) (39700)	Pentachlorophenol, total (μg/L) (39032)
S-001	E10	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
D-001	E10	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
S-011	BH8	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
D-011	BH8	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
S-021	225	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
D-021	225	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
S-031	BH31	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
D-031	BH31	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
S-036	BH31	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25
S-041	235-45	<25	<10	<10	<10	<10	<10	<25	<25	<10	<10	<10	<25

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Phenanthrene, total (µg/L) (34461)	Anthracene, total (µg/L) (34220)	Carbazole (µg/L) (-------)[1]	Di-N-butyl phthalate, total (µg/L) (39110)	Fluoranthene, total (µg/L) (34376)	Pyrene, total (µg/L) (34469)	N-Butyl benzyl phthalate, total (µg/L) (34292)	3,3-Dichlorobenzidine, total (µg/L) (34631)	Benzo(a) anthracene, total (µg/L) (34526)	Chrysene, total (µg/L) (34320)	Bis(2-ethylhexyl) phthalate, total (µg/L) (39100)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10e
D-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.5e
S-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-031	BH31	<10	<10	<10	<10	.5e	<10	<10	<10	<10	<10	.8e
D-031	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.6e
S-036	BH31	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	3e
D-041	235-45	<10	<10	<10	1e	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2e
D-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-081	BH23	.6e	<10	<10	<10	<10	<10	<10	<10	<10	<10	3e
D-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.9e
D-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
D-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 11. Concentrations of target semivolatile organic compounds in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	**Well**

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[1] No available WATSTORE or STORET parameter code for this compound.

Table 12. Concentrations of compounds containing pesticides or polychlorinated biphenyls in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; p, more than 25 percent difference between the two gas chromatograph columns used for analysis, lower value is reported; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Alpha benzene hexa-chloride, total (µg/L) (39337)	Beta benzene hexa-chloride, total (µg/L) (39338)	Delta benzene hexa-chloride, total (µg/L) (34259)	Lindane, total (µg/L) (39340)	Hepta-chlor, total (µg/L) (39410)	Aldrin, total (µg/L) (39330)	Hepta-chlor epoxide, total (µg/L) (39420)	Endo-sulfan I,

Table 12. Concentrations of compounds containing pesticides or polychlorinated biphenyls in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	p,p′ DDE, total (μg/L) (39320)	Endrin, total (μg/L) (39390)	Endosulfan II, total (μg/L) (34356)	p,p′ DDD, total (μg/L) (39310)	Endosulfan sulfate, total (μg/L) (82623)	p,p′ DDT, total (μg/L) (39300)	Methoxychlor, total (μg/L) (39480)	Endrin ketone, total (μg/L) (78008)

Table 12. Concentrations of compounds containing pesticides or polychlorinated biphenyls in duplicate samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Alpha-Chlordane, total (μg/L)

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APPENDIX 3

WATER-QUALITY DATA

Table 14. Date and time of sample and onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993

[°C, degree Celsius; mv, millivolt; mg/L, milligram per liter; µS/cm, microsiemens per centimeter at 25°C; --, not measured; time is in military notation; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Date	Time	Temperature (°C) (00010)	pH (units) (00400)	Eh (mv) (00090)	Dissolved oxygen (mg/L) (00300)	Specific conductance (µS/cm) (00094)	Water-surface altitude
S-001	E10	6/14	1300	13.6	6.9	-64	--	943	583.2
S-002	BH21	6/14	1530	15.8	6.8	-38	0.8	1,560	--
S-003	230-58	6/15	1515	12.8	7.2	-111	.2	1,220	595.6
S-004	E20	6/14	1520	13.4	6.8	-50	--	721	--
S-005	234-142	6/14	1830	13.9	7.8	-164	.3	719	604.0
S-006	D40	6/14	1705	12.1	6.2	-85	.3	842	583.7
S-007	WP1	6/15	0923	13.9	7.4	-.02	--	432	--
S-008	I C	6/15	1112	16.2	8.0	-169	1.5	500	--
S-009	G-1	6/16	1035	14.4	7.5	-167	.1	164	604.9
S-010	230-128	6/15	1632	12.8	7.8	-171	.2	1,740	595.6
S-011	BH8	6/15	0920	11.9	7.5	-259	.6	537	--
S-012	BH22	6/15	1110	10.9	7.0	-265	.6	1,620	--
S-013	BH33	6/15	1225	12.8	7.2	-227	.4	1,150	--
S-014	E2	6/15	0920	12.2	--	136	4.6	702	583.5
S-015	D1	6/15	1325	13.2	--	-134	4.2	538	583.7
S-016	WP2	6/15	1010	10.5	7.8	-65	--	828	--
S-017	230-24	6/15	1544	12.2	6.0	89	.8	354	598.0
S-018	D11	6/15	1145	12.4	--	-118	.1	3,480	584.7

Table 14. Date and time of sample and onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well

Table 14. Date and time of sample and onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Date	Time	Temperature (°C) (00010)	pH (units) (00400)	Eh (mv) (00090)	Dissolved oxygen (mg/L) (00300)	Specific conductance (µS/cm) (00094)	Water-surface altitude
S-054	BH6	6/17	1025	18.6	6.9	-174	1.6	744	--
S-055	BH4D	6/17	1232	16.3	6.7	-152	1.6	919	--
S-056	BH4S	6/17	1315	16.0	7.0	-18	.5	873	--
S-057	BH24	6/17	1455	13.4	7.0	15	1.9	1,880	--
S-058	IP	6/16	1342	14.1	8.0	80	.5	330	--
S-059	I16	6/16	1542	16.6	7.4	-56	.4	2,330	--
S-060	I21	6/18	0934	13.9	7.5	80	--	700	--
S-061	BH7I	6/21	1350	15.2	7.0	-34	.6	1,380	--
S-062	BH9S	6/18	0920	12.4	7.0	-108	.9	1,620	--
S-063	BH15[a]	6/18	0930	12.9	7.3	-127	2.0	430	583.4
S-064	I10	6/21	1242	14.8	9.0	-170	1.4	2,070	--
S-065	BH7S	6/21	1318	12.7	6.8	-125	1.0	2,390	--
S-066	BH7D	6/21	1635	17.1	8.0	-180	.7	449	--
S-067	I9	6/21	1347	13.4	7.2	-66	2.6	5,980	--
S-068	I8	6/22	1100	17.2	7.5	-49	4.2	5,720	--
S-069	B7	6/21	1345	13.8	7.3	-17	9.1	452	589.5
S-070	B5	6/21	1450	12.3	7.3	-172	.2	2,250	586.3
S-071	BH28	6/21	1900	15.7	6.8	-41	1.6	2,090	--
S-072	D67	6/21	1422	17.4	6.4	117	1.8	260	588.5
S-073	D68	6/21	1501	11.9	7.4	-173	.1	524	587.6
S-074	C19	6/21	1613	14.1	6.5	-90	.3	507	590.4
S-075	C25	6/22	0920	16.4	6.4	-32	.3	246	598.1
S-076	C18	6/22	1035	13.4	6.9	-84	.1	1,370	593.8
S-077	B10	6/22	1128	11.7	8.0	36	6.1	260	595.8
S-078	B3	6/22	1325	12.8	6.3	-179	.2	397	585.8
S-079	A20	6/22	1430	17.8	5.3	-89	.3	1,410	596.6
S-080	W-3[a]	6/22	0954	19.0	6.3	-26	--	247	607.8

Table 14. Date and time of sample and onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Date	Time	Temperature (°C) (00010)	pH (units) (00400)	Eh (mv) (00090)	Dissolved oxygen (mg/L) (00300)	Specific conductance (µS/cm) (00094)	Water-surface altitude
S-081	BH23	6/22	1245	13.3	6.8	16	3.1	1,050	--
S-082	232-45	6/22	1150	12.1	7.1	-156	.0	542	587.1
S-083	105	6/22	1442	11.2	7.7	-198	.0	793	606.6
S-084	106	6/22	1529	10.3	7.4	52	6.1	1,190	606.3
S-085	E3	6/22	1708	11.9	7.9	-183	.2	469	583.7
S-086	I3	6/22	1520	15.0	7.9	126	.6	580	--
S-087	I22	6/22	1355	14.9	7.3	133	1.1	106	--
S-088	B8	6/21	1305	12.4	7.0	-149	.1	1,050	589.5
S-089	BH1D	6/22	1015	18.0	12.1	-264	2.2	3,380	--
S-090	BH1S	6/22	1115	17.2	6.8	83	3.8	1,520	--
S-091	BH18S	6/23	1045	14.2	9.4	134	1.2	1,100	--
S-092	BH2	6/22	1550	14.4	6.6	-6	3.5	3,050	--
S-093	BH25	6/22	1715	15.4	6.8	-6	1.6	610	--
S-094	BH14	6/23	0842	13.0	--	41	.8	714	605.1
S-095	BH19	6/23	0950	14.1	6.9	107	.8	937	592.2
S-096	BH13	6/23	1051	14.1	7.0	27	.5	2,110	--
S-097	BH12	6/23	1220	15.1	7.3	107	4.6	604	590.4
S-098	BH20	6/23	1418	13.8	7.3	-18	2.1	939	588.5
S-099	BH17	6/23	1540	14.8	7.3	7	1.9	900	589.5
S-100	D45	6/23	0838	12.1	7.1	31	.4	645	582.6
S-101	MW-1	6/24	1522	14.6	7.3	-164	.1	818	582.0
S-102	I2	6/22	1810	14.9	9.7	94	1.1	761	--
S-103	BH5S	6/23	1507	14.4	7.0	117	1.2	261	--
S-104	C3	6/23	1213	11.7	7.3	-172	.1	982	582.5
S-105	C4	6/23	1241	13.4	7.4	-46	6.3	201	582.5
S-106	C1	6/23	1320	16.0	7.5	-78	1.8	186	585.0
S-107	E5	6/23	1456	15.8	6.9	-60	.3	1,300	582.8

Table 14. Date and time of sample and onsite measurements of selected properties of ground water in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Date	Time	Temperature (°C) (00010)	pH (units) (00400)	Eh (mv) (00090)	Dissolved oxygen (mg/L) (00300)	Specific conductance (µS/cm) (00094)	Water-surface altitude
S-108	BH5D	6/23	1130	--	--	--	--	--	--
S-109	BH18I	6/23	1238	15.9	8.7	79	1.2	192	--
S-110	BH32	6/23	1815	15.0	8.4	124	.8	2,020	--
S-111	BH11	6/23	1005	14.1	7.1	82	1.1	723	--
S-112	BH18D	6/23	1215	16.2	9.1	87	.5	290	--
S-113	D70	6/23	1609	18.3	6.8	7	.3	367	601.3

[a] Sample bailed.

Sample number	Well name	Acidity, (mg/L as $CaCO_3$) (00435)	Calcium, dissolved (μg/L) (91051)	Magnesium, dissolved (μg/L) (91052)	Sodium, dissolved (μg/L) (91053)	Potassium, dissolved (μg/L) (91054)	Alkalinity (mg/L as $CaCO_3$

Table 16. Water-quality properties and concentrations of common ions in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Acidity, (mg/L as $CaCO_3$) (00435)	Calcium, dis-solved (µg/L) (91051)	Magne-sium, dis-solved (µg/L) (91052)	Sodium, dis-solved (µg/L) (91053)	Potas-sium, dis-solved (µg/L) (91054)	Alka-linity (mg/L as $CaCO_3$) (00417)	Sulfate, dis-solved (mg/L) (00945)	Chloride, dis-solved (mg/L) (00940)	Silica, dis-solved (mg/L) (00955)	Dis-solved solids (mg/L) (70301)	Sus-pended solids (mg/L) (70299)	Ammonia, (mg/L as N) (00610)	Iron, dis-solved (µg/L) (01046)	Manga-nese, dis-solved (µg/L) (01056)	Total organic carbon (mg/L) (00680)
S-025	E7	0e	122,000	179	83,000	10,800	146e	192e	81.1e	15.2e	589	114	1.20e	13.9	3.2	6.4e
S-026	24	0	60,000	26,400	30,100	2,650	145e	51e	82.7	12.4	355	15.5	.30e	5,550	226	2.9e
S-027	25	0	54,200	20,500	11,300	871	216e	<5e	12.2	29.7	262	<3.0	1.10e	2,560	137	11.6
S-028	W-1A	0e	12,700	5,030	1,140	515	53.5e	89e	12.3e	12.2e	95	<3.0	.90	5,260	1,230	16.3
S-029	BH30	0	123,000	59,700	24,600	5,010	231e	186e	16.1e	24.0	678	38.5	--	196	377	3.5e
S-030	IT	0	9,180	5,000	85,600	3,070	164e	<5e	36.5e	10.1	257	158	.1e	37.3	4.9	5.0e
S-032	I1	0e	368,000	143,000	1,080,000	12,500	706e	38e	2,008e	29.8e	5,030	234e	10.2e	58,400	2,460	51.0e
S-033	I13	0	36,300	31,500	1,240,000	135,000	694e	154e	2,044e	19.9	3,868	47.5	77.9	288	77.2	115
S-034	I12	0	192,000	211,000	645,000	25,100	662e	1,160e	514e	21.8	3,392	58.0	1.5	995	176	35.0
S-035	I14	0	565,000	241,000	321,000	38,400	527e	2,070e	806e	30.8	4,390e	194	--	26,400	1,770	38.1e
S-036	BH31	0e	163,000	<46	56,000	76,500	284e	100e	34.1e	10.8e	704	27.5	3.5e	846	<1.8	7.9e
S-037	D25	0	435,000	24,600	90,400	102,000	217e	1,220e	152e	25.3	2,144e	214	--	20,600	1,250	24.4e
S-038	BH29	0	470,000	221,000	35,700	7,830	480e	1,520e	32.4e	25.0	2,268e	20.5	--	34.8	1,750	9.8e
S-039	BH26	0	198,000	84,800	51,400	7,580	237e	742e	58.6e	26.5	1,299	37.5	.30	45.6	589	4.7e
S-040	237-45	0	196,000	45,300	253,000	3,850	257e	130e	894e	24.4	1,664	35.5	2.10e	2,120	930	4.0e
S-041	235-45	0	53,700	8,940	4,260	555	163e	27.3e	4.6	18.4	224	<3.0	.30e	2,030	86.7	6.9e
S-042	MW-5	0	27,000	14,400	1,110e	592	95.5e	20e	1.4	10.5	139	<3.0	<.10	72.0	749	4.8e
S-043	MW-15	0	48,500	20,000	3,390e	879	115e	78e	6.7	11.6	256	<3.0	.10e	4,520	630	10.1
S-044	A3	0	162,000	68,400	136,000	5,870	344e	560e	145	27	1,186	30.5	90.3	1,430	1,540	14.0
S-045	E1	0	76,700	17,100	18,600	1,690	197e	400e	16.5	11.1	306	<3.0	<.10	726	437	6.4e
S-046	A2	0	123,000	23,300	19,800	4,560	149e	<5e	28.4	14.3	547	4.5	<.10	2,710	400	4.7e
S-047	BH27	0	218,000	107,000	48,700	6,350	304e	776e	18.3	19.0	1,367	10.0	<.10	34.0	609	3.3e
S-048	B2	0	404,000	123	75,200	161,000	400e	470e	377e	3.2	1,930	267	4.00	13.5	4.3	15.1

Sample number	Well name	Acidity, (mg/L as $CaCO_3$) (00435)	Calcium, dissolved (µg/L) (91051)	Magnesium, dissolved (µg/L) (91052)	Sodium, dissolved (µg/L) (91053)	Potassium, dissolved (µg/L) (91054)	Alka-

S-079	A20	0e	61,500	15,800	186,000	4,830	207e	40e	203	9.2	796	<3.0	.020e	23.9	153	<2.0

Table 16. Water-quality properties and concentrations of common ions in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Acidity, (mg/L as $CaCO_3$) (00435)	Calcium, dissolved (µg/L) (91051)	Magnesium, dissolved (µg/L) (91052)	Sodium, dissolved (µg/L) (91053)	Potassium, dissolved (µg/L) (91054)	Alkalinity (mg/L as $CaCO_3$) (00417)	Sulfate, dissolved (mg/L) (00945)	Chloride, dissolved (mg/L) (00940)	Silica, dissolved (mg/L) (00955)	Dissolved solids (mg/L) (70301)	Suspended solids (mg/L) (70299)	Ammonia (mg/L as N) (00610)	Iron, dissolved (µg/L) (01046)	Manganese, dissolved (µg/L) (01056)	Total organic carbon (mg/L) (00680)
S-107	E5	0	201,000	36,200	36,700	7,450	296	390	20.4	16.3	985	8.5	.30e	1,530	1,210	5.0e
S-108	BH5D	0	164,000	61,900	136,000	6,180	338e	154	375e	27.2	1,250	920e	1.2	2,680	199	19.2e
S-109	BH18I	0e	37,100	4,900	33,300	3,460	81.6e	66e	13.9	13.1	259	44.0	.5e	101	79.1	4.4e
S-110	BH32	0	57,400	120,000	125,000	57,200	657e	396	119e	23.1	1,290	229	44.3	275	115	209e
S-111	BH11	0	109,000	16,400	5,870	2,130	255e	54	9.16e	19.7	428	13.5e	.3e	1,990	486	5.3e
S-112	BH18D	0	10,400	4,040	66,300	4,090	267e	54	27.4e	12.0	305	5,312e	.6	67.2e	3.0	82.9e
S-113	D70	0	45,100	11,300	6,820	2,300	121	33	14.8	6.6e	236	87.5	.14e	160	10.4	7.1e
S-114	BH16D	0	17,100	7,100	63,600	3,480	165	<5	38.9	11.3	270	392	.30	132	6.8	6.2
S-115	BH16S	0	158,000	49,200	43,200	2,470	304	240	29.4	18.6	885	6.5	.20	40.0e	48.8	6.7
S-116	D75	0	64,800	19,500	4,570	594	203	36	2.9	11.6e	333	46.0	.20e	319	177	3.7e
S-117	C12	0	16,900	19,100	40,600	4,020	221e	340	65.7e	17.8	886	28.0e	2.20	10,200	1,590	8.7e
S-118	LK13	0	144,000	27,800	5,410	459	306e	180	18.1e	22	705	32.0e	.80	10,700	313	21.1
S-119	I20	0	437,000	118,000	345,000	31,300	603e	850	389e	--	2,310	1,754e	2.2	51,800	1,910	117.9
S-120	WS9	0	172,000	44,900	120,000	11,500	185e	170	211e	19.3	610	27.0e	1.0	411	661	18.9e
S-121	WS7	0	514,000	22,800	16,900	61,400	74.6e	1,570	8.43e	51.8	2,310	5.0e	.37e	1,130	99.0	2.25e
S-122	WS2	0	134,000	26,600	21,800	24,900	205e	226	11.8e	49.2	673	5.5e	.3e	20.6e	6.3	8.9e
S-123	FILO1	0	9,860	3,970	94,800	2,080	195e	40	29.9e	--	311	780e	.4e	107e	10.0e	15.9e
S-124	WS5	0	166,000	51,700	66,700	22,900	548e	160	14.4e	29.7	981	28.5e	2.6	4,800	2,060	77.5e
S-125	FILO4	0	513,000	322,000	173,000	14,900	661e	1,930	168e	--	3,816	454e	2.7	14,800	640	73.7e
S-126	FILO5	0	320,000	265,000	279,000	8,140	814e	970	145e	--	3,100	646e	.9	400	335	34.5e
S-127	FILO2	0	528,000	794,000	248,000	32,700	1,260e	3,850	188e	--	6,370	64.5e	96	16,400	764	122.8e
S-128	FILO6	--	5,580	5,060	293,000	4,760	--	--	--	--	--	--	<.30e	39.0e	3.5e	14.0e
S-129	C2	0	189,000	58	37,000	60,800	147e	340e	60.6e	9.8	829	<3.0	1.00e	<15.5	2.0e	13.4e

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; --, no data; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic,

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

Sample number	Well name	Mercury, dissolved (μg/L) (71890)	Nickel, dissolved (μg/L) (01065)	Selenium, dissolved (μg/L) (01145)	Silver, dissolved (μg/L) (01075)	Thallium, dissolved (μg/L) (01057)	Vanadium, dissolved (μg/L) (01085)	Zinc, dissolved (μg/L) (01090)	Cyanide, dissolved (μg/L) (00723)
S-001	E-10	0.15e	<6.1	<2.3	<3.8	2.3e	3.7	<3.4	<10
S-002	BH-21	<.1e	41.3	<2.3	<3.8	2.3e	3.8	<3.4	<10
S-003	230-58	.15e	<6.1	<2.3	<3.8	1.4e	<3.3	4e	<10
S-004	E-20	<.1e	<6.1	<2.3	<3.8	2.4e	<3.3	<3.4	<10
S-005	234-142	<.1e	<6.1	<2.3	<3.8	2.3e	<3.3	<3.4	<10
S-006	D-40	<.1e	<6.1	<2.3	<3.8	1.2e	5.8	<3.4	<10
S-007	WP1	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
S-008	IC	.14e	<6.1	<2.3	<3.8	1.5e	<3.3	<3.4	26.2
S-009	G-1	<.1e	<6.1	<2.3	<3.8	3.8e	<3.3	<3.4	<10
S-010	230-128	.1e	<6.1	<2.3	<3.8	2.6e	<3.3	9.4e	<10
S-011	BH-8	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
S-012	BH-22	<.1e	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
S-013	BH-33	<.1e	<6.1	<2.3	<3.8	2.6e	3.4	5.2	212
S-014	E-2	<.1e	12.6	5.6	<3.8	2.3e	<3.3	<3.4	<10
S-015	D-1	<.1e	15	<2.3	<3.8	<1.1	<3.3	<3.4	<10
S-016	WP2	<.1e	<6.1	<2.3	<3.8	1.5e	3.9	<3.4	13.3
S-017	230-24	.1e	<6.1	<2.3	<3.8	1.9e	<3.3	600[a]	<10
S-018	D-11	<.1e	<6.1	<2.3	<3.8	2.2e	<3.3	<3.4	<10
S-019	D-10	.11e	<6.1	<2.3	<3.8	1.9e	9.1	<3.4	<10
S-020	D-5A	.13e	<6.1	2.4	<3.8	1.4e	<3.3	630[a]	<10

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
S-028	W-1A	353	<15.7	<2.7	16.5	<1.2	<1.5	<5.1	<2.5	<4	4.6
S-029	BH-30	1,200	<17.9	<1.7	217	<.5	<1.7	<5.8	<3.8	12.7	1.2
S-030	IT	56.6	<17.9	<1.7	10.7	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-032	I1	33.4	<17.9	10.8	690	<.5	<1.7	<5.8	19.7	<4.2	<1.1
S-033	I13	56.7	<17.9	7.9	38.8	<.5	<1.7	36.1	6.7	<4.2	<1.1
S-034	I12	<23.5	<17.9	6.1	65.6	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-035	I14	52.6	<17.9	127	137	<.5	<1.7	<5.8	<3.8	<4.2	1.5
S-036	BH-31	446	<17.9	2.1	129	<.5	<1.7	<5.8	<3.8	<4.2	1.4
S-037	D-25	46.7	<17.9	18.6	31.6	<.5	<1.7	<5.8	6.1	<4.2	<1.1
S-038	BH-29	53.7	<17.9	<1.7	68.5	<.5	<1.7	<5.8	<3.8	14.2	<1.1
S-039	BH-26	62.8	<17.9	<1.7	332	<.5	<1.7	<5.8	<3.8	10.5	<1.1
S-040	237-45	<20.9	<15.7	<2.7	111	<1.2	<1.5	<5.1	<2.5	<4	1.5
S-041	235-45	74.9	<17.9	8.7	35.6	.77	<1.7	<5.8	<3.8	<4.2	1.6

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Mercury, dissolved (µg/L) (71890)	Nickel, dissolved (µg/L) (01065)	Selenium, dissolved (µg/L) (01145)	Silver, dissolved (µg/L) (01075)	Thallium, dissolved (µg/L) (01057)	Vanadium, dissolved (µg/L) (01085)	Zinc, dissolved (µg/L) (01090)	Cyanide, dissolved (µg/L) (00723)
S-028	W-1A	0.16	<4.7	<3.5e	<5	--	5	4.1	<10e
S-029	BH-30	<.1	<6.1	<2.3	<3.8	2.8	<3.3	20.2	<10
S-030	IT	<.1e	<6.1	<2.3	<3.8	2.8e	<3.3	4.1e	<10
S-032	I1	.32e	<6.1	4.1	<3.8	2.7e	5.2	20.5	<10
S-033	I13	.22e	11.4	2.8	<3.8	3.6e	32.3	10.7e	<10
S-034	I12	.11e	<6.1	<2.3	<3.8	3.6e	<3.3	40.8	<10
S-035	I14	<.1	<6.1	<2.3	<3.8	4.9e	4.2	<3.4	<10
S-036	BH-31	.2e	<6.1	4.9	<3.8	2.1e	14	<3.4	<10
S-037	D-25	<.1	<6.1	<2.3	<3.8	2.3e	4.1	<3.4	14.2
S-038	BH-29	<.1	11.5	<2.3	<3.8	2.5e	<3.3	16.2	<10
S-039	BH-26	<.1	6.9	4.0	<3.8	6e	<3.3	12.9	<10
S-040	237-45	.13	<4.7	<3.5	<5	--	<2.6	4.2	<10e
S-041	235-45	<.1	<6.1	<2.3	<3.8	2.2e	<3.3	<3.4	<10
S-042	MW-5	.14e	<4.7	<3.7	<5	<1.4e	<2.6	<3.7	<10
S-043	MW-15	.15e	<4.7	<3.7	<5	<1.4e	<2.6	8.7	<10
S-044	A-3	<.1	<6.1	<2.3	<3.8	1.2e	<3.3	<3.4	31.4
S-045	E-1	<.1	<4.7	<3.5e	<5	--	<2.6	<3.7	<10e
S-046	A-2	<.1	<6.1	<2.3	<3.8	1.3e	<3.3	<3.4	<10
S-047	BH-27	<.1	<4.7	<3.5	<5.	--	3	14.8	<10e
S-048	B-2	1.1	<6.1	13.3	<3.8	4e	3.6	<3.4	<10
S-049	A-1	<.1	148	14.3	<3.8	1.6e	<3.3	<3.4	12
S-050	A-4	<.1	<6.1	<2.3	<3.8	<1.1	<3.3	<3.4	<10
S-051	I15	<.1	<4.7	<3.5	<5	--	8.1	3.8	21.9e
S-052	244-125	.15e	<4.7	<3.7e	<5	<7e	<2.6	14.1	<10
S-053	244-65	.19e	<4.7	<3.7e	<5	<1.4e	<2.6	<3.7	<10
S-054	BH-6	.12	<4.7	<3.5e	<5	--	<2.6	17.2	<10e
S-055	BH-4D	<.1	<4.7	<3.5e	<5	--	<2.6	<6.2	<10e
S-056	BH-4S	.14e	9.2	<3.7	<5	<7e	3.1	5.5	<10

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
S-057	BH-24	<20.9	<15.7	<2.7	55.5	<1.2	<1.5	<5.1	<2.5	<4	2.8
S-058	IP	<20.9	<15.7	<2.7	11.9	<1.2	<1.5	<5.1	<2.5	<4	4.2
S-059	I16	<20.9	<15.7	73	55.5	<1.2	<1.5	<5.1	<2.5	<4	2.2
S-060	I21	33.8	<17.9	5.1	56.6	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-061	BH-7I	<20.9	<15.7	<2.7	193	<1.2	<1.5	116	4.1	5.6	2.7
S-062	BH-9S	531	<17.9	5.3	207	<.5	<1.7	<5.8	<3.8	<4.3	<1.1
S-063	BH-15	367	<17.9	<1.7	31.6	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-064	I10	23.9	<15.7	3.2	120	<1.2	<1.5	<5.1	<2.5	<4	2.3
S-065	BH-7S	<20.9	<15.7	6.6	145	<1.2	<1.5	<5.1	<2.5	<4	3.5
S-066	BH-7D	38.6	<15.7	2.7	26.3	<1.2	<1.5	<5.1	<2.5	<4	<1.4
S-067	I9	26.2	<15.7	6.8	55.1	<1.2	<1.5	<5.1	<2.5	<4	2.9
S-068	I8	182	<15.7	7.6	356	<1.2	<1.5	<5.1	3.3	1,660	3.5
S-069	B-7	<20.9	19.6	<2.7	5	<1.2	<1.5	<5.1	<2.5	<4	2.1
S-070	B-5	<20.9	<15.7	<2.7	490	<1.2	<1.5	<5.1	<2.5	<4	1.9
S-071	BH-28	21.3	<15.7	<2.7	138	<1.2	<1.5	<5.1	<2.5	<4	<1.4
S-072	D-67	24.5	20.1	<2.7	6.3	<1.2	<1.5	<5.1	<2.5	<4	1.5
S-073	D-68	<20.9	<15.7	3.6	101	<1.2	<1.5	7.9	<2.5	<4	<1.4
S-074	C-19	44	<15.7	3	46.3	<1.2	<1.5	<5.1	<2.5	<4	<1.4
S-075	C-25	196	<15.7	<1.7	36.3	<1.2	<1.5	5.2	<2.5	7.1	3.6
S-076	C-18	<20.9	<15.7	<2.7	108	<1.2	<1.5	<5.1	<2.5	<4	1.5
S-077	B-10	<20.9	<15.7	<2.7	5	<1.2	<1.5	<5.1	<2.5	<4	<1.4
S-078	B-3	42	<15.7	<2.7	332	<1.2	<1.5	<5.1	<2.5	<4	2.5
S-079	A-20	23.3	<15.7	<2.7	25	<1.2	<1.5	<5.1	<2.5	<4	<1.4
S-080	W-3	418	<15.7	8.2	15.6	<1.2	<1.5	<5.1	<2.5	<4	1.1
S-081	BH-23	23.0	<15.7	<2.7	26.3	<1.2	<1.5	<5.1	<2.5	<4	1.7
S-082	232-45	<20.9	<15.7	15.3	75.3	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-083	105	<20.9	<15.7	12.8	83	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-084	106	<20.9	<15.7	<1.7	31.1	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-085	E3	<20.9	<15.7	<1.7	85.6	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-086	I3	676	<15.7	5.4	122	<1.2	<1.5	8.8	3	907	10.8

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Mercury, dissolved (μg/L) (71890)	Nickel, dissolved (μg/L) (01065)	Selenium, dissolved (μg/L) (01145)	Silver, dissolved (μg/L) (01075)	Thallium, dissolved (μg/L) (01057)	Vanadium, dissolved (μg/L) (01085)	Zinc, dissolved (μg/L) (01090)	Cyanide, dissolved (μg/L) (00723)
S-057	BH-24	0.15e	<4.7	<3.7e	<5	<7e	<2.6	<3.7	15.9
S-058	IP	.14e	<4.7	<3.7	<5	<7e	<2.6	<3.7	<10
S-059	I16	.2e	<4.7	<3.7e	<5	<7e	<2.6	<3.7	<10
S-060	I21	<.1	<6.1	<2.3	<3.8	2.3e	<3.3	<3.4	<10
S-061	BH-7I	<.1	156	<3.7e	<5	--	<2.6	7.3	<10e
S-062	BH-9S	<.1	<6.1	<2.3	<3.8	3.8e	<3.3	<3.4	<10
S-063	BH-15	<.1	<6.1	<2.3	<3.8	2e	<3.3	<3.4	<10
S-064	I10	.32	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-065	BH-7S	<.1	<4.7	<3.7e	<5	--	4.3	<3.7	<10e
S-066	BH-7D	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-067	I9	<.1	<4.7	<3.7e	<5	--	<2.6	207	<10e
S-068	I8	<.1	83.7	<3.7e	<5	--	<2.6	33.7	<10e
S-069	B-7	<.1	6.5	4.8e	<5	--	<2.6	<3.7	<10e
S-070	B-5	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-071	BH-28	<.1	12	<3.7e	<5	--	<2.6	<3.7	<10e
S-072	D-67	<.1	<4.7	<3.7e	<5	--	<2.6	7.5	<10e
S-073	D-68	<.1	6.8	<3.7e	<5	--	<2.6	<3.7	<10e
S-074	C-19	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-075	C-25	.71	7.4	<2.3	<5	3.1e	<2.6	<3.7	<10
S-076	C-18	.11	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-077	B-10	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-078	B-3	.22	<4.7	<3.7e	<5	--	<2.6	<3.7	33.3e
S-079	A-20	<.1	27.8	<3.7e	<5	--	<2.6	<3.7	<10e
S-080	W-3	.17	<4.7	2.8e	<5	<1.1	5.7	<3.7	<10
S-081	BH-23	<.1	<4.7	<3.7e	<5	--	<2.6	<3.7	<10e
S-082	232-45	.11	<4.7	<2.3	<5	2.5e	<2.6	<3.7	<10
S-083	105	.11	<4.7	<2.3	<5	2.8e	<2.6	<3.7	<10
S-084	106	<.1	<4.7	2.9e	<5	3.3e	4.1	<3.7	<10
S-085	E3	.16	<4.7	<2.3	<5	2.5e	3.2	<3.7	<10
S-086	I3	.18	13.1	3.2e	<5	3.6e	38	531	<10

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
S-087	I22	53.5	<15.7	3	92.1	<1.2	<1.5	<5.1	<2.5	268	1.4
S-088	B-8	21.4	<15.7	12.2	157	<1.2	<1.5	<5.1	<2.5	<4	2.9
S-089	BH-1D	31.6	<15.7	<1.7	313	<1.2	<1.5	<5.1	<2.5	<4	1.3
S-090	BH-1S	<20.9	<15.7	<1.7	51.9	<1.2	<1.5	<5.1	<2.5	18.6	<1.1
S-091	BH-18S	50.3	<15.7	<1.7	57.1	<1.2	<1.5	<5.1	<2.5	<4	1.9
S-092	BH-2	101	<15.7	2.6	90.8	<1.2	<1.5	9.7	<2.5	4	3
S-093	BH-25	<20.9	<15.7	<1.7	51.9	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-094	BH-14	<20.9	<15.7	<1.7	22.1	<1.2	2	<5.1	<2.5	<4	<1.1
S-095	BH-19	26.5	<15.7	2.1	23.4	<1.2	<1.5	<5.1	<2.5	40.1	1.8
S-096	BH-13	<20.9	<15.7	2.7	43.8	<1.2	<1.5	<5.1	<2.5	100	<1.1
S-097	BH-12	<20.9	<15.7	<1.7	24.4	<1.2	<1.5	<5.1	<2.5	61.4	1.6
S-098	BH-20	<20.9	<15.7	<1.7	32.2	<1.2	<1.5	<5.1	<2.5	8.8	1.3
S-099	BH-17	<23.5	<17.9	3.3	125	<.5	<1.7	<5.8	<3.8	<4.2	<1.1
S-100	D-45	<20.9	<15.7	2.6	29.8	<1.2	<1.5	<5.1	<2.5	6	5
S-101	MW-1	<20.9	<15.7	3.3	121	<1.2	<1.5	<5.1	<2.5	<4	6.5
S-102	I2	49.7	<15.7	3	237	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-103	BH-5S	<20.9	<15.7	2.7	158	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-104	C-3	21.3	<15.7	20	143	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-105	C-4	<20.9	<15.7	<1.7	44	<1.2	<1.5	<5.1	<2.5	<4	2.4
S-106	C-1	<20.9	<15.7	3.6	18.8	<1.2	<1.5	<5.1	<2.5	4.3	<1.1
S-107	E-5	<20.9	<15.7	<1.7	56.6	<1.2	<1.5	<5.1	<2.5	<4	1.1
S-108	BH5D	<20.9	<15.7	5.8	176	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-109	BH18I	24	<15.7	4.6	30.2	<1.2	<1.5	<5.1	<2.5	11.4	1.9
S-110	BH32	<20.9	<15.7	4.1	248	<1.2	<1.5	<5.1	3.2	<4	<1.1
S-111	BH11	233	<15.7	<1.7	47.8	<1.2	<1.5	<5.1	<2.5	18.9	3.7
S-112	BH18D	63.2	<15.7	2	30.2	<1.2	<1.5	<5.1	<2.5	<4	1.9
S-113	D70	<20.9	<15.7	4.7	18.8	<1.2	<1.5	<5.1	<2.5	<4	1.6
S-114	BH16D	<20.9	<15.7	<1.7	26.4	<1.2	<1.5	<5.1	<2.5	<4	1.7

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Mercury, dissolved (µg/L) (71890)	Nickel, dissolved (µg/L) (01065)	Selenium, dissolved (µg/L) (01145)	Silver, dissolved (µg/L) (01075)	Thallium, dissolved (µg/L) (01057)	Vanadium, dissolved (µg/L) (01085)	Zinc, dissolved (µg/L) (01090)	Cyanide, dissolved (µg/L) (00723)
S-087	I22	<0.1	11.5	2.5e	<5	2.8e	4.2	165	<10
S-088	B-8	<.1	<4.7	<3.7e	<5	--	2.9	<3.7	<10e
S-089	BH-1D	.25	<4.7	<2.3	<5	2.2e	3.1	4.3	<10
S-090	BH-1S	<.1	8.3	3.1e	<5	1.5e	2.6	15.6	<10
S-091	BH-18S	<.1	<4.7	3.4e	<5	<1.1	52.7	<3.7	14
S-092	BH-2	<.1	14.4	8.6e	<5	2.3e	3.6	11.6	<10
S-093	BH-25	<.1	<4.7	5.3e	<5	<1.1	<2.6	<3.7	<10
S-094	BH-14	<.1	<4.7	3.7e	<5	2.2e	<2.6	<3.7	<10
S-095	BH-19	<.1	14.7	3.2e	<5	2.8e	3.6	<3.7	<10
S-096	BH-13	.25e	120	<2.3	<5	1.8	3	<3.7	<10
S-097	BH-12	.14e	<4.7	2.8	<5	<1.1	<2.6	6.3	<10
S-098	BH-20	.15e	<4.7	2.7	<5	1.2	<2.6	<3.7	<10
S-099	BH-17	.16e	27.5	<2.3	<5	1.5	<2.6	<3.7	<10
S-100	D-45	<.1	19.5	<2.3	<5	2.5e	3.1	<3.7	<10
S-101	MW-1	.18e	<4.7	<2.3	<5	1.1	<2.6	<3.7	<10
S-102	I2	1.1	5.8	2.8e	<5	4.6e	6.2	<3.7	164
S-103	BH-5S	<.1	<4.7	<2.3	<5	1.9e	<2.6	<3.7	<10
S-104	C-3	<.1	<4.7	<2.3	<5	1.9e	<2.6	<3.7	<10
S-105	C-4	.15e	32.5	4.6e	<5	2.6	<2.6	6.6	<10
S-106	C-1	.14e	38	17.2	<5	2	<2.6	<3.7	11.6
S-107	E-5	.12e	<4.7	<2.3	<5	<1.1	<2.6	<3.7	<10
S-108	BH5D	.15e	34.6	<2.3	<5	1.4	<2.6	34.4	<10
S-109	BH18I	.16e	4.8	<2.3	<5	<1.1	<2.6	<3.7	<10
S-110	BH32	.28e	7	<2.3	<5	<1.1	<2.6	<3.7	18.7
S-111	BH11	.12e	<4.7	4	<5	<1.1	<2.6	40.2	<10
S-112	BH18D	.13e	<4.7	<2.3	<5	1.3	<2.6	<3.7	<10
S-113	D70	.13e	9.4	<2.3	<5	1.5	<2.6	<3.7	<10
S-114	BH16D	.12e	<4.7	<2.3	<5	<1.1	<2.6	<3.7	<10

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aluminum, dissolved (µg/L) (01106)	Antimony, dissolved (µg/L) (01095)	Arsenic, dissolved (µg/L) (01000)	Barium, dissolved (µg/L) (01005)	Beryllium, dissolved (µg/L) (01010)	Cadmium, dissolved (µg/L) (01025)	Chromium, dissolved (µg/L) (01030)	Cobalt, dissolved (µg/L) (01035)	Copper, dissolved (µg/L) (01040)	Lead, dissolved (µg/L) (01049)
S-115	BH16S	<20.9	<15.7	<1.7	47.8	<1.2	<1.5	<5.1	<2.5	106	1.2
S-116	D75	350	<15.7	<1.7	56.6	<1.2	<1.5	11	2.8	13.6	<1.1
S-117	C12	<20.9	<15.7	<1.7	80.4	<1.2	<1.5	<5.1	<2.5	<4	1.2
S-118	LK13	<20.9	<15.7	10.1	124	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-119	I20	7,280	<15.7	18.3	100	1.5	<1.5	21.3	13.6	16.7	54.2
S-120	WS9	<20.9	<15.7	2.8	148	<1.2	<1.5	<5.1	<2.5	11.5	<1.1
S-121	WS7	<20.9	<15.7	<1.7	25.1	<1.2	<1.5	<5.1	<2.5	<4	<1.1
S-122	WS2	<20.9	<15.7	1.9	18	<1.2	<1.5	10.6	<2.5	15.4	<1.1
S-123	FILO1	<20.9	<15.7	<1.7	18	<1.2	<1.5	<5.1	<2.5	<4	3.5
S-124	WS5	<20.9	<15.7	2.1	113	<1.2	<1.5	<5.1	<2.5	<4	2.2
S-125	FILO4	2,220	<15.7	18.4	30.9	<1.2	<1.5	6.1	5	4.3	10.3
S-126	FILO5	<20.9	<15.7	9.5	21.9	<1.2	<1.5	<5.1	11.2	8.1	1.2
S-127	FILO2	<20.9	<15.7	11.6	16.7	<1.2	<1.5	<5.1	51.2	27.9	2.3
S-128	FILO6	<20.9	<15.7	7.9	<5	<1.2	<1.5	<5.1	<2.5	<4	1.4
S-129	C2	107	<15.7	<1.7	54.1	<1.2	<1.5	<5.1	<2.5	<4	1.2

Table 18. Concentrations of trace elements and cyanide in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Mercury, dissolved (μg/L) (71890)	Nickel, dissolved (μg/L) (01065)	Selenium, dissolved (μg/L) (01145)	Silver, dissolved (μg/L) (01075)	Thallium, dissolved (μg/L) (01057)	Vanadium, dissolved (μg/L) (01085)	Zinc, dissolved (μg/L) (01090)	Cyanide, dissolved (μg/L) (00723)
S-115	BH16S	0.12e	<4.7	<2.3	<5	1.9	<2.6	<3.7	<10
S-116	D75	.12e	51	<2.3	<5	<1.1	<2.6	11.1	<10
S-117	C12	.14e	<4.7	<2.3	<5	2.1	4	<3.7	<10
S-118	LK13	.17e	<4.7	2.3	<5	1.5	2.6	<3.7	<10
S-119	I20	.59e	22.8	2.5	<5	<1.1	39.7	151	10.7
S-120	WS9	.16e	<4.7	<2.3	<5	2.1	<2.6	<3.7	<10
S-121	WS7	.14e	<4.7	<2.3	<5	2.1	<2.6	<3.7	<10
S-122	WS2	.12e	<4.7	5.4	<5	<1.1	6.6	<3.7	27.8
S-123	FILO1	.24e	<4.7	<2.3	<5	<1.1	<2.6	58.8	<10
S-124	WS5	.34e	<4.7	<2.3	<5	<1.1	5	<3.7	98.2
S-125	FILO4	.15e	376	3.4	<5	<1.1	9.9	25.9	<10
S-126	FILO5	.13e	233	3	<5	<1.1	7.1	13.1	<10
S-127	FILO2	.13e	104	2.4	<5	1.3	<2.6	7.5	<10
S-128	FILO6	.24e	42.9	<2.3	<5	<1.1	<2.6	<3.7	<10
S-129	C2	.34e	<4.7	<2.3	<5	<1.1	24.5	<3.7	<10

[a] Well is constructed of galvanized casing that is contributing zinc to the sample.

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; d, sample was diluted; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Chloro-methane (µg/L) (30201)	Bromo-methane (µg/L) (30202)	Vinyl chloride, total (µg/L) (39175)	Chloro-ethane, total (µg/L) (34311)	Methylene chloride, total (µg/L) (34423)	Acetone, total (µg/L) (81552)	Carbon di-sulfide, total (µg/L) (77041)	1,1-Di-chloro-ethylene, total (µg/L) (34501)	1,1-Di-chloro-ethane, total (µg/L) (34496)	1,2-Di-chloro-ethene, (µg/L) (45617)	Chloro-form, total (µg/L) (32106)	1,2-Di-chloro-ethane (µg/L) (32103)	Methyl-ethyl-ketone, total (µg/L) (81595)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-002	BH21	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-003	230-58	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-004	E20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-005	234-142	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,1-Tri-chloro-ethane, total (µg/L) (34506)	Carbon tetra-chloride, total (µg/L) (32102)	Di-chloro-bromo-methane, total (µg/L) (32101)	1,2-Di-chloro-propane, total (µg/L) (34541)	cis-1,3-Di-chloro-propene, total (µg/L) (34704)	Tri-chloro-ethlyene, total (µg/L) (39180)	Chloro-di-bromo-methane, total (µg/L) (32105)	1,1,2-Tri-chloro-ethane, total (µg/L) (34511)	Benzene, total (µg/L) (34030)	trans-1,3-Di-chloro-propane, total (µg/L) (34699)	Bromo-form, total (µg/L) (32104)	Methyl-isobutyl ketone, total (µg/L) (78133)	2-Hexa-none, total (µg/L) (77103)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-002	BH21	<10	<10	<10	<10	<10	<10	<10	<10	8e	<10	<10	<10	<10
S-003	230-58	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-004	E20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-005	234-142	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-006	D40	<10	<10	<10	<10	<10	<10	<10	<10	110	<10	<10	<10	<10
S-007	WP1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-008	IC	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-009	G-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-010	230-128	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-012	BH22	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-013	BH33	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-014	E2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-015	D1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-016	WP2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-017	230-24	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-018	D11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-019	D10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-020	D-5A	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-021	225	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-022	D20	<120d	<120d	<120d	<120d	<120d	<120d	<120d	<120d	1,800d	<120d	<120d	<120d	<120d
S-023	D21	<10	<10	<10	<10	<10	<10	<10	<10	42	<10	<10	<10	<10
S-024	E6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-025	E7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-026	24	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-027	25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-028	W-1A	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-029	BH30	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Tetra-chloro-ethylene, total (μg/L) (34475)	1,1,2,2-Tetra-chloro-ethane (μg/L) (34516)	Toluene, total (μg/L) (34010)	Chloro-benzene, total (μg/L) (34301)	Ethyl benzene, total (μg/L) (34371)	Styrene, total (μg/L) (77128)	Xylene, total (μg/L) (81551)
S-001	E10	<10	<10	<10	<10	<10	<10	<10
S-002	BH21	<10	<10	<10	<10	<10	<10	<10
S-003	230-58	<10	<10	<10	<10	<10	<10	<10
S-004	E20	<10	<10	<10	<10	<10	<10	<10
S-005	234-142	<10	<10	<10	<10	<10	<10	<10
S-006	D40	<10	<10	<10	<10	<10	<10	<10
S-007	WP1	<10	<10	<10	<10	<10	<10	<10
S-008	IC	<10	<10	<10	<10	<10	<10	<10
S-009	G-1	<10	<10	<10	<10	<10	<10	<10
S-010	230-128	<10	<10	<10	<10	<10	<10	<10
S-011	BH8	<10	<10	<10	<10	<10	<10	<10
S-012	BH22	<10	<10	<10	<10	<10	<10	<10
S-013	BH33	<10	<10	<10	<10	<10	<10	<10
S-014	E2	<10	<10	<10	<10	<10	<10	<10
S-015	D1	<10	<10	<10	<10	<10	<10	<10
S-016	WP2	<10	<10	<10	<10	<10	<10	<10
S-017	230-24	<10	<10	<10	<10	<10	<10	<10
S-018	D11	<10	<10	<10	<10	<10	<10	<10
S-019	D10	<10	<10	<10	<10	<10	<10	3e
S-020	D-5A	<10	<10	<10	<10	<10	<10	<10
S-021	225	<10	<10	<10	<10	<10	<10	<10
S-022	D20	<120d	<120d	<120d	<120d	<120d	<120d	<120d
S-023	D21	<10	<10	<10	<10	<10	<10	<10
S-024	E6	<10	<10	<10	<10	<10	<10	<10
S-025	E7	<10	<10	<10	<10	<10	<10	<10
S-026	24	<10	<10	<10	<10	<10	<10	<10
S-027	25	<10	<10	<10	<10	<10	<10	<10
S-028	W-1A	<10	<10	<10	<10	<10	<10	<10
S-029	BH30	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Chloro-methane (µg/L) (30201)	Bromo-methane (µg/L) (30202)	Vinyl chloride, total (µg/L) (39175)	Chloro-ethane, total (µg/L) (34311)	Methylene chloride, total (µg/L) (34423)	Acetone, total (µg/L) (81552)	Carbon di-sulfide, total (µg/L) (77041)	1,1-Di-chloro-ethylene, total (µg/L) (34501)	1,1-Di-chloro-ethane, total (µg/L) (34496)	1,2-Di-chloro-ethene (µg/L) (45617)	Chloro-form, total (µg/L) (32106)	1,2-Di-chloro-ethane (µg/L) (32103)	Methyl-ethyl-ketone, total (µg/L) (81595)
S-030	IT	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-032	I1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-033	I13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-034	I12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-035	I14	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	19	<10	<10	<10	<10	<10	<10	<10
S-037	D25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-038	BH29	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-039	BH26	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-040	237-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-042	MW-5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-043	MW-15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-044	A3	<33d	<33d	<33d	<33d	<33d	<33d	<33d	<33d	7e,d	<33d	<33d	<33d	<33d
S-045	E1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-046	A2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-047	BH27	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-048	B2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-049	A1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-050	A4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-052	244-125	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-053	244-65	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-054	BH6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-055	BH4D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-056	BH4S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,1-Trichloroethane, total (μg/L) (34506)	Carbon tetrachloride, total (μg/L) (32102)	Dichlorobromomethane, total (μg/L) (32101)	1,2-Dichloropropane, total (μg/L) (34541)	cis-1,3-Dichloropropene, total

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Tetra-chloro-ethylene, total (µg/L) (34475)	1,1,2,2-Tetra-chloro-ethane (µg/L) (34516)	Toluene, total (µg/L) (34010)	Chloro-benzene, total (µg/L) (34301)	Ethyl benzene, total (µg/L) (34371)	Styrene, total (µg/L) (77128)	Xylene, total (µg/L) (81551)
S-030	IT	<10	<10	<10	<10	<10	<10	<10
S-032	I1	<10	<10	<10	<10	<10	<10	<10
S-033	I13	<10	<10	<10	<10	<10	<10	<10
S-034	I12	<10	<10	<10	<10	<10	<10	<10
S-035	I14	<10	3e	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	<10	<10
S-037	D25	<10	<10	<10	<10	<10	<10	<10
S-038	BH29	<10	<10	<10	<10	<10	<10	<10
S-039	BH26	<10	<10	<10	<10	<10	<10	<10
S-040	237-45	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10
S-042	MW-5	<10	<10	<10	<10	<10	<10	<10
S-043	MW-15	<10	<10	<10	<10	<10	<10	<10
S-044	A3	<33d	<33d	<33d	<33d	<33d	<33d	<33d
S-045	E1	<10	<10	<10	<10	<10	<10	<10
S-046	A2	<10	<10	<10	<10	<10	<10	<10
S-047	BH27	<10	<10	<10	<10	<10	<10	<10
S-048	B2	<10	<10	<10	<10	<10	<10	2e
S-049	A1	<10	<10	<10	<10	<10	<10	<10
S-050	A4	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10
S-052	244-125	<10	<10	<10	<10	<10	<10	<10
S-053	244-65	<10	<10	<10	<10	<10	<10	<10
S-054	BH6	<10	<10	<10	<10	<10	<10	<10
S-055	BH4D	<10	<10	<10	<10	<10	<10	<10
S-056	BH4S	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Chloromethane (μg/L) (30201)	Bromomethane (μg/L) (30202)	Vinyl chloride, total (μg/L) (39175)	Chloroethane, total (μg/L) (34311)	Methylene chloride, total (μg/L) (34423)	Acetone, total (μg/L) (81552)	Carbon disulfide, total (μg/L) (77041)	1,1-Dichloroethylene, total (μg/L) (34501)	1,1-Dichloroethane, total (μg/L) (34496)	1,2-Dichloroethene (μg/L) (45617)	Chloroform, total (μg/L) (32106)	1,2-Dichloroethane (μg/L) (32103)	Methylethylketone, total (μg/L) (81595)

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,1-Tri-

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Tetra-chloro-ethylene, total (µg/L) (34475)	1,1,2,2-Tetra-chloro-ethane (µg/L) (34516)	Toluene, total (µg/L) (34010)	Chloro-benzene, total (µg/L) (34301)	Ethyl benzene, total (µg/L) (34371)	Styrene, total (µg/L) (77128)	Xylene, total (µg/L) (81551)
S-057	BH24	<10	<10	<10	<10	<10	<10	<10
S-058	IP	<10	<10	<10	<10	<10	<10	3e
S-059	I16	<10	<10	<10	<10	<10	<10	<10
S-060	I21	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Chloro-methane (μg/L) (30201)	Bromo-methane (μg/L) (30202)	Vinyl chloride, total (μg/L) (39175)	Chloro-ethane, total (μg/L) (34311)	Methylene chloride, total (μg/L) (34423)	Acetone, total (μg/L) (81552)	Carbon di-sulfide, total (μg/L) (77041)	1,1-Di-chloro-ethylene, total (μg/L) (34501)	1,1-Di-chloro-ethane, total (μg/L) (34496)	1,2-Di-chloro-ethene (μg/L) (45617)	Chloro-form, total (μg/L) (32106)	1,2-Di-chloro-ethane (μg/L) (32103)	Methyl-ethyl-ketone, total (μg/L) (81595)
S-083	105	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,1-Trichloroethane, total (µg/L) (34506)	Carbon tetrachloride, total (µg/L) (32102)	Dichlorobromomethane, total (µg/L) (32101)	1,2-Dichloropropane, total (µg/L) (34541)	cis-1,3-Dichloropropene, total (µg/L) (34704)	Trichloroethlyene, total (µg/L) (39180)	Chlorodibromomethane, total (µg/L) (32105)	1,1,2-Trichloroethane, total (µg/L) (34511)	Benzene, total (µg/L) (34030)	trans-1,3-Dichloropropane, total (

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Tetra-chloro-ethylene, total (µg/L) (34475)	1,1,2,2-Tetra-chloro-ethane (µg/L) (34516)	Toluene, total (µg/L) (34010)	Chloro-benzene, total (µg/L) (34301)	Ethyl benzene, total (µg/L) (34371)	Styrene, total (µg/L) (77128)	Xylene, total (µg/L) (81551)
S-083	105	<10	<10	<10	<10	<10	<10	<10
S-084	106	<10	<10	<10	<10	<10	<10	<10
S-085	E3	<10	<10	<10	<10	<10	<10	<10
S-086	I3	<10	<10	490d	<10	6e	5e	140
S-087	I22	<10	<10	<10	<10	<10	<10	<10
S-088	B8	<10	<10	<10	<10	<10	<10	<10
S-089	BH1D	<10	<10	<10	<10	<10	<10	<10
S-090	BH1S	<10	<10	<10	<10	<10	<10	<10
S-091	BH18S	<10	<10	<10	<10	<10	<10	<10
S-092	BH2	<10	<10	<10	<10	<10	<10	<10
S-093	BH25	<10	<10	<10	<10	<10	<10	<10
S-094	BH14	<10	<10	<10	<10	<10	<10	<10
S-095	BH19	<10	<10	<10	<10	<10	<10	<10
S-096	BH13	<10	<10	<10	<10	<10	<10	<10
S-097	BH12	<10	<10	<10	<10	<10	<10	<10
S-098	BH20	<10	<10	<10	<10	<10	<10	<10
S-099	BH17	<10	<10	<10	<10	<10	<10	<10
S-100	D45	<10	<10	<10	<10	<10	<10	<10
S-101	MW-1	<10	<10	<10	<10	<10	<10	<10
S-102	I2	<100d	<100d	600d	<100d	<100d	<100d	220d
S-103	BH5S	<10	<10	<10	<10	<10	<10	<10
S-104	C3	<10	<10	<10	<10	<10	<10	<10
S-105	C4	<10	<10	<10	<10	<10	<10	<10
S-106	C1	<10	<10	<10	<10	<10	<10	<10
S-107	E5	<10	<10	<10	<10	<10	<10	<10
S-108	BH5D	<10	<10	<10	<10	<10	<10	<10
S-109	BH18I	<10	<10	<10	<10	<10	<10	<10
S-110	BH32	<10	<10	<10	<10	<10	<10	<10
S-111	BH11	<10	<10	<10	<10	<10	<10	<10
S-112	BH18D	<10	<10	<10	<10	<10	<10	<10
S-113	D70	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Chloro-methane (µg/L) (30201)	Bromo-methane (µg/L) (30202)	Vinyl chloride, total (µg/L) (39175)	Chloro-ethane, total (µg/L) (34311)	Methylene chloride, total (µg/L) (34423)	Acetone, total (µg/L) (81552)	Carbon di-sulfide, total (µg/L) (77041)	1,1-Di-chloro-ethylene, total (µg/L) (34501)	1,1-Di-chloro-ethane, total (µg/L) (34496)	1,2-Di-chloro-ethene (µg/L) (45617)	Chloro-form, total (µg/L) (32106)	1,2-Di-chloro-ethane (µg/L) (32103)	Methyl-ethyl-ketone, total (µg/L) (81595)
S-114	BH16D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-115	BH16S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-116	D75	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-117	C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-118	LK13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-119	I20	<10	<10	10,000d	<10	<10	<10	<10	66	<10	42,000d	<10	<10	<10
S-120	WS9	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-122	WS2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-123	FILO1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-124	WS5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-125	FILO4	<10	<10	8e	<10	<10	<10	<10	<10	<10	5e	<10	<10	<10
S-126	FILO5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-127	FILO2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-128	FILO6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-129	C2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	1,1,1-Tri-chloro-ethane, total (μg/L) (34506)	Carbon tetra-chloride, total (μg/L) (32102)	Di-chloro-bromo-methane, total (μg/L) (32101)	1,2-Di-chloro-propane, total (μg/L) (34541)	cis-1,3-Di-chloro-propene, total (μg/L) (34704)	Tri-chloro-ethlyene, total (μg/L) (39180)	Chloro-di-bromo-methane, total (μg/L) (32105)	1,1,2-Tri-chloro-ethane, total (μg/L) (34511)	Benzene, total (μg/L) (34030)	trans-1,3-Di-chloro-propane, total (μg/L) (34699)	Bromo-form, total (μg/L) (32104)	Methyl-isobutyl ketone, total (μg/L) (78133)	2-Hexa-none, total (μg/L) (77103)
S-114	BH16D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-115	BH16S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-116	D75	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-117	C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-118	LK13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-119	I20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-120	WS9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-122	WS2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-123	FILO1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-124	WS5	<10	<10	<10	<10	<10	<10	<10	<10	9,900d	<10	<10	<10	<10
S-125	FILO4	<10	<10	<10	<10	<10	<10	<10	<10	11	<10	<10	<10	<10
S-126	FILO5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-127	FILO2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-128	FILO6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-129	C2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 20. Concentrations of target volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Tetra-chloro-ethylene, total (μg/L) (34475)	1,1,2,2-Tetra-chloro-ethane (μg/L) (34516)	Toluene, total (μg/L) (34010)	Chloro-benzene, total (μg/L) (34301)	Ethyl benzene, total (μg/L) (34371)	Styrene, total (μg/L) (77128)	Xylene, total (μg/L) (81551)
S-114	BH16D	<10	<10	<10	<10	<10	<10	<10
S-115	BH16S	<10	<10	<10	<10	<10	<10	<10
S-116	D75	<10	<10	<10	<10	<10	<10	<10
S-117	C12	<10	<10	<10	<10	<10	<10	<10
S-118	LK13	<10	<10	<10	<10	<10	<10	<10
S-119	I20	<10	<10	10	<10	<10	<10	<10
S-120	WS9	<10	<10	<10	<10	<10	<10	<10
S-121	WS7	<10	<10	<10	<10	<10	<10	<10
S-122	WS2	<10	<10	<10	<10	<10	<10	<10
S-123	FILO1	<10	<10	<10	<10	<10	<10	<10
S-124	WS5	<10	<10	23	<10	330d, e	<10	400d, e
S-125	FILO4	<10	<10	<10	<10	<10	<10	<10
S-126	FILO5	<10	<10	<10	<10	<10	<10	<10
S-127	FILO2	<10	<10	<10	<10	<10	<10	<10
S-128	FILO6	<10	<10	<10	<10	<10	<10	<10
S-129	C2	<10	<10	<10	<10	<10	<10	<10

Table 21. Concentrations of tentatively identified volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[μg/L, microgram per liter; n.d., not detected; e, estimated; d, sample was diluted]

Sample number	Well name	Aliphatic hydrocarbon compounds (μg/L)	Number of aliphatic compounds detected	Aromatic hydrocarbon compounds (μg/L)	Number of aromatic compounds detected	Unknown compounds (μg/L)	Number of unknown compounds detected
S-001	E10	n.d.	0	n.d.	0	n.d.	0
S-002	BH21	n.d.	0	n.d.	0	n.d.	0
S-003	230-58	n.d.	0	n.d.	0	n.d.	0
S-004	E20	n.d.	0	n.d.	0	n.d.	0
S-005	234-142	n.d.	0	n.d.	0	n.d.	0
S-006	D40	25e	3	n.d.	0	n.d.	0
S-007	WP1	n.d.	0	n.d.	0	n.d.	0

S-040	237-45	n.d.	0	n.d.	0	n.d.	0
S-041	235-45	n.d.	0	n.d.	0	n.d.	0
S-042	MW-5	n.d.	0	n.d.	0	n.d.	0
S-043	MW-15	n.d.	0	n.d.	0	n.d.	0
S-044	A3	n.d.	0	n.d.	0	n.d.	0
S-045	E1	n.d.	0	n.d.	0	n.d.	0
S-046	A2	n.d.	0	n.d.	0	n.d.	0
S-047	BH27	n.d.	0	n.d.	0	n.d.	0
S-048	B2	n.d.	0	n.d.	0	n.d.	0
S-049	A1	n.d.	0	n.d.	0	n.d.	0
S-050	A4	n.d.	0	n.d.	0	n.d.	0
S-051	I15	17e	1	n.d.	0	n.d.	0
S-052	244-125	n.d.	0	n.d.	0	n.d.	0
S-053	244-65	n.d.	0	n.d.	0	n.d.	0
S-054	BH6	n.d.	0	n.d.	0	n.d.	0
S-055	BH4D	n.d.	0	n.d.	0	n.d.	0
S-056	BH4S	n.d.	0	n.d.	0	n.d.	0
S-057	BH24	n.d.	0	n.d.	0	n.d.	0
S-058	IP	n.d.	0	n.d.	0	n.d.	0
S-059	I16	n.d.	0	n.d.	0	n.d.	0

Sample number	Well name						
S-078	B3	n.d.	0	n.d.	0	n.d.	0
S-079	A20	n.d.	0	n.d.	0	n.d.	0
S-080	W-3	n.d.	0	n.d.	0	n.d.	0
S-081	BH23	n.d.	0	n.d.	0	n.d.	0
S-082	232-45	n.d.	0	n.d.	0	n.d.	0
S-083	105	n.d.	0	n.d.	0	n.d.	0
S-084	106	n.d.	0	n.d.	0	n.d.	0
S-085	E3	n.d.	0	n.d.	0	n.d.	0
S-086	I3	n.d.	0	n.d.	0	n.d.	0
S-087	I22	n.d.	0	n.d.	0	n.d.	0
S-088	B8	n.d.	0	n.d.	0	n.d.	0
S-089	BH1D	n.d.	0	n.d.	0	n.d.	0
S-090	BH1S	n.d.	0	n.d.	0	n.d.	0
S-091	BH18S	n.d.	0	n.d.	0	n.d.	0
S-092	BH2	n.d.	0	n.d.	0	n.d.	0
S-093	BH25	n.d.	0	n.d.	0	n.d.	0
S-094	BH14	n.d.	0	n.d.	0	n.d.	0
S-095	BH19	n.d.	0	n.d.	0	n.d.	0
S-096	BH13	n.d.	0	n.d.	0	n.d.	0
S-097	BH12	n.d.	0	14e	1	n.d.	0
S-098	BH20	n.d.	0	n.d.	0	n.d.	0
S-099	BH17	n.d.	0	n.d.	0	n.d.	0
S-100	D45	n.d.	0	n.d.	0	n.d.	0
S-101	MW-1	n.d.	0	n.d.	0	n.d.	0
S-102	I2	n.d.	0	n.d.	0	n.d.	0
S-103	BH5S	n.d.	0	n.d.	0	n.d.	0
S-104	C3	n.d.	0	n.d.	0	n.d.	0
S-105	C4	n.d.	0	n.d.	0	n.d.	0
S-106	C1	n.d.	0	n.d.	0	n.d.	0
S-107	E5	n.d.	0	n.d.	0	n.d.	0
S-108	BH5D	5e	1	n.d.	0	n.d.	0
S-109	BH18I	n.d.	0	n.d.	0	n.d.	0
S-110	BH32	n.d.	0	n.d.	0	n.d.	0
S-111	BH11	n.d.	0	n.d.	0	n.d.	0
S-112	BH18D	n.d.	0	n.d.	0	n.d.	0
S-113	D70	n.d.	0	n.d.	0	n.d.	0
S-114	BH16D	n.d.	0	n.d.	0	n.d.	0
S-115	BH16S	n.d.	0	n.d.	0	n.d.	0

Table 21. Concentrations of tentatively identified volatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aliphatic hydrocarbon compounds (μg/L)	Number of aliphatic compounds detected	Aromatic hydrocarbon compounds (μg/L)	Number of aromatic compounds detected	Unknown compounds (μg/L)	Number of unknown compounds detected
S-116	D75	n.d.	0	n.d.	0	n.d.	0
S-117	C12	n.d.	0	n.d.	0	n.d.	0
S-118	LK13	n.d.	0	n.d.	0	n.d.	0
S-119	I20	n.d.	0	n.d.	0	n.d.	0
S-120	WS9	n.d.	0	n.d.	0	n.d.	0
S-121	WS7	n.d.	0	n.d.	0	n.d.	0
S-122	WS2	n.d.	0	n.d.	0	n.d.	0
S-123	FILO1	n.d.	0	n.d.	0	n.d.	0
S-124	WS5	26e	1	n.d.	0	n.d.	0
S-125	FILO4	n.d.	0	n.d.	0	186e	4
S-126	FILO5	n.d.	0	n.d.	0	32e	1
S-127	FILO2	n.d.	0	n.d.	0	n.d.	0
S-128	FILO6	n.d.	0	n.d.	0	n.d.	0
S-129	C2	n.d.	0	n.d.	0	n.d.	0

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; <, less than; e, estimated; d, sample was diluted; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Phenols, total (µg/L) (32730)	Bis(2-Chloroethyl) ether, total (µg/L) (34273)	2-phenol, total (µg/L) (34586)	1,3-Dichlorobenzene (µg/L) (34566)	1,4-Dichlorobenzene (µg/L) (34571)	o-Chlorobenzene (µg/L) (34536)	Ortho cresol, total (µg/L) (77152)	2-2′-oxybis 1-Chloropropane (µg/L) (-----)[1]	Para cresol, total (µg/L) (77146)	N-Nitrosodi-N-propylamine, total (µg/L) (34428)	Hexachloroethane, total (µg/L) (34396)	Nitrobenzene, total (µg/L) (34447)	Isophorone, total (µg/L) (34408)	2-Nitrophenol, total (µg/L) (34591)
S-001	E10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-002	BH21	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-003	230-58	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-004	E20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	2,4-Dimethylphenol, total (μg/L)

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Dimethyl phthalate, total (μg/L) (34341)	Acenapthylene, total (μg/L) (34200)	2,6-Dinitrotoluene, total (μg/L) (34626)	3-Nitroaniline, total (μg/L) (78300)	Acenaphthene, total (μg/L) (34205)	2,4-Dinitrophenol, total (μg/L) (34616)	4-Nitrophenol, total (μg/L) (34646)	Dibenzofuran, total (μg/L) (81302)	2,4-Dinitrotoluene, total (μg/L) (34611)	Diethyl phthalate, total (μg/L) (34336)	4-Chlorophenyl phenyl ether, total (μg/L) (34641)	Fluorene, total (μg/L) (34381)	4-Nitroaniline (μg/L) (30196)	2-Methyl 4,6-Dinitrophenol (μg/L) (30204)
S-001	E10	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-002	BH21	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	N-Nitrosodiphenyl amine, total (μg/L) (34433)	4-Bromophenyl phenyl ether, total (μg/L) (34636)	Hexachlorobenzene, total (μg/L) (39700)	Pentachlorophenol, total (μg/L) (39032)	Phenanthrene, total (μg/L) (34461)

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Phenols, total (µg/L) (32730)	Bis(2-Chloro-ethyl) ether, total (µg/L) (34273)	2-phenol, total (µg/L) (34586)	1,3-Di-chloro-benzene (µg/L) (34566)	1,4-Di-chloro-benzene (µg/L) (34571)	o-Chloro-benzene (µg/L) (34536)	Ortho cresol, total (µg/L) (77152)	2-2′-oxybis 1-Chloro-propane (µg/L) (-----)[1]	Para cresol, total (µg/L) (77146)	N-Nitro-sodi-N-propyl-amine, total (µg/L) (34428)	Hexa-chloro-ethane, total (µg/L) (34396)	Nitro-benzene, total (µg/L) (34447)	Iso-phorone, total (µg/L) (34408)	2-Nitro-phenol, total (µg/L) (34591)
S-027	25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-028	W-1A	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-029	BH30	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-030	IT	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-032	I1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-033	I13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-034	I12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-035	I14	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	23	<10	<10	<10	<10	<10	<10	<10	1e	<10	<10	<10	<10	<10
S-037	D25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-038	BH29	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-039	BH26	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-040	237-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-042	MW-5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-043	MW-15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-044	A3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-045	E1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-046	A2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-047	BH27	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-048	B2	2e	<10	<10	<10	<10	<10	<10	<10	1e	<10	<10	<10	<10	<10
S-049	A1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-050	A4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-052	244-125	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	2,4-Dimethylphenol, total (μg/L) (34606)	Bis(2-chloroethoxy) methane, total (μg/L) (34278)	2,4-Dichlorophenol, total (μg/L) (34601)	1,2,4-Trichlorobenzene (μg/L) (34551)	Naphthalene,

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Dimethyl phthalate, total (µg/L) (34341)	Acenapthylene, total (µg/L) (34200)	2,6-Dinitrotoluene, total (µg/L) (34626)	3-Nitroaniline, total (µg/L) (78300)	Acenaphthene, total (µg/L) (34205)	2,4-Dinitrophenol, total (µg/L) (34616)	4-Nitrophenol, total (µg/L) (34646)	Dibenzofuran, total (µg/L) (81302)	2,4-Dinitrotoluene, total (µg/L) (34611)	Diethyl phthalate, total (µg/L) (34336)	4-Chlorophenyl phenyl ether, total (µg/L) (34641)	Fluorene, total (µg/L) (34381)	4-Nitroaniline (µg/L) (30196)	2-Methyl 4,6-Dinitrophenol (µg/L) (30204)

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	N-Nitrosodiphenyl amine, total (µg/L) (34433)	4-Bromophenyl phenyl ether, total (µg/L) (34636)	Hexachlorobenzene, total (µg/L) (39700)	Pentachlorophenol, total (µg/L) (39032)	Phenanthrene, total (µg/L) (34461)	Anthracene, total (µg/L) (34220)	Carbazole (µg/L) (-----)[1]	Di-N-butyl phthalate, total (µg/L) (39110)	Fluoranthene, total (µg/L) (34376)	Pyrene, total (µg/L) (34469)	N-Butyl benzyl phthalate, total (µg/L) (34292)	3,3′-Dichlorobenzidine, total (µg/L) (34631)	Benzo(a) anthracene, total (µg/L) (34526)	Chrysene, total (µg/L) (34320)	Bis(2-ethylhexyl) phthalate, total (µg/L) (39100)
S-027	25	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-028	W-1A	<10	<10	<10	<25	<10	<10	<10	.5e	<10	<10	<10	<10	<10	<10	<10
S-029	BH30	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-030	IT	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-032	I1	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-033	I13	<10	<10	<10	<25	.9e	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-034	I12	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.8e
S-035	I14	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-037	D25	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2e
S-038	BH29	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-039	BH26	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-040	237-45	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	3e
S-042	MW-5	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.6e
S-043	MW-15	<10	<10	<10	<25	<10	<10	<10	2e	<10	<10	<10	<10	<10	<10	<10
S-044	A3	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.8e
S-045	E1	<10	<10	<10	<25	<10	<10	<10	.5e	<10	<10	<10	<10	<10	<10	<10
S-046	A2	<10	<10	<10	<25	<10	<10	<10	.7e	<10	<10	<10	<10	<10	<10	<10
S-047	BH27	<10	<10	<10	<25	<10	<10	<10	.6e	<10	<10	<10	<10	<10	<10	<10
S-048	B2	<10	<10	<10	<25	3e	<10	1e	<10	1e	1e	<10	<10	<10	<10	2e
S-049	A1	<10	<10	<10	<25	<10	<10	<10	.9e	<10	<10	<10	<10	<10	<10	<10
S-050	A4	<10	<10	<10	<25	<10	<10	<10	.6e	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	2e
S-052	244-125	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	1e

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Di-n-octyl phthalate, total (μg/L) (34596)	Benzo(b) fluoranthene, total (μg/L) (34230)	Benzo(k) fluoranthene, total (μg/L) (34242)	Benzo(a) pyrene, total (μg/L) (34247)	Indeno (1,2,3-cd) pyrene, total (μg/L) (34403)	1,2,5,6-Dibenzanthracene, total (μg/L) (34556)	Benzo(g,h,i) perylene, total (μg/L) (34521)
S-027	25	<10	<10	<10	<10	<10	<10	<10
S-028	W-1A	<10	<10	<10	<10	<10	<10	<10
S-029	BH30	<10	<10	<10	<10	<10	<10	<10
S-030	IT	<10	<10	<10	<10	<10	<10	<10
S-032	I1	<10	<10	<10	<10	<10	<10	<10
S-033	I13	<10	<10	<10	<10	<10	<10	<10
S-034	I12	<10	<10	<10	<10	<10	<10	<10
S-035	I14	<10	<10	<10	<10	<10	<10	<10
S-036	BH31	<10	<10	<10	<10	<10	<10	<10
S-037	D25	<10	<10	<10	<10	<10	<10	<10
S-038	BH29	<10	<10	<10	<10	<10	<10	<10
S-039	BH26	<10	<10	<10	<10	<10	<10	<10
S-040	237-45	<10	<10	<10	<10	<10	<10	<10
S-041	235-45	<10	<10	<10	<10	<10	<10	<10
S-042	MW-5	<10	<10	<10	<10	<10	<10	<10
S-043	MW-15	<10	<10	<10	<10	<10	<10	<10
S-044	A3	<10	<10	<10	<10	<10	<10	<10
S-045	E1	<10	<10	<10	<10	<10	<10	<10
S-046	A2	<10	<10	<10	<10	<10	<10	<10
S-047	BH27	<10	<10	<10	<10	<10	<10	<10
S-048	B2	<10	<10	<10	<10	<10	<10	<10
S-049	A1	<10	<10	<10	<10	<10	<10	<10
S-050	A4	<10	<10	<10	<10	<10	<10	<10
S-051	I15	<10	<10	<10	<10	<10	<10	<10
S-052	244-125	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Phenols, total (µg/L) (32730)	Bis(2-Chloro-ethyl) ether, total (µg/L) (34273)	2-phenol, total (µg/L) (34586)	1,3-Di-chloro-

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	2,4-Di-methyl-phenol, total (µg/L) (34606)	Bis(2-chloro-ethoxy) methane, total (µg/L) (34278)	2,4-Di-chloro-phenol, total (µg/L) (34601)	1,2,4-Tri-chloro-benzene (µg/L) (34551)	Naphth-alene, total (µg/L) (34696)	4-Chloro-aniline (µg/L) (30343)	Hexa-chloro-buta-diene (µg/L) (34391)	Para-chloro-meta cresol, total (µg/L) (34452)	2-Methyl naph-thalene (µg/L) (30194)	Hexa-chloro-cyclo-pent-adiene, total (µg/L) (34386)	2,4,6-Tri-chloro-phenol, total (µg/L) (34621)	2,4,5-Tri-chloro-phenol, total (µg/L) (77687)	2-Chloro-naph-thalene, total (µg/L) (34581)	2-Nitro-aniline (µg/L) (30195)
S-053	244-65	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-054	BH6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-055	BH4D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-056	BH4S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-057	BH24	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-058	IP	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-059	I16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-060	I21	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-061	BH7I	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-062	BH9S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-063	BH15	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-064	I10	<10	<10	<10	<10	.5e	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-065	BH7S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-066	BH7D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-067	I9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-068	I8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-069	B7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-070	B5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-071	BH28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-072	D67	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-073	D68	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-074	C19	<10	<10	<10	<10	.8e	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-075	C25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-076	C18	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-077	B10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Di-methyl phthal-ate, total (µg/L) (34341)	Ace-napth-ylene, total (µg/L) (34200)	2,6-Di-nitro-toluene, total (µg/L) (34626)	3-Nitro-aniline, total (µg/L) (78300)	Ace-naphth-ene, total (µg/L) (34205)	2,4-Di-nitro-phenol, total (µg/L) (34616)	4-Nitro-phenol, total (µg/L) (34646)	Di-benzo-furan, total (µg/L) (81302)	2,4-Di-nitro-toluene, total (µg/L) (34611)

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	N-Nitrosodiphenylamine, total (µg/L) (34433)	4-Bromophenyl phenyl ether, total (µg/L) (34636)	Hexachlorobenzene, total (µg/L) (39700)	Pentachlorophenol, total (µg/L) (39032)	Phenanthrene, total (µg/L) (34461)	Anthracene, total (µg/L) (34220)	Carbazole (µg/L) (-----)[1]	Di-N-butyl phthalate, total (µg/L) (39110)	Fluoranthene, total (µg/L) (34376)	Pyrene, total (µg/L) (34469)	N-Butyl benzyl phthalate, total (µg/L) (34292)	3,3′-Dichlorobenzidine, total (µg/L) (34631)	Benzo(a)anthracene, total (µg/L) (34526)	Chrysene, total (µg/L) (34320)	Bis(2-ethylhexyl) phthalate, total (µg/L) (39100)
S-053	244-65	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-054	BH6	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.7e
S-055	BH4D	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-056	BH4S	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-057	BH24	<10	<10	<10	<25	<10	<10	<10	.6e	<10	<10	<10	<10	<10	<10	<10
S-058	IP	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-059	I16	<10	<10	<10	<25	<10	<10	<10	.7e	<10	<10	<10	<10	<10	<10	.7e
S-060	I21	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-061	BH7I	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
S-062	BH9S	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-063	BH15	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	1e
S-064	I10	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-065	BH7S	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-066	BH7D	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-067	I9	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Di-n-octyl phthalate, total (µg/L) (34596)	Benzo(b) fluoranthene, total (µg/L) (34230)	Benzo(k) fluoranthene, total (µg/L) (34242)	Benzo(a) pyrene, total (µg/L) (34247)	Indeno (1,2,3-cd) pyrene, total (µg/L) (34403)	1,2,5,6-Dibenzanthracene, total (µg/L) (34556)	Benzo(g,h,i) perylene, total (µg/L) (34521)
S-053	244-65	<10	<10	<10	<10	<10	<10	<10
S-054	BH6	<10	<10	<10	<10	<10	<10	<10
S-055	BH4D	<10	<10	<10	<10	<10	<10	<10
S-056	BH4S	<10	<10	<10	<10	<10	<10	<10
S-057	BH24	<10	<10	<10	<10	<10	<10	<10
S-058	IP	<10	<10	<10	<10	<10	<10	<10
S-059	I16	<10	<10	<10	<10	<10	<10	<10
S-060	I21	<10	<10	<10	<10	<10	<10	<10
S-061	BH7I	<10	<10	<10	<10	<10	<10	<10
S-062	BH9S	<10	<10	<10	<10	<10	<10	<10
S-063	BH15	<10	<10	<10	<10	<10	<10	<10
S-064	I10	<10	<10	<10	<10	<10	<10	<10
S-065	BH7S	<10	<10	<10	<10	<10	<10	<10
S-066	BH7D	<10	<10	<10	<10	<10	<10	<10
S-067	I9	<10	<10	<10	<10	<10	<10	<10
S-068	I8	<10	<10	<10	<10	<10	<10	<10
S-069	B7	<10	<10	<10	<10	<10	<10	<10
S-070	B5	<10	<10	<10	<10	<10	<10	<10
S-071	BH28	<10	<10	<10	<10	<10	<10	<10
S-072	D67	<10	<10	<10	<10	<10	<10	<10
S-073	D68	<10	<10	<10	<10	<10	<10	<10
S-074	C19	<10	<10	<10	<10	<10	<10	<10
S-075	C25	<10	<10	<10	<10	<10	<10	<10
S-076	C18	<10	<10	<10	<10	<10	<10	<10
S-077	B10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Phenols, total (µg/L) (32730)	Bis(2-Chloro-ethyl) ether, total (µg/L) (34273)	2-phenol, total (µg/L) (34586)	1,3-Di-chloro-benzene (µg/L) (34566)	1,4-Di-chloro-benzene (µg/L) (34571)	o-Chloro-benzene (µg/L) (34536)	Ortho cresol, total (µg/L) (77152)	2-2′-oxybis 1-Chloro-propane (µg/L) (-----)[1]	Para cresol, total (µg/L) (77146)	N-Nitro-sodi-N-propyl-amine, total (µg/L) (34428)	Hexa-chloro-ethane, total (µg/L) (34396)	Nitro-benzene, total (µg/L) (34447)	Iso-phorone, total (µg/L) (34408)	2-Nitro-phenol, total (µg/L) (34591)
S-078	B3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-079	A20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-080	W-3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-081	BH23	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-082	232-45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-083	105	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-084	106	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-085	E3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-086	I3	34	<10	<10	<10	<10	<10	12	<10	22	<10	<10	<10	<10	<10
S-087	I22	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-088	B8	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-089	BH1D	2e	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-090	BH1S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-091	BH18S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-092	BH2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-093	BH25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-094	BH14	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-095	BH19	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-096	BH13	<10	<10	<10	<10	4e	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-097	BH12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-098	BH20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-099	BH17	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-100	D45	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-101	MW-1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-102	I2	1,600d	<10	<10	<10	<10	<10	550d	<10	1,400d	<10	<10	<10	<10	<10
S-103	BH5S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-104	C3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-105	C4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	N-Nitrosodiphenyl amine, total (μg/L) (34433)	4-Bromophenyl phenyl ether, total (μg/L) (34636)	Hexachlorobenzene, total (μg/L) (39700)	Pentachlorophenol, total (μg/L) (39032)	Phenanthrene, total

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Phenols, total (µg/L) (32730)	Bis(2-Chloro-ethyl) ether, total (µg/L) (34273)	2-phenol, total (µg/L) (34586)	1,3-Di-chloro-benzene (µg/L) (34566)	1,4-Di-chloro-benzene (µg/L) (34571)	o-Chloro-benzene (µg/L) (34536)	Ortho cresol, total (µg/L) (77152)	2-2′-oxybis 1-Chloro-propane (µg/L) (-----)[1]	Para cresol, total (µg/L) (77146)	N-Nitro-sodi-N-propyl-amine, total (µg/L) (34428)	Hexa-chloro-ethane, total (µg/L) (34396)	Nitro-benzene, total (µg/L) (34447)	Iso-phorone, total (µ

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	2,4-Dimethylphenol, total (µg/L) (34606)	Bis(2-chloroethoxy) methane, total (µg/L) (34278)	2,4-Dichlorophenol, total (µg/L) (34601)	1,2,4-Trichlorobenzene (µg/L) (34551)	Naphthalene, total (µg/L) (34696)	4-Chloroaniline (µg/L) (30343)	Hexachlorobutadiene (µg/L) (34391)	Parachlorometa cresol, total (µg/L) (34452)	2-Methyl naphthalene (µg/L) (30194)	Hexachlorocyclopentadiene, total (µg/L) (34386)	2,4,6-Trichlorophenol, total (µg/L) (34621)	2,4,5-Trichlorophenol, total (µg/L) (77687)	2-Chloronaphthalene, total (µg/L) (34581)	2-Nitroaniline (µg/L) (30195)
S-106	C1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-107	E5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-108	BH5D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-109	BH18I	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-110	BH32	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-111	BH11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-112	BH18D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-113	D70	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-114	BH16D	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-115	BH16S	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-116	D75	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-117	C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-118	LK13	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-119	I20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-120	WS9	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-121	WS7	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-122	WS2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-123	FILO1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-124	WS5	9e	<10	<10	<10	4e,d	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-125	FILO4	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-126	FILO5	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-127	FILO2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-128	FILO6	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25
S-129	C2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<25	<10	<25

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Dimethyl phthalate, total (µg/L) (34341)	Acenapthylene, total (µg/L) (34200)	2,6-Dinitrotoluene, total (µg/L) (34626)	3-Nitroaniline, total (µg/L) (78300)	Acenaphthene, total (µg/L) (34205)	2,4-Dinitrophenol, total (µg/L) (34616)	4-Nitrophenol, total (µg/L) (34646)	Dibenzofuran, total (µg/L) (81302)	2,4-Dinitrotoluene, total (µg/L) (34611)	Diethyl phthalate, total (µg/L) (34336)	4-Chlorophenyl phenyl ether, total (µg/L) (34641)	Fluorene, total (µg/L) (34381)	4-Nitroaniline (µg/L) (30196)	2-Methyl 4,6-Dinitrophenol (µg/L) (30204)
S-106	C1	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-107	E5	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-108	BH5D	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-109	BH18I	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-110	BH32	<10	<10	<10	<25	.6e	<25	<25	<10	<10	<10	<10	.4e	<25	<25
S-111	BH11	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-112	BH18D	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-113	D70	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-114	BH16D	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-115	BH16S	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-116	D75	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-117	C12	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-118	LK13	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-119	I20	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-120	WS9	<10	<10	<10	<25	<10	<25	<25	<10	<10	3e	<10	<10	<25	<25
S-121	WS7	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-122	WS2	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-123	FILO1	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-124	WS5	<10	.8e	<10	<25	4e	<25	<25	2e	<10	<10	<10	2e	<25	<25
S-125	FILO4	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-126	FILO5	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-127	FILO2	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-128	FILO6	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25
S-129	C2	<10	<10	<10	<25	<10	<25	<25	<10	<10	<10	<10	<10	<25	<25

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	N-Nitrosodiphenylamine, total (µg/L) (34433)	4-Bromophenyl phenyl ether, total (µg/L) (34636)	Hexachlorobenzene, total (µg/L) (39700)	Pentachlorophenol, total (µg/L) (39032)	Phenanthrene, total (µg/L) (34461)	Anthracene, total (µg/L) (34220)	Carbazole (µg/L) (-----)[1]	Di-N-butyl phthalate, total (µg/L) (39110)	Fluoranthene, total (µg/L) (34376)	Pyrene, total (µg/L) (34469)	N-Butyl benzyl phthalate, total (µg/L) (34292)	3,3′-Dichlorobenzidine, total (µg/L) (34631)	Benzo(a) anthracene, total (µg/L) (34526)	Chrysene, total (µg/L) (34320)	Bis(2-ethylhexyl) phthalate, total (µg/L) (39100)
S-106	C1	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-107	E5	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-108	BH5D	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-109	BH18I	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-110	BH32	<10	<10	<10	<25	.8e	<10	<10	1e	.4e	.4e	<10	<10	<10	<10	.9e
S-111	BH11	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.9e
S-112	BH18D	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-113	D70	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-114	BH16D	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.7e
S-115	BH16S	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-116	D75	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	.5e
S-117	C12	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-118	LK13	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-119	I20	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-120	WS9	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	11e
S-121	WS7	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-122	WS2	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-123	FILO1	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-124	WS5	<10	<10	<10	<25	3e	.4e	<10	<10	.9e	.7e	<10	<10	<10	<10	<10
S-125	FILO4	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-126	FILO5	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-127	FILO2	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-128	FILO6	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
S-129	C2	<10	<10	<10	<25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 23. Concentrations of target semivolatile organic compounds in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Di-n-octyl phthalate, total (µg/L) (34596)	Benzo(b) fluoranthene, total (µg/L) (34230)	Benzo(k) fluoranthene, total (µg/L) (34242)	Benzo(a) pyrene, total (µg/L) (34247)	Indeno (1,2,3-cd) pyrene, total (µg/L) (34403)	1,2,5,6-Dibenzanthracene, total (µg/L) (34556)	Benzo(g,h,i) perylene, total (µg/L) (34521)
S-106	C1	<10	<10	<10	<10	<10	<10	<10
S-107	E5	<10	<10	<10	<10	<10	<10	<10
S-108	BH5D	<10	<10	<10	<10	<10	<10	<10
S-109	BH18I	<10	<10	<10	<10	<10	<10	<10
S-110	BH32	<10	<10	<10	<10	<10	<10	<10
S-111	BH11	<10	<10	<10	<10	<10	<10	<10
S-112	BH18D	<10	<10	<10	<10	<10	<10	<10

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Table 24. Concentrations of tentatively identified semivolatile organic compounds and molecular sulfur in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[µg/L, microgram per liter; n.d., not detected; e, estimated; d, sample was diluted]

Sample number	Well name	Aliphatic hydrocarbon compounds (µg/L)	Number of aliphatic compounds detected	Aromatic hydrocarbon compounds (µg/L)	Number of aromatic compounds detected	Unknown compounds (µg/L)	Number of unknown compounds detected	Molecular sulfur (µg/L)
S-001	E10	n.d.	0	n.d.	0	2e	1	n.d.
S-002	BH21	n.d.	0	n.d.	0	12e	4	n.d.
S-003	230-58	n.d.	0	n.d.	0	2e	1	n.d.
S-004	E20	n.d.	0	n.d.	0	n.d.	0	n.d.
S-005	234-142	n.d.	0	n.d.	0	n.d.	0	n.d.
S-006	D40	n.d.	0	21e	1	202e	17	n.d.
S-007	WP1	n.d.	0	n.d.	0	2e	1	n.d.
S-008	IC	n.d.	0	n.d.	0	n.d.	0	n.d.
S-009	G-1	n.d.	0	n.d.	0	n.d.	0	n.d.
S-010	230-128	n.d.	0	n.d.	0	n.d.	0	n.d.
S-011	BH8	n.d.	0	n.d.	0	n.d.	0	n.d.
S-012	BH22	n.d.	0	n.d.	0	n.d.	0	n.d.
S-013	BH33	n.d.	0	2e	1	10e	3	n.d.
S-014	E2	n.d.	0	n.d.	0	n.d.	0	n.d.
S-015	D1	n.d.	0	n.d.	0	n.d.	0	n.d.
S-016	WP2	n.d.	0	n.d.	0	n.d.	0	n.d.
S-017	230-24	n.d.	0	n.d.	0	n.d.	0	n.d.
S-018	D11	n.d.	0	n.d.	0	6e	1	2e
S-019	D10	n.d.	0	58e, d	1	4,622e, d	19	n.d.
S-020	D-5A	n.d.	0	n.d.	0	2e	1	n.d.

Table 24. Concentrations of tentatively identified semivolatile organic compounds and molecular sulfur in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aliphatic hydrocarbon compounds (μg/L)	Number of aliphatic compounds detected	Aromatic hydrocarbon compounds (μg/L)	Number of aromatic compounds detected	Unknown compounds (μg/L)	Number of unknown compounds detected	Molecular sulfur (μg/L)
S-040	237-45	n.d.	0	n.d.	0	3e	1	2e
S-041	235-45	n.d.	0	n.d.	0	6e	2	n.d.
S-042	MW-5	n.d.	0	n.d.	0	5e	2	n.d.
S-043	MW-15	35e	3	n.d.	0	89e	16	n.d.
S-044	A3	n.d.	0	3e	1	85e	15	n.d.
S-045	E1	n.d.	0	n.d.	0	n.d.	0	n.d.
S-046	A2	n.d.	0	n.d.	0	n.d.	0	n.d.
S-047	BH27	n.d.	0	n.d.	0	2e	1	n.d.
S-048	B2	n.d.	0	22e	2	225	15	151e
S-049	A1	n.d.	0	15e	1	174e	19	n.d.
S-050	A4	n.d.	0	n.d.	0	n.d.	0	n.d.
S-051	I15	n.d.	0	n.d.	0	98e	19	n.d.
S-052	244-125	n.d.	0	n.d.	0	9e	4	n.d.
S-053	244-65	n.d.	0	5e	1	14e	5	n.d.
S-054	BH6	n.d.	0	n.d.	0	2e	1	n.d.
S-055	BH4D	n.d.	0	n.d.	0	n.d.	0	4e
S-056	BH4S	n.d.	0	n.d.	0	3e	1	n.d.
S-057	BH24	n.d.	0	n.d.	0	n.d.	0	n.d.
S-058	IP	n.d.	0	n.d.	0	6e	2	n.d.
S-059	I16	n.d.	0	n.d.	0	n.d.	0	n.d.
S-060	I21	n.d.	0	n.d.	0	3e	1	n.d.
S-061	BH7I	n.d.	0	n.d.	0	n.d.	0	n.d.
S-062	BH9S	n.d.	0	n.d.	0	n.d.	0	n.d.
S-063	BH15	n.d.	0	n.d.	0	5e	2	n.d.
S-064	I10	n.d.	0	n.d.	0	15e	1	550e
S-065	BH7S	n.d.	0	n.d.	0	n.d.	0	n.d.
S-066	BH7D	n.d.	0	n.d.	0	32e	7	n.d.
S-067	I9	n.d.	0	n.d.	0	n.d.	0	n.d.
S-068	I8	n.d.	0	n.d.	0	21e	5	n.d.
S-069	B7	15e	5	n.d.	0	3e	1	n.d.
S-070	B5	n.d.	0	n.d.	0	n.d.	0	n.d.
S-071	BH28	n.d.	0	n.d.	0	n.d.	0	n.d.
S-072	D67	n.d.	0	n.d.	0	16e	1	n.d.
S-073	D68	n.d.	0	n.d.	0	n.d.	0	n.d.
S-074	C19	n.d.	0	567e	15	730e	5	n.d.
S-075	C25	n.d.	0	n.d.	0	n.d.	0	n.d.
S-076	C18	n.d.	0	n.d.	0	n.d.	0	n.d.
S-077	B10	77e	2	n.d.	0	n.d.	0	n.d.
S-078	B3	n.d.	0	n.d.	0	n.d.	0	n.d.

Table 24. Concentrations of tentatively identified semivolatile organic compounds and molecular sulfur in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Aliphatic hydrocarbon compounds (μg/L)	Number of aliphatic compounds detected	Aromatic hydrocarbon compounds (μg/L)	Number of aromatic compounds detected	Unknown compounds (μg/L)	Number of unknown compounds detected	Molecular sulfur (μg/L)
S-117	C12	n.d.	0	n.d.	0	n.d.	0	n.d.
S-118	LK13	n.d.	0	n.d.	0	n.d.	0	n.d.
S-119	I20	n.d.	0	n.d.	0	n.d.	0	12e
S-120	WS9	n.d.	0	n.d.	0	n.d.	0	n.d.
S-121	WS7	n.d.	0	n.d.	0	n.d.	0	n.d.
S-122	WS2	n.d.	0	n.d.	0	n.d.	0	n.d.
S-123	FILO1	n.d.	0	n.d.	0	12e	4	n.d.
S-124	WS5	1,561e	9	n.d.	0	21,303e	10	260e
S-125	FILO4	n.d.	0	30e	2	16,513e	18	n.d.
S-126	FILO5	5e	2	n.d.	0	11e	4	n.d.
S-127	FILO2	n.d.	0	n.d.	0	13,035e	7	n.d.
S-128	FILO6	14e	3	29e	10	2e	1	n.d.
S-129	C2	n.d.	0	23e	1	9e	2	21e

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

[μg/L, microgram per liter; <, less than; e, estimated; p, more than 25 percent difference between the two gas chromatograph columns used for analysis, lower value is reported; -- no data; numbers in parentheses in column header are U.S. Geological Survey WATSTORE and U.S. Environmental Protection Agency STORET parameter codes]

Sample number	Well name	Alpha benzene hexa-chloride, total (μg/L) (39337)	Beta benzene hexa-chloride, total (μg/L) (39338)	Delta benzene hexa-chloride, total (μg/L) (34259)	Lindane, total (μg/L) (39340)	Hepta-chlor, total (μg/L) (39410)	Aldrin, total (μg/L) (39330)	Hepta-chlor epoxide, total (μg/L) (39420)	Endo-sulfan I, total (μg/L) (34361)	Dieldrin, total (μg/L) (39380)	p,p ′ DDE, total (μg/L) (39320)	Endrin, total (μg/L) (39390)

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	p,p ′ DDT, total (μg/L) (39300)	Meth-oxy-chlor, total (μg/L) (39480)	Endrin ketone, total (μg/L) (78008)	Endrin alde-hyde, total (μg/L) (82622)	Alpha-Chlor-dane, total (μg/L) (39348)	Gamma-Chlor-dane, total (μg/L) (39810)	Tox-aphene, total (μg/L) (39400)	Aroclor 1016 PCB, total (μg/L) (34671)	Aroclor 1221 PCB, total (μg/L) (34988)	Aroclor 1232 PCB, total (μg/L) (39492)	Aroclor 1242 PCB, total (μg/L) (39496)	Aroclor 1248 PCB, total (μg/L) (39500)	Aroclor 1254 PCB, total (μg/L) (39504)	Aroclor 1260 PCB, total (μg/L) (39508)
S-001	E10	<0.1	<0.5	<0.1	<0.1	<0.05	<0.05	<5	<1	<2	<1	<1	<1	<1	<1
S-002	BH21	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-003	230-58	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-004	E20	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-005	234-142	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-006	D40	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-007	W1	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-008	IC	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-009	G-1	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-010	230-128	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-011	BH8	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-012	BH22	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-013	BH33	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-014	E2	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-015	D1	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-016	WP2	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-017	230-24	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-018	D11	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-019	D10	<.2	<1	<.2	<.2	<.1	.007e,p	<10	<2	<4	<2	<2	<2	<2	<2
S-020	D-5A	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-021	225	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-022	D20	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-023	D21	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-024	E6	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-025	E7	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993

Sample number	Well name	Alpha benzene hexa-chloride, total (μg/L) (39337)	Beta benzene hexa-chloride, total (μg/L) (39338)	Delta benzene hexa-chloride, total (μg/L) (34259)	Lindane, total (μg/L) (39340)	Hepta-chlor, total (μg/L) (39410)	Aldrin, total (μg/L) (39330)	Hepta-chlor epoxide, total (μg/L) (39420)	Endo-sulfan I, total (μg/L) (34361)	Dieldrin, total (μg/L) (39380)	p,p ′ DDE, total (μg/L) (39320)	Endrin, total (μg/L) (39390)	Endo-sulfan II,

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	p,p ′ DDT, total (µg/L) (39300)	Methoxychlor, total (µg/L) (39480)	Endrin ketone, total (µg/L) (78008)	Endrin aldehyde, total (µg/L) (82622)	Alpha-Chlordane, total (µg/L) (39348)	Gamma-Chlordane, total (µg/L)

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Alpha benzene hexa-chloride, total (µg/L) (39337)	Beta benzene hexa-chloride, total (µg/L) (39338)	Delta benzene hexa-chloride, total (µg/L) (34259)	Lindane, total (µg/L) (39340)	Hepta-chlor, total (µg/L) (39410)	Aldrin, total (

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continue

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Alpha benzene hexa-chloride, total (μg/L) (39337)	Beta benzene hexa-chloride, total (μg/L) (39338)	Delta benzene hexa-chloride, total (μg/L) (34259)	Lindane, total (μg/L) (39340)	Hepta-chlor, total (μg/L) (39410)	Aldrin, total (μg/L) (39330)	Hepta-chlor epoxide, total (μg/L) (39420)	Endo-sulfan I, total (μg/L) (34361)	Dieldrin, total (μg/L) (39380)	p,p ′

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	p,p ′ DDT, total (μg/L) (39300)	Meth-oxy-chlor, total (μg/L) (39480)	Endrin ketone, total (μg/L) (78008)	Endrin alde-hyde, total (μg/L) (82622)	Alpha chlor-dane, total (μg/L) (39348)	Gamma-Chlor-dane, total (μg/L) (39810)	Tox-aphene, total (μg/L) (39400)	Aroclor 1016 PCB, total (μg/L) (34671)	Aroclor 1221 PCB, total (μg/L) (34988)	Aroclor 1232 PCB, total (μg/L) (39492)	Aroclor 1242 PCB, total (μg/L) (39496)	Aroclor 1248 PCB, total (μg/L) (39500)	Aroclor 1254 PCB, total (μg/L) (39504)	Aroclor 1260 PCB, total (μg/L) (39508)
S-090	BH1S	0.013e,p	<0.5	<0.1	<0.1	<0.05	<0.05	<5	<1	<2	<1	<1	<1	<1	<1
S-091	BH18S	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-092	BH2	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-093	BH25	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-094	BH14	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-095	BH19	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-096	BH13	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-097	BH12	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-098	BH20	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-099	BH17	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-100	D45	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-101	MW-1	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-102	I2	.34p	<.5	.061e,p	.037e,p	.011e,p	.021e	<5	<1	<2	<1	<1	<1	.52e	<1
S-103	BH5S	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-104	C3	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-105	C4	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-106	C1	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-107	E5	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-108	BH5D	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-109	BH18I	.18p	<.5	<.1	.01e,p	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-110	BH32	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-111	BH11	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-112	BH18D	.012e,p	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-113	D70	<.1	<.5	<.1	.014e,p	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-114	BH16D	.034e,p	<.5	<.1	.015e,p	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-115	BH16S	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-116	D75	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1
S-117	C12	<.1	<.5	<.1	<.1	<.05	<.05	<5	<1	<2	<1	<1	<1	<1	<1

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	Alpha benzene hexa-chloride, total (µg/L) (39337)	Beta benzene hexa-chloride, total (µg/L) (39338)	Delta benzene hexa-chloride, total (µg/L) (34259)	Lindane, total (µg/L) (39340)	Hepta-chlor, total (µg/L) (39410)	Aldrin, total (µg/L) (39330)	Hepta-chlor epoxide, total (µg/L) (39420)	Endo-sulfan I, total (µg/L) (34361)	Dieldrin, total (µg/L) (39380)	p,p ′ DDE, total (µg/L) (39320)	Endrin, total (µg/L) (39390)	Endo-sulfan II, total (µg/L) (34356)	p,p ′ DDD, total (µg/L) (39310)	Endo-sulfan sulfate, total (µg/L) (82623)
S-118	LK13	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
S-119	I20	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1	<.1	<.1	<.1	<.1
S-120	WS9	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1	<.1	<.1	<.1	<.1
S-121	WS7	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1	<.1	<.1	<.1	<.1
S-122	WS2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
S-123	FILO1	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.1	<.1	<.1	<.1	<.1	<.1

Table 26. Concentrations of compounds containing pesticides or polychlorinated biphenyls in ground-water samples collected in the Calumet Region, Indiana and Illinois, June 1993—Continued

Sample number	Well name	p,p ′ DDT, total (µg/L) (39300)	Methoxychlor,