Department of Natural Resources
Resource Assessment Service
MARYLAND GEOLOGICAL SURVEY
Emery T. Cleaves, Director

REPORT OF INVESTIGATIONS NO. 66

GROUND-WATER QUALITY IN THE PIEDMONT REGION OF BALTIMORE COUNTY, MARYLAND

by

David W. Bolton

Prepared in cooperation with
the Baltimore County Department of
Environmental Protection and Resource Management
and the
United States Department of the Interior
Geological Survey

1998

ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

CBE	charge-balance error
DEA	deethyl atrazine
DEPRM	Baltimore County Department of Environmental Protection and Resource Management
DI	deionized
DO	dissolved oxygen
GC/MS	gas chromatography/mass spectrometry
GWQN	Maryland Ground-Water Quality Network
HAL	Health Advisory Level
MAIA	Mid-Atlantic Integrated Assessment Program
MBAs	methylene blue active substances
MCL	Maximum Contaminant Level
MDA	Maryland Department of Agriculture
MGS	Maryland Geological Survey
MRL	minimum reporting limit
NAWWS	National Alachlor Well-Water Survey
NPS	National Pesticide Survey
NWQL	U.S. Geological Survey National Water Quality Laboratory
PVC	polyvinyl chloride
ROE	residue on evaporation at 180°C.
SMCL	Secondary Maximum Contaminant Level
SWRL	Iowa State-Wide Rural Well-Water Survey
TDS	total dissolved solids
TOC	total organic carbon
TU	tritium units
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds

μg/L	micrograms per liter
μg/mL	micrograms per milliliter
mL	milliliter
mg/L	milligrams per liter
meq/L	milliequivalents per liter
pCi/L	picocuries per liter
μS/cm	microsiemens per centimeter at 25°C.
ft	feet
p-c	platinum-cobalt
$\delta^{15}N_{NO3}$ (N15/N14)	$[(^{15}N/^{14}N)_{sample}/(^{15}N/^{14}N)_{standard} - 1] \times 1000$ (expressed as ‰, or per mil)
gpm	gallons per minute

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KEY RESULTS

A ground-water-quality study was conducted in the Piedmont portion of Baltimore County. Water samples from 112 wells and springs were analyzed for major ions, nutrients, trace elements, radon, pesticides, and volatile organic compounds (VOCs). The key results of this study are:

- **Ground water** in the study area tends to be **acidic**, **low in dissolved solids**, and **well oxygenated.**

- **Maximum Contaminant Levels** (MCLs; health-related criteria established by the U.S. Environmental Protection Agency [USEPA]) were exceeded for **nitrate** and **lead**. About 5 percent of samples had **nitrate** concentrations greater than 10 milligrams per liter (mg/L) as nitrogen; about 2 percent of samples had **lead** concentrations greater than 15 micrograms per liter (µg/L). No other MCLs were exceeded for any inorganic constituent. **Secondary Maximum Contaminant Levels** (SMCLs; non-enforceable standards related to **taste, odor**, or **other aesthetic qualities**) were exceeded for **pH** (71 percent of samples had pH less than 6.5), **iron** (30 percent of samples contained greater than 300 µg/L), **manganese** (14 percent of samples contained greater than 50 µg/L), **color** (about 5 percent of samples contained greater than 15 color units), **total dissolved solids** (TDS) (about 2 percent of samples contained greater than 500 mg/L), and **chloride** (about 1 percent of samples contained greater than 250 mg/L).

- **Pesticides** (including pesticide breakdown products) were detected in samples from 71 percent of the sites. Ninety-eight percent of the pesticide detections were less than 1 µg/L, and most were less than 0.1 µg/L. None of the pesticide detections exceeded any MCL. The most frequently detected pesticides were **deethyl atrazine** (DEA; a breakdown product of the herbicide atrazine), **metolachlor, atrazine, carbofuran,** and **simazine**. **Volatile organic compounds** (VOCs) were detected at 3 of 112 sites. Three compounds (**methylene chloride, tetrachloroethylene,** and **1,1,1-trichloroethane**) were detected, two of which (**methylene chloride** and **tetrachloroethylene**) exceeded their respective MCLs.

- More than 95 percent of wells in the study area had detectable levels of **nitrate**. Analysis of nitrate with respect to **land-use data, nitrogen isotopes,** and **pesticide detections** indicates that nitrate concentrations in well water are associated with current and former **agricultural activity** (such as fertilizer application), and that **septic-system effluent** has had little overall impact on nitrate or other water-quality constituents.

- **Chloride** concentrations tended to be highest in wells located less than 200 ft from a paved road, indicating that chloride concentrations in ground water may be associated with **road salt.** However, only one well in the study had a chloride concentration higher than 250 mg/L, the SMCL for chloride.

- **Chloride, nitrate,** and **atrazine** concentrations did not vary greatly in most of the wells that were sampled monthly between May 1995 and April 1996. There was little relationship between well-water **chloride concentration** and **time of year,** even in wells that had been affected by road salt. **Atrazine** concentrations tended to increase in late summer and early fall and decrease through January.

- There was little relationship between concentrations of **water-quality** constituents and **well depth, casing depth, depth to water, well yield**, or other well characteristics.

- **Radon** concentrations exceeded 4,000 picocuries per liter (pCi/L) in samples from 29 percent of the sites. **Radon** concentrations tended to be higher in samples from **schists** and **gneisses** (median concentrations: 2,900 and 2,600 pCi/L, respectively), than in samples from **marble** and **mafic rocks** (median concentrations: 550 and 540 pCi/L, respectively).

- There was little **local variation in well-water quality** for wells sampled from the same residential development.

- There were statistically significant differences in concentrations of most **major-ion constituents** between the four rock types in the study area (**schist, gneiss, marble,** and **mafic rocks**).

INTRODUCTION

Ground water is the primary source of water for residents of the rural areas of Baltimore County. The crystalline-rock aquifers underlying these areas are vulnerable to contamination because they lack protective (confining) layers that are common in the Coastal Plain. Although water wells are tested for nitrate and bacteria when property is sold or refinanced, there have been no large-scale studies that have characterized ground-water quality in the Piedmont portion of Baltimore County. As residential development continues in the central and northern portions of the county, the documentation of current ground-water-quality becomes increasingly important for the effective management of the ground-water resources. Because of this, the Maryland Geological Survey conducted an investigation of ground-water quality in the area of the county that is underlain by crystalline rocks and that is not serviced by public water supplies. The study was conducted as part of the Baltimore County's Comprehensive Ground Water Management and Protection Strategy.

PURPOSE AND SCOPE

This report provides an assessment of the overall quality of ground water in the portion of the Piedmont region of Baltimore County that is not serviced by public water supplies. Study design and sampling methods are presented. Concentrations of ground-water quality constituents (major ions, trace elements, nutrients, radon, pesticides, and volatile organic compounds [VOCs]) are summarized and related to drinking-water regulations and health advisories. Ground-water quality is discussed in relation to aquifer lithology, land use, well characteristics, and topographic position. Temporal and local variation in ground-water quality are discussed. Recommendations are made concerning future ground-water investigations. The information in this report can be used as a baseline against which future ground-water-quality data can be compared in order to assess the effectiveness of policy initiatives provided by the Baltimore County Comprehensive Ground Water Protection Strategy.

PREVIOUS INVESTIGATIONS

Dingman and Ferguson (1956) reviewed the ground-water resources of the Piedmont portion of Baltimore County. Nutter and Otton (1969) studied the occurrence and availability of ground water in the crystalline-rock aquifers of the Maryland Piedmont. Well and spring records in Baltimore County were compiled by Laughlin (1966), and water-quality data from wells and springs were compiled by Woll (1978). The Maryland Geological Survey (MGS) has published a series of hydrogeologic atlases, each corresponding to individual U.S. Geological Survey (USGS) 7.5-minute quadrangles, which contain maps of ground water availability, depth to the water table, slope of the land surface, locations of wells and springs, and other hydrogeologic features. The geology of the crystalline rocks in Baltimore County and the eastern Maryland Piedmont was discussed by Cleaves (1968; 1974) and Crowley (1976). Chemical weathering processes in two small watersheds in Baltimore County are discussed by Cleaves, Godfrey, and Bricker (1970) and Cleaves, Fisher, and Bricker (1974). Cleaves and others (1987) assessed the ground-water pollution potential in Baltimore County and vicinity.

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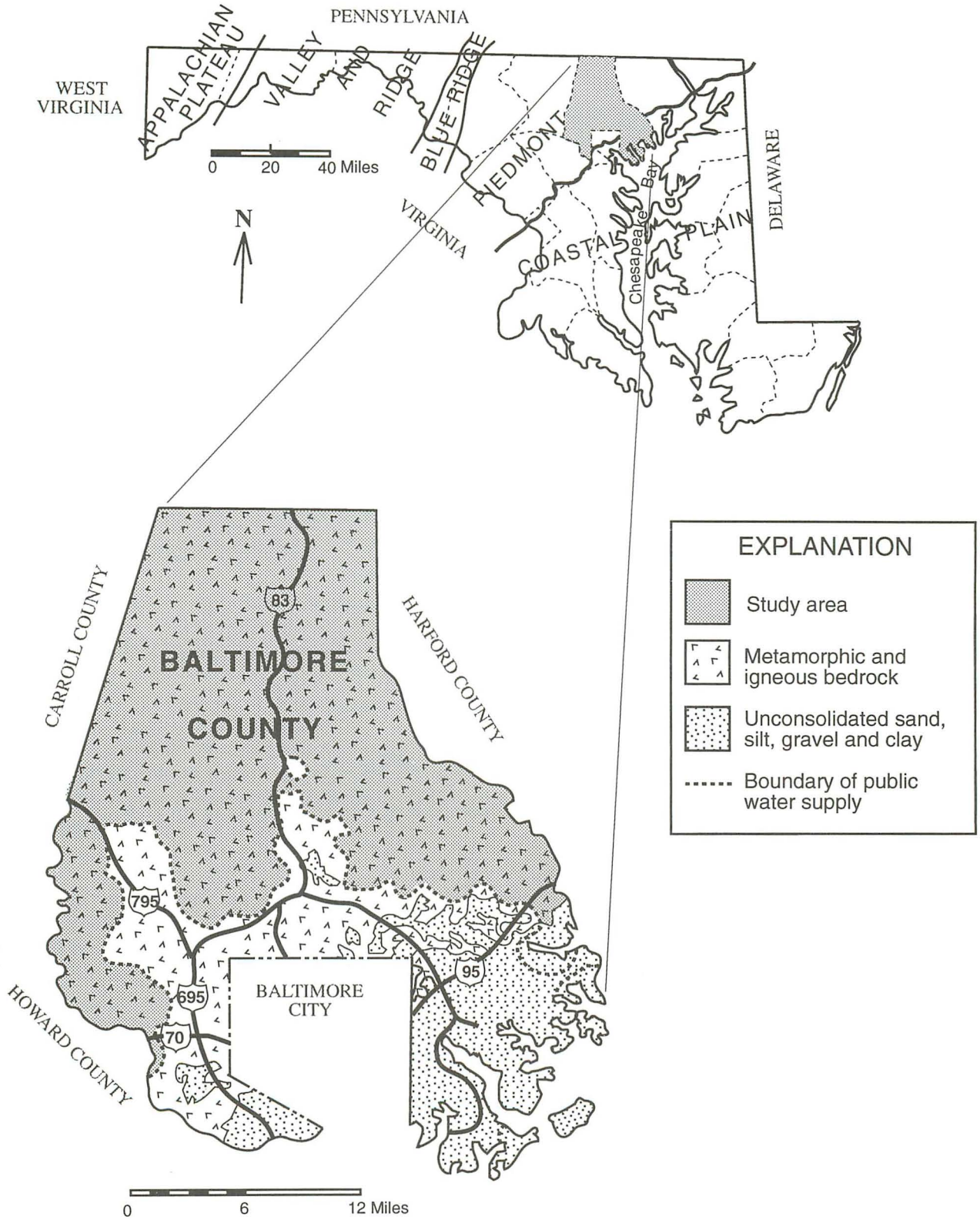


Figure 1. Location of the study area, showing physiographic provinces.

DESCRIPTION OF THE STUDY AREA

The study area consists of the portion of Baltimore County that is underlain by crystalline (metamorphic and igneous) rocks and that is not serviced by public water supplies (fig. 1). This area covers approximately 370 square miles, or about 60 percent of the county. Elevations in the county range from sea level to 966 ft above sea level; most of the county lies between 200 and 700 ft above sea level. The topography is characterized by gently rolling hills.

GEOLOGY

Baltimore County includes portions of both the Piedmont and the Coastal Plain physiographic provinces (fig. 1). Approximately 80 percent of the county is located in the Piedmont physiographic province, which is underlain by Precambrian and Paleozoic crystalline (metamorphic and igneous) rocks (fig. 2; tab. 1). The extreme southern and southeastern areas of the county are in the Coastal Plain physiographic province and are underlain by unconsolidated sands, silts, gravels, and clays of the (Cretaceous) Potomac Group and Quaternary deposits (Cleaves, Edwards, and Glaser, 1968).

The crystalline rocks in Baltimore County can be grouped into three mineralogic categories: silicic, mafic, and carbonate rocks. The silicic rocks (chiefly schist and gneiss, with smaller amounts of quartzite and granite) are composed largely of quartz and feldspar minerals, and underlie approximately 85 percent of the study area. The three most extensive geologic formations in this category in the study area are the Prettyboy Schist (formerly called the Wissahickon albite-chlorite-mica schist or the Wissahickon upper pelitic schist), the Loch Raven Schist (formerly called the Wissahickon oligoclase mica schist or the Wissahickon lower pelitic schist), and the Baltimore Gneiss. Together, these three formations underlie approximately two-thirds of the study area. The mafic rocks (including the Baltimore Mafic Complex) are composed primarily of amphibolite with smaller amounts of other rocks. Amphibole and plagioclase are the dominant minerals; quartz is not a major component of these rocks. The mafic rocks underlie approximately 5 percent of the study area. The carbonate rocks include the Cockeysville Marble and the Hydes Marble Member of the Loch Raven Schist; these rocks underlie about 10 percent of the study area. Calcite and dolomite are the dominant minerals in these rocks, although silicate minerals are present locally. The carbonate minerals in these rocks dissolve more rapidly in ground water than the silicate minerals in the noncarbonate rocks; as a result, valleys are developed in areas underlain by marble.

The geologic structure of the crystalline rocks in the eastern Piedmont of Maryland is dominated by a series of gneiss domes which trend approximately northeast-southwest. The Baltimore Gneiss (which forms the core of the domes) and the overlying rocks have undergone multiple episodes of deformation and metamorphism. Additional information on the geology of Baltimore County and vicinity is presented in Knopf and Jonas (1929), Broedel (1937), Vokes and Edwards (1974), Crowley (1976), Muller and Chapin (1984), and Horton and Rast (1989).

Bedrock in the study area is typically covered with a layer of material called saprolite that forms *in situ* through the weathering of the underlying crystalline rocks. Saprolite characteristics are related to the type of parent rock: schist and gneiss tend to weather to a sandy permeable saprolite, while quartz-poor rocks such as gabbro and metabasalt tend to weather to a less permeable saprolite with a higher clay content. Saprolite developed on marble varies from high clay content and low permeability to permeable dolomite sand (Nutter and Otton, 1969). Textural features of the parent rock are often retained in the saprolite. In Maryland, saprolite thickness ranges from zero to greater than 100 ft, and averages 45 ft (Nutter and Otton, 1969). Saprolite thickness is greater beneath uplands, slopes, and hilltops than beneath valleys and draws, largely due to stream erosion (Dingman and Ferguson, 1956).

SOILS

Nine soil associations (landscapes that have distinct proportional patterns of soils) have been mapped in Baltimore County. Four of the soil associations cover most of the study area. The Chester-Glenelg and Manor-Glenelg associations consist of deep, well-drained soils having a subsoil of loam and silt loam to light silty clay loam. They are underlain by schists, gneisses, and other silicic rocks, and are developed on uplands. The Baltimore-Conestoga-Hagerstown association consists of deep, well-drained soils with a subsoil of clay loam to clay. They are found in valleys developed on the carbonate rocks. The Legore-Aldino-Neshaminy association, which is developed on mafic rocks, includes deep, well-drained soils that have a subsoil of silty clay loam or clay loam and moderately well-drained soils with a subsoil of silty clay loam and a fragipan. These soil associations are described in more detail in Reybold and Matthews (1976).

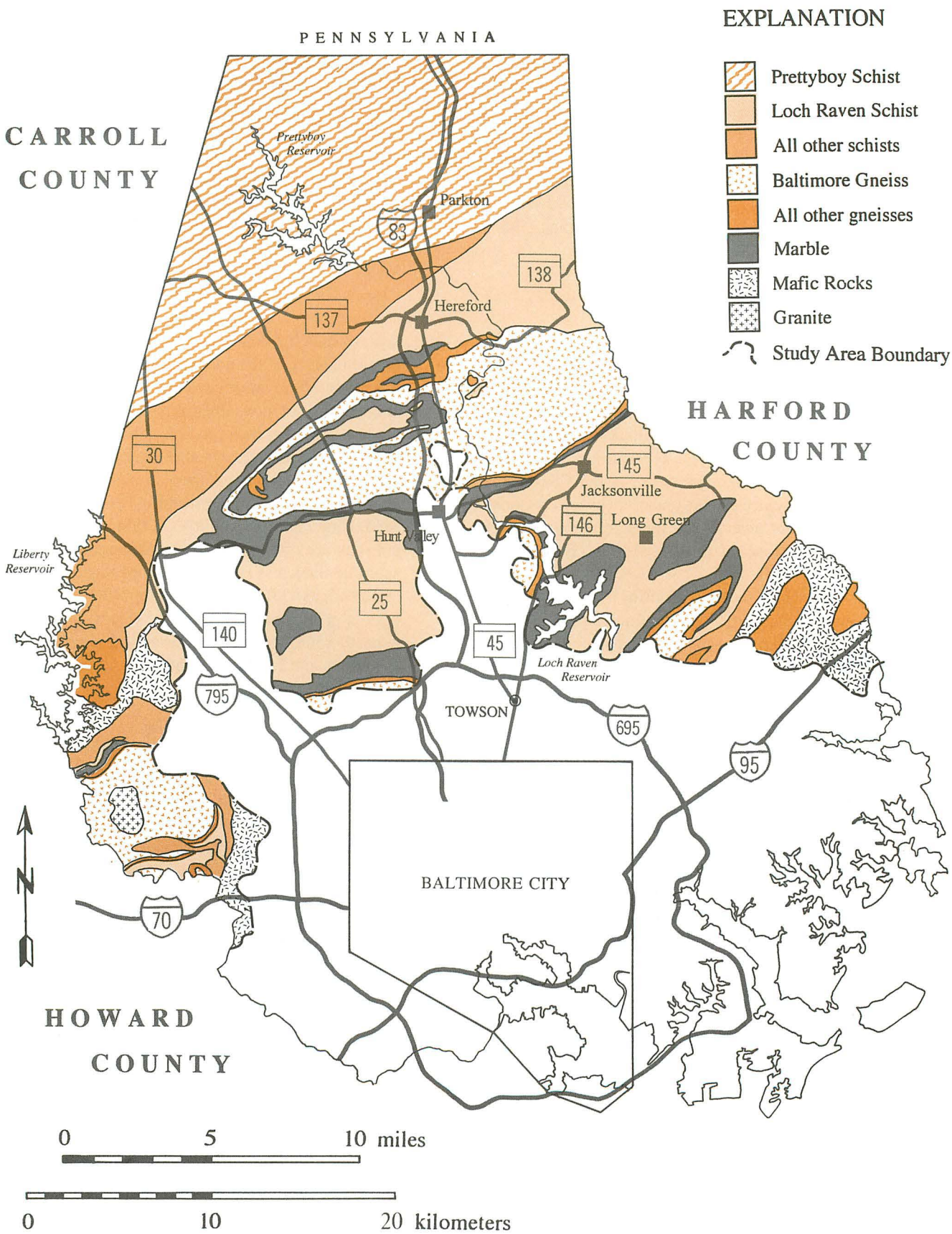


Figure 2. Generalized geologic map of the study area.

Table 1.
Generalized description of crystalline rocks in Baltimore County.

[Source: Crowley, Reinhardt, and Cleaves (1976)]

Age	Name			Description
GLENARM SUPERGROUP AND BALTIMORE GNEISS				
Cambro-Ordovician (?)	Glen Arm Supergroup	Wissahickon Group	Prettyboy Schist	Plagioclase-chlorite-muscovite-quartz schist, commonly with magnetite and conspicuous albite porphyroblasts
			Pleasant Grove Schist	Plagioclase-chlorite-muscovite-quartz schist, locally with magnetite
			Sykesville Formation	Gneiss Member: biotite-feldspar-quartz gneiss, commonly with clasts Schist Member: resembles gneiss member but generally finer grained; commonly garnetiferous, muscovitic, foliated, locally devoid of clasts
			Piney Run Formation	Plagioclase-chlorite-muscovite-quartz schist
			Oella Formation	Biotite-plagioclase-muscovite-quartz schist interlayered with biotite-plagioclase-quartz gneiss or fels Sweathouse Amphibolite Member: as above but interlayered with epidote amphibolite
			Loch Raven Schist	Biotite-plagioclase-muscovite-quartz schist with lenticles and pods of vein quartz Hydes Marble Member: metalimestone and metadolostone Rush Brook Member: quartz-rich schist and gneiss
Cambro-Ordovician (?)		Cockeysville Marble		Marble, metalimestone, metadolostone
Cambro-Ordovician (?)		Setters Formation		Gneiss, schist, and quartzite
Precambrian	Baltimore Gneiss			Biotite-microcline-quartz-plagioclase gneiss
LAUREL AND BEL AIR BELTS				
Cambro-Ordovician (?)	Perry Hall Gneiss			Interlayered biotite-quartz-plagioclase gneiss and hornblende-quartz-plagioclase gneiss
Cambro-Ordovician (?)	Franklinville Gneiss			Biotite-quartz-plagioclase gneiss
Cambrian (?)	Jones Falls Schist			Biotite-plagioclase-muscovite-quartz schist
Cambrian (?)	James Run Formation			Biotite-quartz-plagioclase gneiss and amphibolite
Cambrian (?) (Baltimore Mafic Complex)	Mt. Washington Amphibolite			Amphibolite, locally with pyroxene
	Hollofield Layered Ultramafite			Ultramafic and mafic rocks, chiefly actinofels and actinoschist
	Raspeburg Amphibolite			Amphibolite with rare streaks of more felsic gneiss
	Bradshaw Layered Amphibolite			Interlayered amphibolite and hornblende-quartz-plagioclase gneiss

Table 1 (continued).
Generalized description of crystalline rocks in Baltimore County

[Source: Crowley, Reinhardt, and Cleaves (1976)]

Age	Name	Description
INTRUSIVE ROCKS		
Silurian (?)	Pegmatite	Quartz, feldspar, and commonly mica (chiefly muscovite)
Silurian (?)	Woodstock Granite	Epidote-muscovite-biotite-microcline-quartz-plagioclase granite
Silurian (?)	Ellicott City Granite	Epidote-microcline-biotite-quartz-plagioclase granite
?	Cold Spring Gneiss	Biotite-muscovite-microcline-quartz-plagioclase gneiss or schistose gneiss
Ordovician (?)	Gunpowder Gneiss	Plagioclase-quartz-microcline gneiss, generally with both biotite and muscovite
Precambrian	Slaughterhouse Gneiss	Biotite-muscovite-microcline-quartz-plagioclase gneiss

HYDROLOGY

Ground-Water Hydrology

Ground water in crystalline-rock terrains is stored in the saprolite and the joints, fractures, and other secondary openings in the rocks owing to their low primary porosities, which are rarely larger than 2 percent (fig. 3) (Freeze and Cherry, 1979). Ground-water systems in crystalline rocks tend to be localized; flow is from the interstream divides towards the nearest perennial stream, and there is very little interbasin ground-water flow (LeGrand, 1988; 1989). Saprolite tends to be characterized by high porosity and a wide range of permeability, whereas the bedrock has a relatively low storage capacity but is capable of transmitting water readily when fractures are present (LeGrand, 1989). Saprolite porosities in samples from the Maryland Piedmont ranged from 34.3 percent to 60.3 percent (average: 46.8 percent); saprolite permeabilities tend to be greatest in the soil zone and near the saprolite-bedrock contact (Nutter and Otton, 1969). The water table in most crystalline-rock terrains is in the saprolite, and ground water occurs under unconfined conditions. Fractures in the bedrock, which develop in response to crustal forces and removal of overburden, tend to decrease in size and number with increasing depth; the lower boundary of the saturated zone is the base of the zone in which interconnected fractures exist. Permeability tends to decrease with depth in crystalline rocks, and well yields are generally not increased by drilling deeper than about 300 ft (Davis and DeWiest, 1966; Heath, 1984). Fracture widths are generally less than a tenth of an inch (Freeze and Cherry, 1979), but drillers' logs commonly indicate only those "breaks" large enough to be recorded. Fractures influence surface topography: the orientations of stream reaches in Baltimore County have been shown to correlate closely to the joint orientations measured in rocks in nearby quarries (Nutter and Otton, 1969). In the Maryland Piedmont, wells located in valleys and draws generally have greater well yields than those drilled on hilltops, uplands, or slopes (Nutter and Otton, 1969; Dingman and Ferguson, 1956; Dine, Adamski, and Duigon, 1995). This is partly because the valleys develop along fracture zones, and also because the water table is closer to the surface (where the fractures are more numerous and wider). Well yield depends on the number and type of fractures that intersect the well, and on the amount of recharge to the fractures from the overlying saprolite.

Surface-Water Hydrology

The major surface-water drainages in Baltimore County are Gunpowder Falls, Little Gunpowder Falls, and the Patapsco River. Smaller areas are drained by Gwynns Falls and Jones Falls (near Baltimore City) and Deer Creek (in the northeastern corner of the county), which flows to the Susquehanna River in Harford County. All surface waters in the study area drain to the Chesapeake Bay. Prettyboy, Loch Raven, and Liberty Reservoirs provide water for Baltimore City and neighboring areas. Further information on flow characteristics of surface water in the study area is found in Martin (1956).

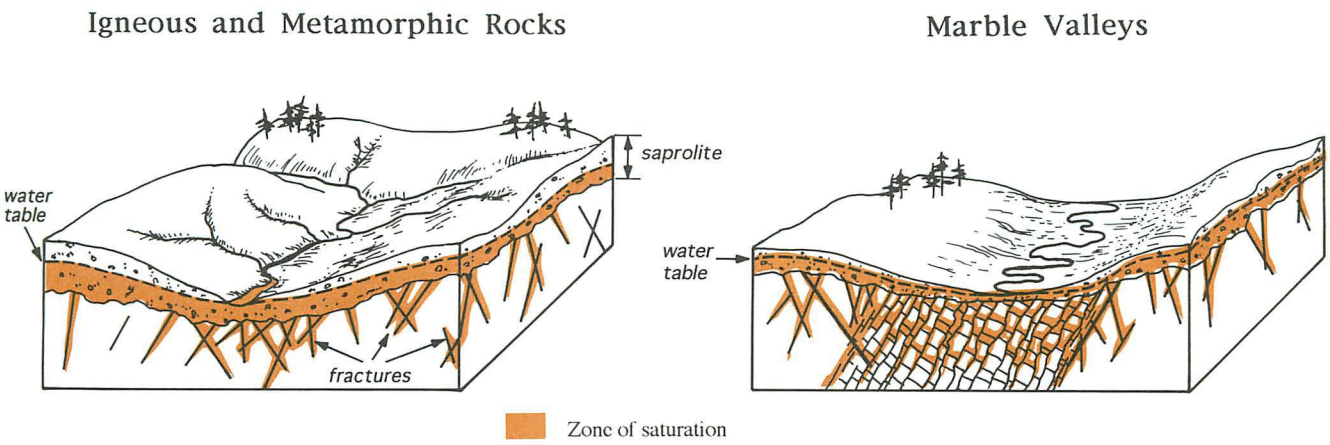


Figure 3. Block diagrams showing general ground-water hydrologic features in igneous and metamorphic rocks and marble valleys.

LAND USE

Approximately 83 percent of the study area is either forested (42 percent) or agricultural (41 percent). Residential land use makes up about 13 percent of the study area; commercial, institutional, and other land uses make up the remaining area. Between 1973 and 1990, a decrease in the amount of forest and agricultural land cover was accompanied by an increase in residential land use, with the greatest percentage increase occurring in low-density residential land use (Maryland Office of Planning, 1991). Corn, soybeans, and hay are the dominant crops (as measured by acreage), with smaller amounts of wheat, barley, commercial vegetables, and melons. There are several dairy farms in the county (3,600 head of milk cows in 1995) (Maryland Department of Agriculture [MDA], 1996a).

SITE IDENTIFICATION SYSTEM

Wells and springs in Maryland are identified by an alphanumeric system. The first two letters, both capitalized, indicate the county where the site is located (BA for Baltimore County). The next two letters (the first letter capitalized, the second letter lowercase) correspond to a 5-minute by 5-minute block of a grid superimposed over the county: the first letter corresponds to the row and the second letter corresponds to the column within the grid (fig. 40). Wells and springs within each block are numbered sequentially as they are inventoried. Thus, well BA Fb 81 refers to the eighty-first well inventoried in the block located at the intersection of row "F" and column "b" in Baltimore County. Because all wells and springs in this report are in Baltimore County, the "BA" has been dropped from the beginning of the well number when referring to a specific well or spring in the text of this report.

STUDY DESIGN

The study was conducted in two phases. In Phase I, 106 wells and 6 springs were sampled for a broad range of chemical constituents in order to provide an overall assessment of ground-water quality in the study area. In Phase II, additional samples were collected from Phase I wells and several new wells to provide data on temporal and local variation of well-water quality, age of ground water, and sources of nitrate to well water.

PHASE I

Candidate Sites

Candidate sites for Phase I included both wells and springs. Candidate wells included all documented water-supply wells in the study area. "Water-supply wells" included both producing wells and wells that had not yet been

connected to a distribution system. "Documented" wells were defined as those with known total depth, casing depth, and grouting record. The sources of the documentation for each well were the well permit application and the well completion report. Well selection was restricted to documented wells because the construction requirements of the candidate wells are the same as for all crystalline-rock wells currently (1997) drilled in Baltimore County; furthermore, evaluation of ground-water quality with respect to construction characteristics is maximized. Dug wells were not considered because they may be more susceptible than drilled wells to contamination from material washed in from the surface. Sites were not excluded if they were known to be contaminated or if they were near areas of known contamination. Springs were included in the selection process primarily to provide information on shallow ground-water quality. Candidate springs included all perennial springs whose water quality did not appear to have been affected by improvements such as collecting basins or springhouses.

Site Selection

Most Phase I sites were selected by simple random sampling. A grid of lines spaced at 400-foot intervals was generated over the study area, using a geographic-information-systems approach. The grid contained approximately 64,000 line intersections which were numbered consecutively. From these, 100 intersections were selected using a random number generator. Each random point was located on a USGS 7.5-minute topographic map (scale 1:24,000). The nearest well or spring to each random point was then located using a combination of field reconnaissance, examination of aerial photographs, and computerized data retrieval. Project personnel interviewed people living or working near each random point. If occupants were available during the field visit, they were told about the project and were interviewed about wells and springs on and near the property. If no one was available near the site, the street addresses near the random points were recorded and the corresponding telephone numbers were located using Baltimore County Criss-Cross Directory (which lists entries by street address), and phone contact was attempted at a later time. Aerial photographs were used to help locate houses or buildings that were not immediately visible during field reconnaissance. A computer-based retrieval was made of DEPRM's database for all wells whose Maryland grid coordinates (as recorded on the well permit application) fell within a search radius of 1,000 ft around each random point. Contact with the owner of the nearest potential site was attempted several times via site visits, telephone, or mail. If the owner could not be contacted, or if the well or spring was unsuitable, then contact with the owner of the next closest site was attempted, and so forth, until sampling permission was granted for the nearest available suitable site. Field reconnaissance proved to be the most effective method for locating candidate sites.

Ninety-seven wells and three springs were selected in this manner from the one hundred random points. Many springs were investigated but most were found to be unsuitable because improvements such as collecting basins or other structures altered the water quality (as indicated by large variations in specific conductance within the basins). Three additional suitable springs were selected from among the springs inventoried in the USGS WATSTORE database in order to obtain more data on shallow ground-water quality. Nine additional wells were selected in the Cockeysville Marble and the Hydes Marble Member of the Loch Raven Schist because only two of the Phase I sites were located in the marble aquifers, which have the highest ground-water pollution potential of all the crystalline-rock settings in Baltimore County (Cleaves and others, 1987). Additional random points were generated in areas underlain by these formations, and the nearest wells or springs in marble were identified in the same way as the first 100 sites.

Of the 112 Phase I sites (106 wells and 6 springs), 75 sites (71 wells and 4 springs) were in schist; 21 sites (20 wells and 1 spring) were in gneiss; 11 sites (10 wells and 1 spring) were in marble; and 5 sites (all wells) were in mafic rocks. Well characteristics are summarized in figure 4. Well and spring locations are shown in figure 5 and in Appendix C.

Site selection and sampling proceeded concurrently. The 97 Phase I wells and three randomly-selected springs were sampled between August 1994 and July 1995. The additional nine wells in marble aquifers were sampled between October and December 1995. The three springs selected from the WATSTORE database were sampled in August 1996.

The vast majority of well and spring owners were willing to have their wells or springs sampled. The most common reason for non-selection of a well was lack of suitable documentation; many wells were too old or the well completion report could not be located. Commonly cited reasons for refusing permission to sample were: (1) concern that an unfavorable analysis would require drilling a replacement well or some other remedial action; (2) previous negative encounters with DEPRM, the Maryland Department of Natural Resources, or other government agencies; and (3) general distrust of the government. Several localities with existing ground-water disputes required extra effort to secure permission to sample.

Water-Quality Constituents

Phase I water samples were analyzed for inorganic constituents and indicators, pesticides, and VOCs. Inorganic constituents include major ions, nutrients, trace elements, and radon (tab. 2). Major ions were analyzed because they reflect the hydrochemical processes occurring in ground

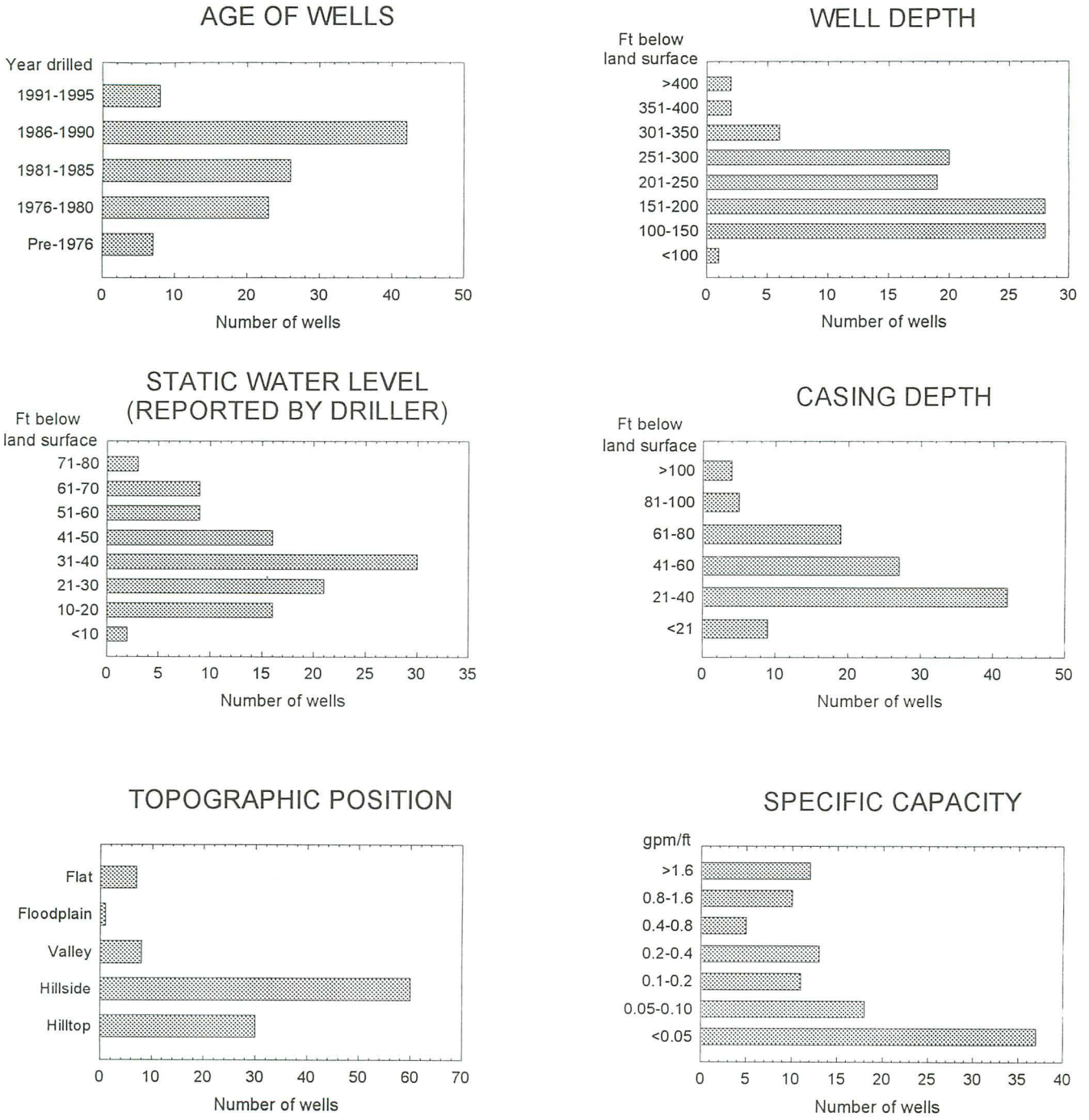


Figure 4. Characteristics of Phase I wells.

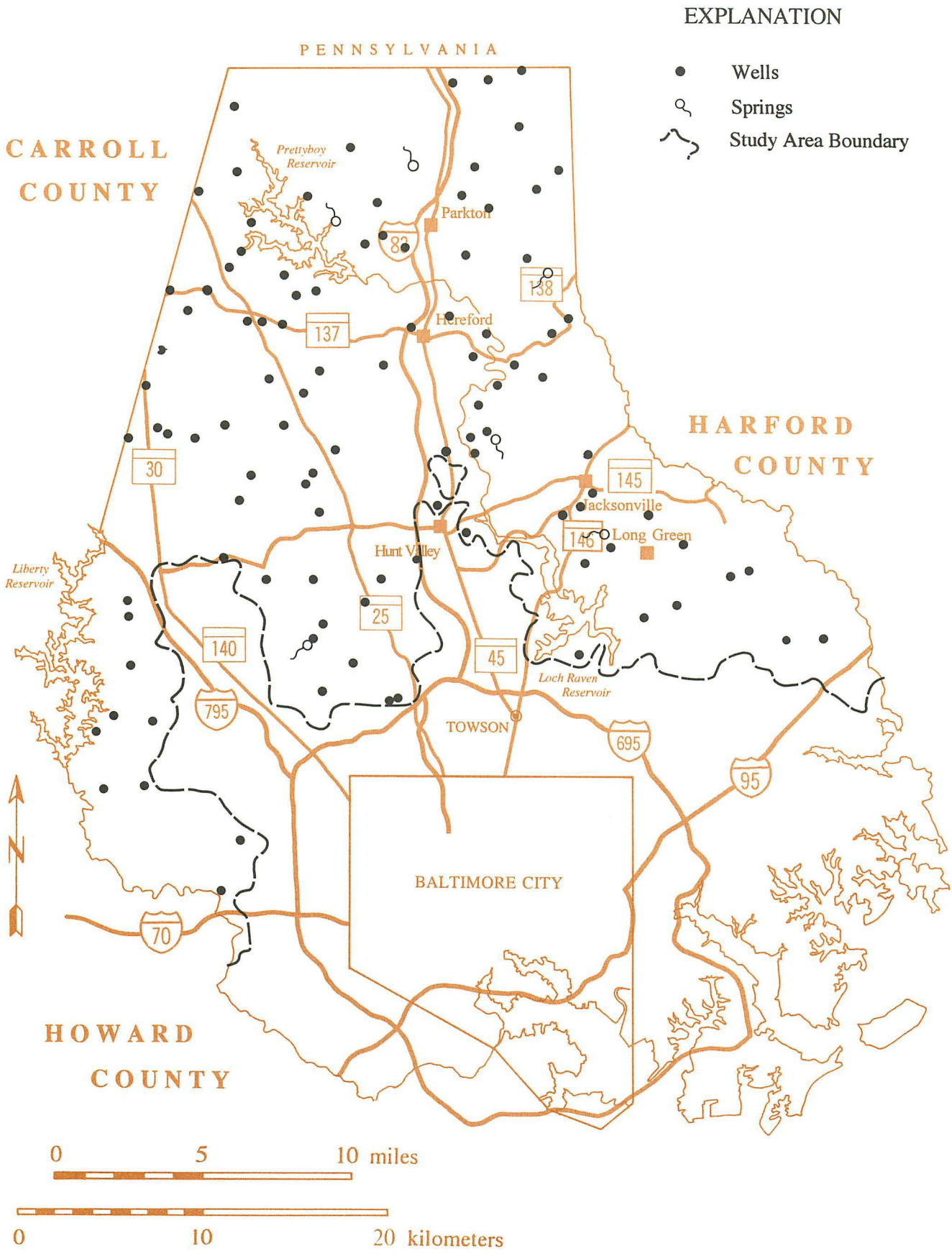


Figure 5. Locations of Phase I wells and springs.

water; furthermore, health criteria have been established for several ions. Nutrients (nitrogen and phosphorus species) were analyzed to evaluate both the extent of nitrate contamination and the relationship between nutrients and land use. Trace elements, loosely defined as inorganic ions with concentrations less than about 1 µg/L, included those for which a final MCL has been established by the USEPA. Many of the trace elements do not occur naturally at concentrations of health concern, based on aquifer mineralogy, but were nevertheless included because of the possibility of point-source contamination. Indicators (measurements that reflect some aspect of general water-quality conditions) included pH, TDS, specific conductance, alkalinity, dissolved oxygen (DO), total organic carbon (TOC), color, and methylene-blue active substances (MBAs).

Phase I sites were analyzed for approximately 55 pesticides and pesticide metabolites. Pesticides that were analyzed in Phase I included most of the pesticides that were reported to be widely used in Maryland (Maryland Department of Agriculture, 1996b). All samples from Phase I sites were analyzed for triazine herbicides and other pesticides via C-18 solid-phase extraction and gas chromatography/mass spectrometry (GC/MS) (USGS schedule 2001; tab. 3). Samples were analyzed for carbamate insecticides via high-performance liquid chromatography (USGS schedule 1359; tab. 4). Samples were also tested for the herbicide 2,4-D using an immunoassay test kit (Strategic Diagnostics, Inc., Newtown, Pennsylvania)[1]; approximately 10 percent of the samples were also analyzed for 2,4-D and other phenoxy herbicides (USGS schedule 79; tab. 5) by gas chromatography for confirmation of immunoassay results. Phase I sites were analyzed for approximately 60 VOCs (tab. 6), both to check for unsuspected sources of contamination and because some of these compounds have been identified in septic effluent (Viraraghavan and Hashem, 1986).

Specific conductance, pH, dissolved oxygen, and alkalinity were measured in the field. Laboratory analysis was performed by the USGS National Water Quality Laboratory (NWQL) in Arvada, Colorado. Immunoassay analysis was performed by project personnel. Analytical methods for inorganic constituents are given in Fishman and Friedman (1989), Faures (1993), and Fishman (1993). Analytical methods for synthetic organic compounds are described in Wershaw and others (1987) (phenoxy herbicides); Werner and Johnson (1994) (carbamate insecticides); Rose and Schroeder (1995) (VOCs); and Zaugg and others (1995) (triazine herbicides and other pesticides).

[1] The use of tradenames and product names in this report is for identification purposes only, and does not constitute endorsement.

PHASE II

In Phase II of the study, additional samples were collected from selected Phase I wells and from new wells. Ten wells were sampled at monthly intervals from May 1995 to April 1996; the monthly samples were analyzed for nitrate-plus-nitrite, chloride, atrazine (by immunoassay), pH, and specific conductance. The wells for monthly sampling were selected from among the Phase I wells with the highest chloride, nitrate, or atrazine concentrations as of May 1995. Twenty-six wells and one spring were sampled for tritium in order to provide data on the age of ground water in the study area. Twenty-two wells and one spring in different land-use areas were analyzed for $^{15}N_{NO3}$ (a stable isotope of nitrogen in nitrate) to identify sources of nitrate in ground water. Six wells within a single residential development were sampled for all Phase I constituents, tritium, and $^{15}N_{NO3}$ in order to observe ground-water quality variation within a small geographic area. A pair of adjacent wells with different depths (400 ft and 1,050 ft) were sampled to compare shallow and deep ground-water quality at the same location. Three wells (two Phase I wells and a previously sampled USGS monitor well) that showed little or no evidence of human impact were resampled in 1995 and 1996 as part of a long-term ground-water-quality data-collection program. $^{15}N_{NO3}$ was analyzed by Global Geochemistry Corporation (Canoga Park, California). Tritium was analyzed by the USGS laboratory in Menlo Park, California. Atrazine immunoassay analysis was performed by project personnel. All other Phase II laboratory analysis was performed by the NWQL.

SAMPLING METHODS

Well-water samples were collected from the closest available spigot to the well. Most were collected at the pressure-tank spigot; others were collected from outside spigots. Water-treatment systems were bypassed in all cases. Upon arrival at each site, the pH meter (Beckman Φ11 pH meter with a Model 39847 combination electrode) was calibrated using a 2-buffer standardization procedure. The buffers were selected to bracket the anticipated pH of the sample. A YSI Model 3000 TLC specific conductance meter was checked against low (25 to 50 microsiemens per centimeter [µS/cm]) and high (400-750 µS/cm) specific conductance standards. Water-level measurements were obtained where possible (about half of the Phase I wells).

After the instruments were calibrated and checked, the well was purged. A hose was connected to one outlet of a Y-valve attached to the spigot where the sample was to be collected. The flow rate (usually about 2 gallons per minute [gpm]) was measured, and pH, specific conductance, and water temperature were recorded at five-minute intervals. The pH electrode and specific conductance probe were usu-

Table 2.
Inorganic constituents and indicators analyzed in Phase I wells and springs.

[Sample container designations are described in table 7. mg/L, milligrams per liter; μg/L, micrograms per liter; μS/cm, microsiemens per centimeter; pCi/L, picocuries per liter]

Constituent	Minimum reporting level	Laboratory (L) or field (Fd) measurement	Sample container designation
Alkalinity	1.0 mg/L as $CaCO_3$	L, Fd	RU
Ammonium	0.01 mg/L as N	L	FCC
Antimony	1 μg/L	L	FA
Arsenic	1 μg/L	L	FA
Barium	2 μg/L (100 μg/L)[2]	L	FA
Beryllium	10 μg/L (0.5 μg/L)[2]	L	FA
Cadmium	1 μg/L	L	FA
Calcium	0.1 mg/L	L	FA
Chemical oxygen demand[1]	10 mg/L	L	LC0076
Chloride	0.1 mg/L	L	FU
Chromium	1 μg/L	L	FA
Color	1.0 platinum-cobalt unit	L	RCB
Copper	1 μg/L	L	FA
Cyanide	10 μg/L	L	LC0880
Dissolved oxygen	1 mg/L	Fd	BOD
Fluoride	0.1 mg/L	L	FU
Hardness	Calculated	L	--
Iron (filtered)	3 μg/L	L	FA
Iron (unfiltered)	10 μg/L	L	RA
Lead	1 μg/L	L	FA
Lithium[1]	0.5 μg/L	L	FA
Magnesium	0.1 mg/L	L	FA
Manganese (filtered)	1 μg/L	L	FA
Manganese (unfiltered)	10 μg/L	L	RA

[1] Analyzed in Phase II only
[2] Some samples were analyzed using the reporting level in parentheses

Table 2, continued.
Inorganic constituents and indicators analyzed in Phase I wells and springs.

[Sample container designations are described in table 7. mg/L, milligrams per liter; μg/L, micrograms per liter; μS/cm, microsiemens per centimeter; pCi/L, picocuries per liter]

Constituent	Minimum reporting level	Laboratory (L) or field (F) measurement	Sample container designation
Mercury	0.1 μg/L	L	FAM
Methylene-blue active substances	0.02 mg/L	L	RCB
Nickel	1 μg/L	L	FA
Nitrate plus nitrite	0.05 mg/L as N	L	FCC
Nitrite	0.01 mg/L as N	L	FCC
$^{15}N_{NO3}$[1]	--	L	RUS
Organic carbon (total)	0.1 mg/L as C	L	TOC
Orthophosphorus	0.01 mg/L as N	L	FCC
pH	--	L, Fd	RU
Phosphorus	0.01 mg/L as N	L	FCC
Potassium	0.1 mg/L	L	FA
Radon-222	80 pCi/L	L	LS
Selenium	1 μg/L	L	FA
Silica	0.1 mg/L as SiO_2	L	FU
Sodium	0.1 mg/L	L	FA
Specific conductance	1 μS/cm	L, Fd	RU
Strontium[1]	4 μg/L	L	FA
Sulfate	0.1 mg/L	L	FU
Thallium	1 μg/L	L	FAB
Solids (residue on evaporation)	1.0 mg/L	L	FU
Solids, total dissolved (sum of constituents)	Calculated	L	--
Tritium (^3H)[1]	1 pCi/L	L	RUR
Zinc	10 μg/L (3 μg/L)[2]	L	FA

[1] Analyzed in Phase II only
[2] Some samples were analyzed using the reporting level in parentheses

Table 3.
Triazine herbicides and other pesticides (USGS schedule 2001) analyzed in Phase I wells and springs.

[Analysis was performed on filtered samples collected in GCC bottles; see table 7 for bottle description. Widely-used synonyms are in parentheses. Source: Zaugg and others (1995), p. 32-33. μg/L, micrograms per liter]

Constituent	Minimum reporting limit (μg/L)
Acetochlor[1]	0.002
Alachlor	0.002
Atrazine	0.001
Azinphos-methyl[2]	0.001
Benfluralin	0.002
Butylate	0.002
Carbaryl[2]	0.003
Carbofuran[2]	0.003
Chlorpyrifos	0.004
Cyanazine	0.004
DCPA (Dacthal)	0.002
DDE, *p,p'*-	0.006
Deethyl atrazine[2]	0.002
Diazinon	0.002
Dieldrin	0.001
Diethylaniline, 2,6-	0.003
Dimethoate[3]	0.004
Disulfoton	0.017
EPTC	0.002
Ethalfluralin	0.004
Ethoprop	0.003
Fonofos	0.003
BHC, *alpha*- (HCH, *alpha*-)	0.002
Lindane (HCH, *gamma*-)	0.004

Constituent	Minimum reporting limit (μg/L)
Linuron	0.002
Malathion	0.005
Methyl parathion	0.006
Metolachlor	0.002
Metribuzin	0.004
Molinate	0.004
Napropamide	0.003
Parathion	0.004
Pebulate	0.004
Pendimethalin	0.004
Permethrin, *cis*-	0.005
Phorate	0.002
Prometon	0.018
Pronamide	0.003
Propachlor	0.007
Propanil	0.004
Propargite	0.013
Simazine	0.005
Tebuthiuron	0.010
Terbacil[2]	0.007
Terbufos	0.013
Thiobencarb	0.002
Triallate	0.001
Trifluralin	0.002

[1] Added to Schedule 2001 in September 1994
[2] Constituent had poor method performance; all detections reported as estimated
[3] Deleted from Schedule 2001 in November 1994

Table 4.
Carbamate insecticides (USGS schedule 1359) analyzed in Phase I wells and springs.

[Analysis was performed on unfiltered samples collected in GCC bottles; see table 7 for bottle descriptions. μg/L, micrograms per liter]

Constituent	Minimum reporting limit (μg/L)
Aldicarb	0.5
Carbaryl	0.5
Carbofuran	0.5
Methiocarb	0.5
Methomyl	0.5
1-Naphthol	0.5
Propham	0.5
Propoxur	0.5

ally placed in a 2-gallon bucket into which the purge water flowed; for springs, the probes were placed directly in the flowing spring water. When the ambient air temperature was outside the operating range of the meters, purge samples were collected and measurements were made inside the sampling vehicle.

The wells were purged until the following stabilization criteria were met: pH, ±0.05 pH units; specific conductance, ±5 percent; water temperature, ±0.5 degrees Celsius; all recorded over three consecutive measurements made at five-minute intervals. Because the well water usually ran through a long section of pipe below the frost line before reaching the sampling point, the water temperature did not reflect the aquifer-water temperature; however, it did help indicate when standing water had been removed from the distribution system.

Samples were collected after stabilization criteria were met. Samples were drawn from a short teflon tube attached to the other outlet on the Y-valve as the water continued to run. Unfiltered samples were collected directly at the sampling point. A 4-liter glass amber bottle was then rinsed and filled with water to be used as the source for the filtered samples. Radon samples were collected by inserting a syringe needle through a teflon diaphragm located in a brass fixture attached to the purge hose, and allowing approximately 20 milliliters of sample to enter the syringe under positive pressure. When collecting radon samples from springs, the plunger was removed from the syringe, the syringe and plunger were submerged in the spring water, and the plunger was reinserted into the syringe. After filling the syringe, ten milliliters of the sample were then injected into a vial of mineral oil, which was shaken to dissolve the radon in the oil. Samples not requiring any additional preparation and requiring refrigeration were then placed in an ice-filled cooler. Bottle types and preservatives for all constituents are given in table 7.

Filtered samples were obtained by pumping sample water through a 0.1-micron microcellulose filter with a peristaltic pump. Deionized (DI) water was first pumped through the filter assembly, followed by approximately 0.5 liters of sample water. The filtered samples were then collected, and preservatives were added as required (tab. 7). Samples requiring refrigeration were put in an ice-filled cooler, where they remained until they were prepared for shipment to the NWQL later the same day. Alkalinity was determined by digital titration with either 0.1600N or 1.600N sulfuric acid, depending upon the pH and specific conductance of the sample. Dissolved oxygen was determined by digital titration using a modified Winkler titration method.

Sampling equipment was cleaned upon completion of sampling by rinsing the equipment thoroughly in DI water, washing with Liquinox detergent, and re-rinsing with DI water until all traces of soap were gone. The filter stand was reassembled and a 5-percent solution of hydrochloric acid pumped through it, followed by another DI rinse. The 4-liter bottle was also rinsed with acid and DI water. The filter stand, Y-valves, and teflon tubing were all stored in plastic bags after cleaning.

A sketch was made of the area around the well and spring, showing the land cover and any significant features

Table 5.
Phenoxy herbicides (USGS schedule 79) analyzed in Phase I wells and springs.

[Sample container designations are described in table 7. μg/L, micrograms per liter]

Constituent	Minimum reporting limit (μg/L)	Sample container designation
2,4-D (by immunoassay)	1	TOC
2,4-D (dichlorprop)	0.05	GCC
2,4,5-T	0.01	GCC
2,4-DP	0.01	GCC
Dicamba	0.01	GCC
Picloram	0.01	GCC
Silvex	0.01	GCC

Table 6.
Volatile organic compounds (USGS schedule 1390) analyzed in Phase I wells and springs.

[Samples collected in GCV bottles; see table 7 for bottle description. μg/L, micrograms per liter]

Constituent	Minimum reporting limit (μg/L)
Acrolein[1]	20
Acrylonitrile[1]	20
Benzene	3.0
Bromobenzene	3.0
Bromochloromethane	3.0
Bromoform	3.0
n-Butyl benzene	3.0
sec-Butyl benzene	3.0
tert-Butyl benzene	3.0
Carbon tetrachloride	3.0
Chlorobenzene	3.0
Chlorodibromomethane	3.0
Chloroethane	3.0
2-Chloroethyl vinyl ether	3.0
Chloroform	3.0
o-Chlorotoluene	3.0
p-Chlorotoluene	3.0
Dibromochloropropane	3.0
1,2-Dibromoethane	3.0
Dibromomethane	3.0

Constituent	Minimum reporting limit (μg/L)
o-Dichlorobenzene	3.0
1,3-Dichlorobenzene	3.0
1,4-Dichlorobenzene	3.0
Dichlorodibromomethane	3.0
Dichlorodifluoromethane	3.0
1,1-Dichloroethane	3.0
1,2-Dichloroethane	3.0
cis-1,2-Dichloroethene	3.0
trans-1,2-Dichloroethene	3.0
1,1-Dichloroethylene	3.0
1,2-Dichloropropane	3.0
1,3-Dichloropropane	3.0
2,2-Dichloropropane	3.0
1,1-Dichloropropene	3.0
cis-1,3-Dichloropropene	3.0
trans-1,3-Dichloro-propene	3.0
Ethylbenzene	3.0
Freon-113 (1,1,2-Trichloro-trifluoroethane)	3.0
Hexachlorobutadiene	3.0
Isopropyl benzene	3.0

[1] Deleted from Schedule 1390 in September 1994

within a 100-ft radius. A schematic diagram was made of the distribution system between the well and the sampling point. Homeowners were interviewed about their well, well water, and land use near the well. The interview was conducted primarily to find out if there were any known groundwater contamination problems in the area.

A maximum of two sites per day were sampled. At the end of each sampling day, samples were shipped to the NWQL via overnight courier in order to have radon analyzed as quickly as possible, and also to minimize the possibility of exceeding holding times for other unstable constituents.

QUALITY ASSURANCE

Quality assurance of the chemical data was monitored by evaluating charge-balance errors for major ions and col-

Table 6, continued.
Volatile organic compounds (USGS schedule 1390) analyzed in Phase I wells and springs.

[Samples collected in GCV bottles; see table 7 for bottle description. μg/L, micrograms per liter]

Constituent	Minimum reporting limit (μg/L)
p-Isopropyl toluene	3.0
Mesitylene (1,3,5-Trimethylbenzene)	3.0
Methyl bromide	3.0
Methyl *tert*-butyl ether (MTBE)	3.0
Methyl chloride	3.0
Methylene chloride (dichloromethane)	3.0
Naphthalene	3.0
n-Propyl benzene	3.0
Pseudocumene (1,2,4-Trimethylbenzene)	3.0
Styrene	3.0
1,1,1,2-Tetrachloroethane	3.0
1,1,2,2-Tetrachloroethane	3.0

Constituent	Minimum reporting limit (μg/L)
Tetrachloroethylene	3.0
Toluene	3.0
1,2,3-Trichlorobenzene	3.0
1,2,4-Trichlorobenzene	3.0
1,1,1-Trichloroethane	3.0
1,1,2-Trichloroethane	3.0
Trichloroethylene	3.0
Trichlorofluoromethane	3.0
1,2,3-Trichloropropane	3.0
Vinyl chloride	1.0
Xylene	3.0

lecting quality-assurance samples. Charge-balance errors (CBEs) give a general indication of the overall accuracy of the major-ion analysis. To satisfy the condition of electroneutrality, the milliequivalent sums of cations of a water sample should equal the milliequivalent sums of anions. If a chemical analysis is complete, the accuracy of the analysis for the major dissolved constituents can be checked by calculating CBE via the formula:

$$CBE = \frac{(\Sigma cations - \Sigma anions)}{(\Sigma cations + \Sigma anions)} \times 100.$$

Ninety-two percent of samples had CBEs less than ±5 percent (fig. 6). CBEs tended to increase with decreasing TDS because at low concentrations of TDS, a small difference in the measured amount can result in a large percentage change in the CBE.

Several types of quality-assurance samples were collected during the study, including field blanks, field duplicates, and spiked samples. Field blank samples were collected to ensure that there was no sample contamination during collection, processing, transport, or analysis of the samples. Field blanks were collected at a sampling site by putting blank water into the same 4-liter glass amber bottle as the environmental samples (for filtered samples), or by putting blank water directly into the sample container (for unfiltered samples). The blank sample was then processed in the same manner as the environmental samples. Inorganic blank water (for inorganic constituents) and organic-free blank water (for pesticides and VOCs) were supplied by the USGS. The effects of pumps and other parts of the water distribution system on water quality could not be evaluated through the use of field blank samples.

Four to five field blank samples were collected and analyzed for most of the inorganic constituents; more were analyzed for chloride (eight blanks) and nitrate (nine blanks). Concentrations of most constituents were below minimum reporting limits (MRLs) in the blank samples. No systematic contamination problems were observed, although there were occasional low-level detections of several constituents. One nitrate field-blank sample had a concentration of 0.61 mg/L; the cause was not identified. Five field blanks were analyzed for triazine herbicides and other pesticides, and three field blank samples were analyzed for carbamate insecticides; there were no detections reported in any of these samples.

Duplicate samples were collected to evaluate the variability due to sampling and analysis. Four to five duplicate samples were collected for most inorganic constituents; 12

Table 7.
Descriptions of sample containers and treatments.

[<, less than; >, greater than]

Sample container designation	Sample container material	Sample filtered (F) or unfiltered (U)	Container rinsed (R) or not rinsed (NR) in field	Treatment
BOD	Glass, stoppered-top	U	R	None
FA	Polyethylene, acid-rinsed	F	R	HNO_3 added to pH<2
FAB	Teflon, acid-rinsed	F	R	Ultrapure HNO_3 added to pH<2
FAM	Glass, acid-rinsed	F	R	HNO_3 and $K_2Cr_2O_7$ added
FCC	Polyethylene, brown	F	R	Chilled[1]
FU	Polyethylene	F	R	None
GCC (Schedule 2001)	Glass, baked amber	F	NR	Chilled
GCC (Schedules 79 and 1359)	Glass, baked amber	U	NR	Chilled
GCV	Glass septum vial, amber	U	NR	Chilled
LC0076	Glass, baked	U	NR	H_2SO_4 added to pH<2; chilled
LC0880	Polyethylene	F	R	NaOH added to pH>12; chilled
LS	Glass vial with mineral oil	U	NR	None
RA	Polyethylene, acid-rinsed	U	R	HNO_3 added to pH<2
RCB	Polyethylene	U	R	Chilled
RU	Polyethylene	U	R	None
RUR	Polyethylene, acid-rinsed	U	R	None
RUS	Glass, baked amber	U	NR	Chilled
TOC	Glass, baked amber	U	NR	Chilled

[1] Samples prior to 10/1/94 were preserved with $HgCl_2$

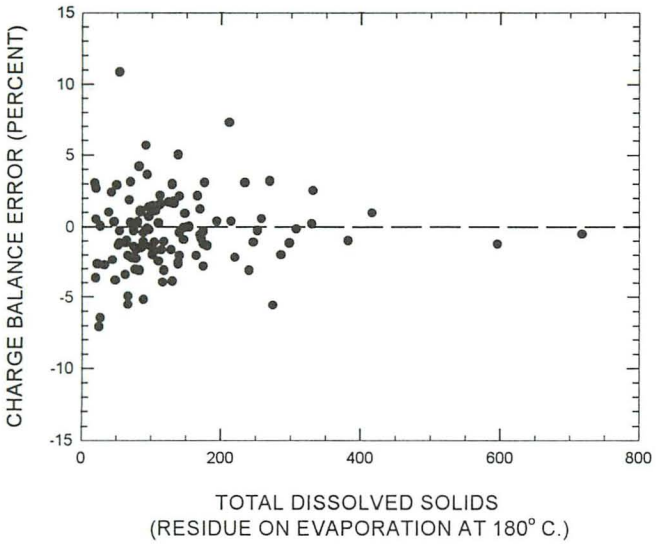


Figure 6. Relationship between charge-balance errors and total dissolved solids.

duplicate samples were analyzed for both nitrate and chloride. Duplicate samples were collected immediately after the environmental samples. No systematic problems (i.e., consistent problems with any one constituent) were detected upon examination of the environmental and duplicate samples. Ninety-one percent of duplicate samples were within 5 percent of each other; almost all of the rest were detected at concentrations close to MRLs, where large percent differences result from small differences in concentrations. Five duplicate samples were analyzed for triazines and other pesticides. Five compounds (alachlor, atrazine, deethyl atrazine, carbofuran, and metolachlor) were detected in both the environmental and the duplicate samples; no other compounds were detected in either the duplicate or environmental samples. The detections for all but one pair of samples were below 1 µg/L; the differences between the environmental and duplicate samples were no greater than 0.2 µg/L (median percent difference, 3.4 percent; range, zero to 14.3 percent). The data indicate a high degree of precision for the schedule 2001 constituents, including those having poor method performances (deethyl atrazine and carbofuran). Three duplicate samples were analyzed for carbamate insecticides; there were no detections in either the environmental or duplicate samples. Thirteen samples were analyzed for phenoxy herbicides to confirm the immunoassay testing for the herbicide 2,4-D. There were no detections of 2,4-D in samples analyzed either by immunoassay or by the NWQL. The herbicide 2,4,5-T was detected in one of the NWQL-analyzed samples. One duplicate sample was analyzed for VOCs; there were no detections in either the environmental or the duplicate sample.

Samples from three wells were spiked with triazine herbicides and other pesticides. Spiked samples are samples which have had known concentrations of chemicals added to them. Since the added amount and the environmental concentration are known, the percent recovery of the compounds can be determined to check on sample degradation or contamination. For each of the three wells, two samples (a field spike and a field spike replicate) were spiked in the field with 0.100 milliliter (mL) of a solution containing 1.0 micrograms per milliliter (µg/mL) of each of 47 pesticides. A third unspiked quality-assurance sample from one well was shipped with a spike-solution ampule and was spiked in the laboratory. The average recovery for all spiked samples was about 97 percent; recoveries ranged from 10 percent to 215 percent. The low recoveries tended to be for compounds with poor method performance such as DEA and permethrin. There was total loss of DEA in one field spike replicate. Recoveries of disulfoton in all three spiked samples from well Cd 238 were greater than 1,500 percent; the reason for the high recovery is not known. These extreme recoveries are not included in the range and average recovery figures. Most of the recoveries were higher than those reported by Zaugg and others (1995) for low-level concentrations of these compounds in ground water. The recoveries from the field spikes and lab spike were similar, indicating that there was little compound degradation during sample transport. The similarity of the field spike, field-spike replicate, and laboratory spike concentrations for each sample indicates that the spiking process appeared to be consistent.

STUDY RESULTS

GROUND-WATER QUALITY

Inorganic Constituents and Indicators

This section presents an overview of the inorganic constituents (major cations, anions, trace elements) and indicators (TDS, specific conductance, alkalinity, pH, dissolved oxygen, TOC, color, MBAs) analyzed in the 106 wells and 6 springs sampled during Phase I. In general, samples were low in TDS (median TDS: 104 mg/L), acidic (median pH: 6.0), and oxygen-rich (median dissolved oxygen: 7.4 mg/L) (tab. 8, located in the appendix; fig. 7). Many of the inor-

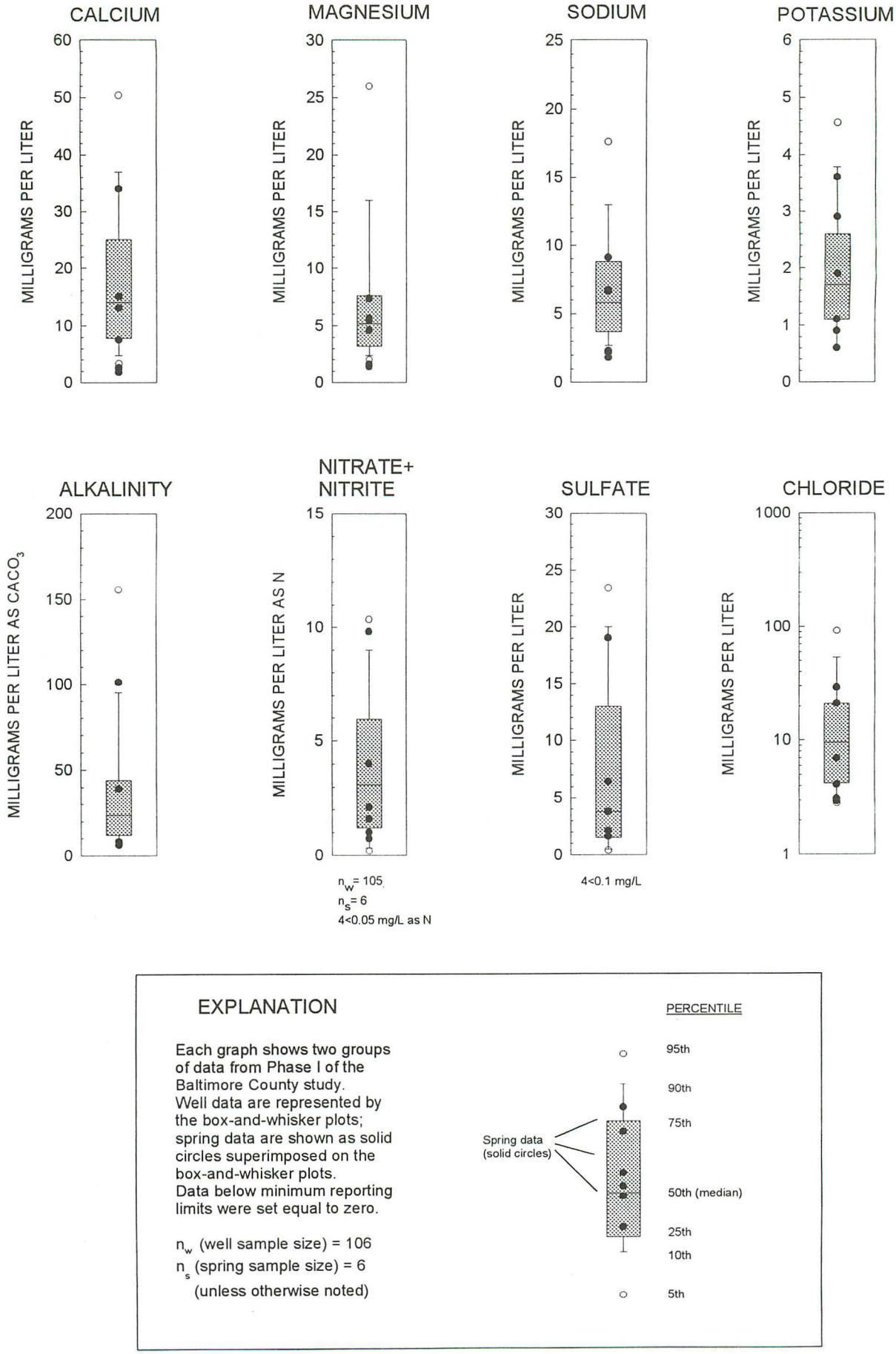


Figure 7. Box-and-whisker plots of selected inorganic constituents.

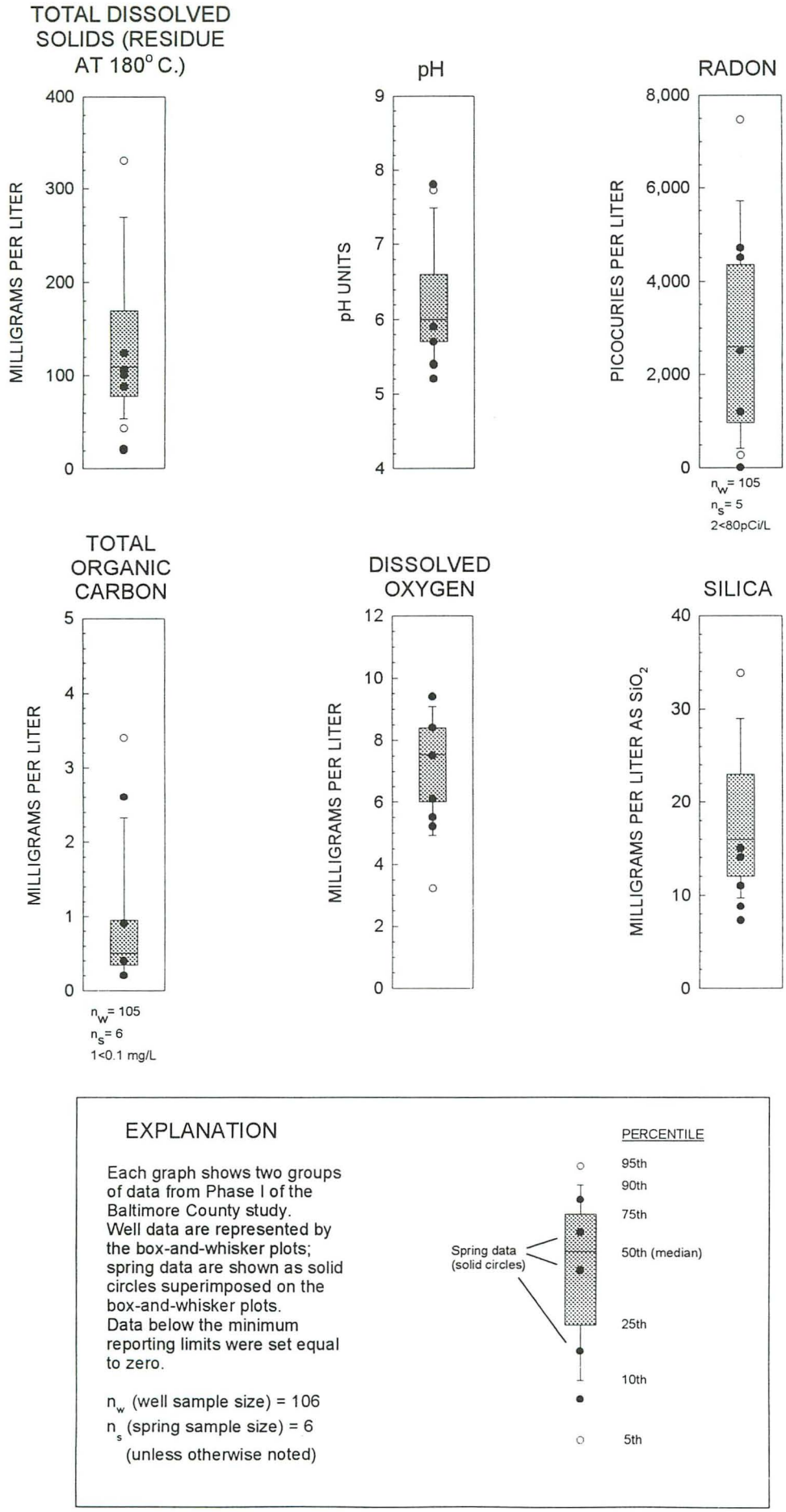
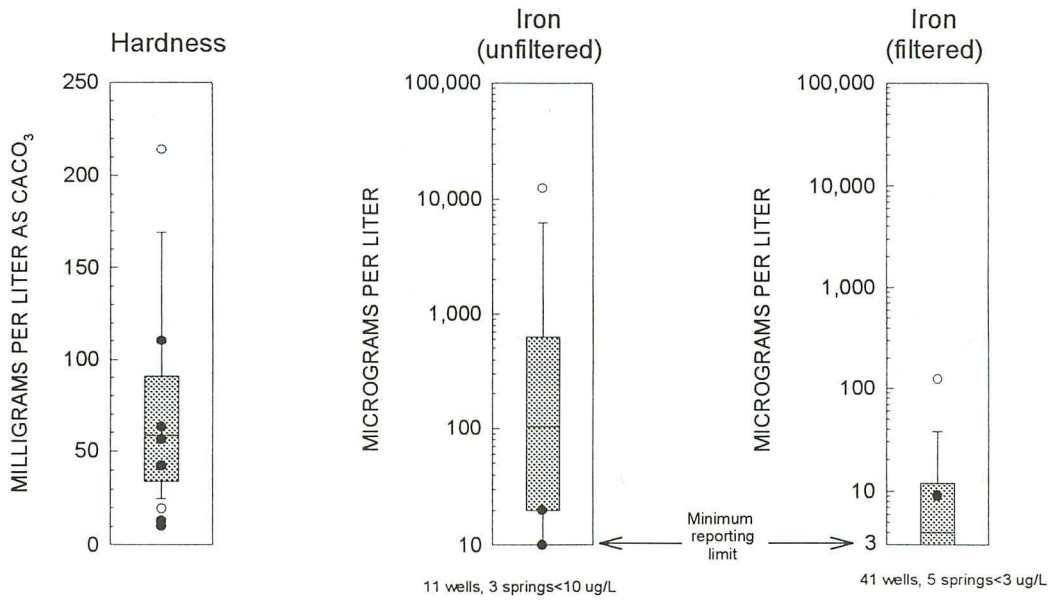


Figure 7, continued. Box-and-whisker plots of selected inorganic constituents.



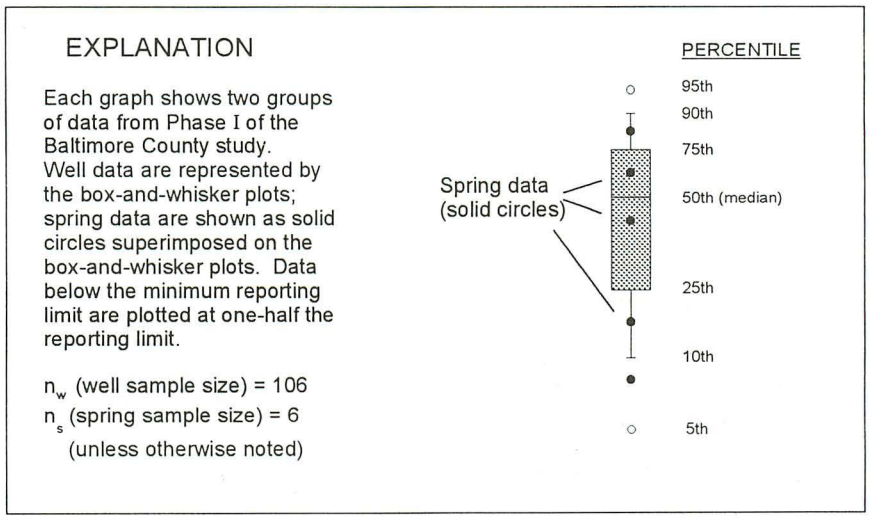


Figure 7, continued. Box-and-whisker plots of selected inorganic constituents.

ganic constituents are associated with aquifer lithology; these associations are briefly noted here, and are discussed in more detail in the section of the report entitled "Factors Associated With Ground-Water Quality." (Lithologic groups are defined in table 9). Water-quality data for inorganic constituents and indicators are summarized in table 8; all the data are presented in Appendix A, table A1.

Table 9.
Definitions of lithologic groups.

[Formations not sampled during the project are not listed]

Lithologic group	Formations included in group (number of Phase I wells and springs in each formation)
Schist	Prettyboy Schist (34 wells, 2 springs) Pleasant Grove Schist (5 wells) Piney Run Formation (7 wells) Oella Formation (1 well) Loch Raven Schist (not including Hydes Marble Member) (23 wells, 2 springs) Setters Formation (1 well)
Gneiss	Baltimore Gneiss (17 wells, 1 spring) Slaughterhouse Gneiss (2 wells) Sykesville Formation (1 well)
Marble	Cockeysville Marble (9 wells, 1 spring) Loch Raven Schist (Hydes Marble Member) (1 well)
Mafic rocks	Baltimore Mafic Complex (5 wells)

Total dissolved solids and specific conductance

TDS in a water sample is determined in two ways: (1) by weighing the residue left after evaporating the sample at 180 degrees Celsius (residue on evaporation, or ROE); and (2) by calculating TDS from the analytical results of individual constituents. TDS values in this report refer to ROE values, unless otherwise specified. TDS determined by ROE was higher than calculated TDS for samples with greater than 300 mg/L TDS, possibly due to water retained by minerals during crystallization.

TDS for all sites ranged from 18 to 718 mg/L (median: 104 mg/L). Samples from marble aquifers had the highest median TDS (220 mg/L); schists had the lowest median value (84 mg/L). This reflects the greater solubility of the carbonate minerals compared to the silicate minerals. TDS values greater than about 300 mg/L were associated with high chloride concentrations (fig. 8).

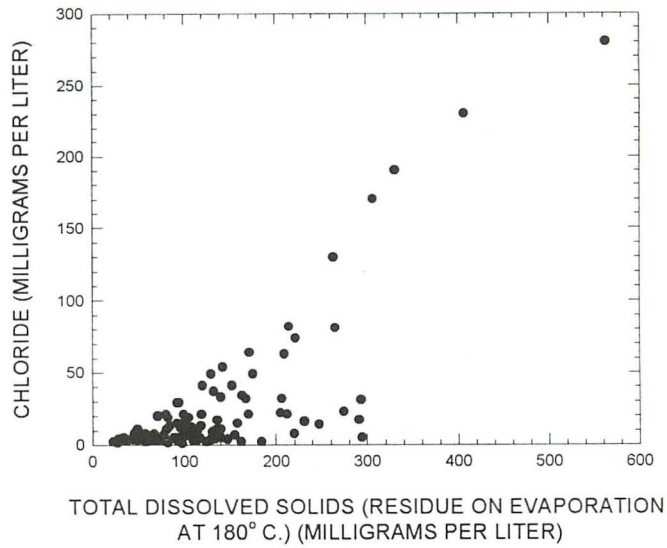


Figure 8. Relationship between total dissolved solids (residue on evaporation at 180°C.) and chloride concentrations.

Specific conductance, reported in microsiemens per centimeter (µS/cm) at 25 degrees Celsius, is a measurement of the ability of a water sample to conduct an electric current. Pure water has very low conductance; the greater the concentration of charged ionic species that are present in a water sample, the greater the electrical conductance. Specific conductance values from Phase I sites were highly correlated (r=0.98) with TDS (fig. 9); because specific conductance is a quick and easy measurement to make in the field, it can serve as an inexpensive surrogate for TDS. Lack of exact agreement between TDS by evaporation and specific conductance is due to the presence of uncharged dissolved species, temperature compensation of the specific conductance meter, and other factors.

Alkalinity

Alkalinity is the capacity of a solution to react with and neutralize acid. Except for waters with either high pH (greater than 9.5) or unusual chemical composition, alkalinity is attributed to dissolved bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) ions (Hem, 1985, p. 106). In the pH range of the Phase I samples (5.1 to 8.0), alkalinity is entirely attributable to bicarbonate. Alkalinity is most commonly reported in mg/L as $CaCO_3$. Alkalinity from all Phase I sites ranged from 3 to 275 mg/L (median: 23 mg/L). Samples from marble aquifers had the highest median value (145 mg/L) of the four aquifer lithologies; this reflects the production of bicarbonate ions due to carbonate mineral dissolution.

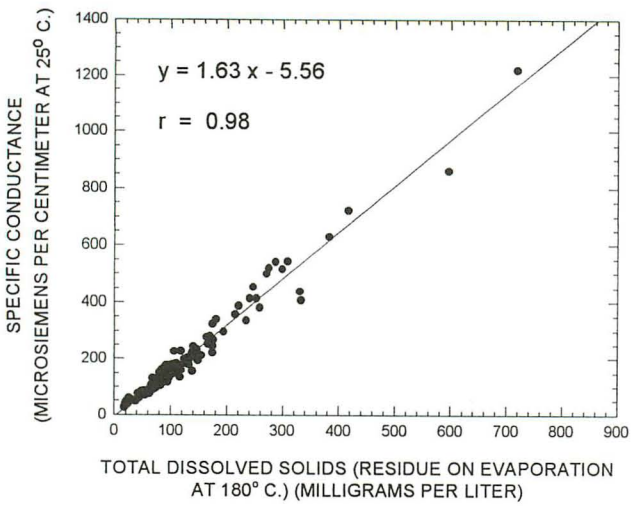


Figure 9. Relationship between total dissolved solids (residue on evaporation at 180°C.) and specific conductance.

Median alkalinity values in the schists (17 mg/L) and gneisses (36 mg/L) were lower than the mafic rocks (68 mg/L).

pH

The pH of a solution is defined as the negative logarithm of the effective concentration (activity) of hydrogen ions. Median pH for all Phase I samples was 6.0 (range: 5.1 to 8.0). More than 70 percent of samples had pH values below 6.5, which is the lower limit of the SMCL. Well water with low pH can corrode metal pipes, and many well owners have had neutralizers installed in their water systems. Median pH values from schists and gneisses (5.8 and 6.0, respectively) were lower than from mafic rocks and marble aquifers (6.6 and 7.6, respectively).

Major cations

The major cations (calcium, magnesium, sodium, and potassium) in ground-water samples are derived principally from the weathering of aquifer minerals. Differences in contact time and rates at which minerals react with acidic ground water result in different concentrations. Calcium (range: 1.8 to 98 mg/L) and magnesium (range: 0.75 to 56 mg/L) concentrations in ground water tended to be higher in carbonate aquifers than in aluminosilicate aquifers because carbonate aquifers are composed mainly of calcite and dolomite. Several of the wells in schist and gneiss had higher calcium concentrations than would be expected from mineral dissolution reactions. The high calcium is associated with high chloride, and is believed to be related to deicing salt application to roads; this is discussed in the section of the report entitled "Sources of chloride." Hardness, the tendency of a water to form an insoluble residue with soap, is caused by calcium and magnesium and can be calculated from the concentrations of these constituents (tab. 10). Most waters in the study were soft (overall median hardness: 57 mg/L as $CaCO_3$); samples from the schists, gneisses, and mafic aquifers tended to be soft to moderately hard, while samples from the marble aquifers were moderately hard to very hard. Sodium concentrations ranged from 1.4 to 69 mg/L (median: 5.5 mg/L). Potassium concentrations ranged from 0.2 to 9.2 mg/L (median: 1.7 mg/L).

Table 10. Classification of hardness.

[from Durfor and Becker (1964, p. 24). mg/L, milligrams per liter; >, greater than]

Hardness range (mg/L as $CaCO_3$)	Description
0-60	Soft
61-120	Moderately hard
121-180	Hard
>180	Very hard

Major anions

The major anions in ground water in Baltimore County (bicarbonate, nitrate, chloride, and sulfate) are derived from several different sources. Bicarbonate is a product of carbonate equilibria reactions, and is determined from analysis of alkalinity. Nitrate is the dominant nitrogen species found in Baltimore County ground water. (The NWQL analyzes for nitrate-plus-nitrite and for nitrite; nitrate is not analyzed separately. Because nitrite values were negligible, nitrate concentrations in this report refer to the analytical values of nitrate-plus-nitrite, and are reported in mg/L as nitrogen.) Nitrate concentrations in the study ranged from less than 0.05 to 35 mg/L (median: 2.9 mg/L). Five sites exceeded 10 mg/L, which is the MCL for nitrate. Nitrate was detected in 107 of 111 sites (96 percent) (fig.10a). At high concentrations, nitrate can cause methemoglobinemia ("blue-baby syndrome") in infants; this condition results from the reduced ability of hemoglobin in the blood to transport oxygen. Ground-water nitrate is derived from nitrogen in precipitation, organic matter in soils, fertilizers, and human and animal wastes.

Chloride concentrations ranged from 1.2 to 280 mg/L (median: 8.6 mg/L). Chloride concentrations above about

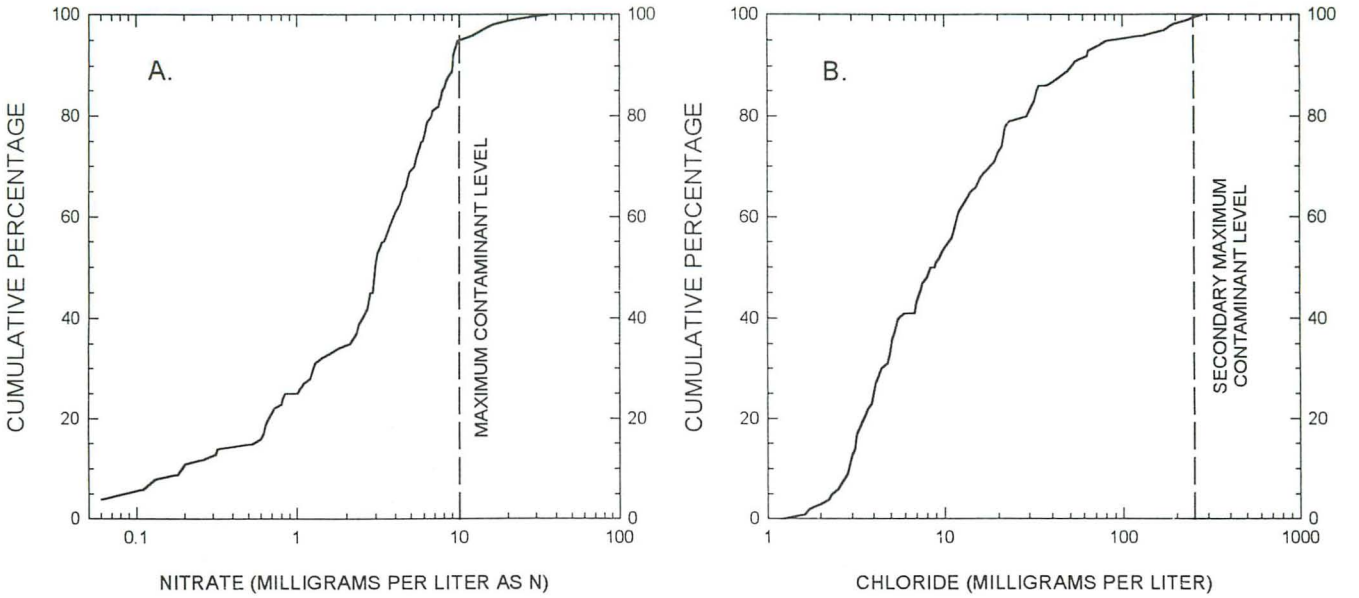


Figure 10. Cumulative percentage plots of (a) nitrate and (b) chloride concentrations.

250 mg/L cause water to taste salty, and can be corrosive to well pumps, appliances, and other plumbing fixtures. Chloride concentrations were less than 100 mg/L in 95 percent of the samples, and only one exceeded 250 mg/L (the SMCL for chloride) (fig. 10b). However, high chloride concentrations in well water have been reported by well owners in several areas in Baltimore County (S. Farinetti, Baltimore County Department of Environmental Protection and Resource Management, oral comm., 1996). Chloride is not a common constituent of minerals in the study area; the primary source of high chloride concentrations appears to be deicing salts applied to roads.

Sulfate concentrations ranged from less than 0.1 to 41 mg/L (median: 3.6 mg/L). In the study area, sulfate may form from the oxidation of pyrite, a sulfide mineral that is a minor component of schists in the Maryland Piedmont (Crowley, Reinhardt, and Cleaves, 1976; McFarland, 1989). Some sulfate in ground water is derived from atmospheric sulfur resulting from industrial processes and combustion of fossil fuels.

Trace elements

Iron and manganese were the most commonly detected trace elements in the Phase I samples. Iron was analyzed in both filtered and unfiltered samples at each site. Iron concentrations in unfiltered samples ranged from less than 10 to 380,000 µg/L (median: 100 µg/L) and were often much higher than filtered-iron concentrations (range: less than 3 to 4,900 µg/L; median, 4 µg/L), indicating the presence of particulate or colloidal iron. Although iron-bearing minerals are common in Piedmont rocks, most of the iron released during mineral dissolution is reprecipitated as sedimentary minerals because the ground water is oxygenated. Manganese concentrations in unfiltered samples ranged from less than 1 to 310 µg/L (median: 4 µg/L), and there was very little difference between filtered and unfiltered manganese concentrations. Manganese is a minor constituent in many igneous and metamorphic minerals, and has a somewhat similar chemical behavior to iron in weathering environments. Barium concentrations ranged from less than 2 to 280 µg/L (median: 14 µg/L). Barium is a naturally occurring component of igneous and sedimentary rocks; anthropogenic sources include pigments and epoxy sealants (Hem, 1985; U.S. Environmental Protection Agency, 1994). Samples from many wells had low-level detections of lead, nickel, copper, and zinc, some of which may be derived from metal pipes in the well-water distribution systems. Chromium was detected at low concentrations (4 to 20 µg/L) in three of the five wells in mafic-rock aquifers. Fluoride, which at concentrations above 2 mg/L can cause discoloration of teeth, was not detected in most samples (range: less than 0.1 to 0.3 mg/L). Most of the other trace elements that may cause adverse health effects (arsenic, antimony, beryllium, cadmium, cyanide, mercury, selenium, and thallium) were rarely detected; when present, the concentrations were close to the detection limit.

Radon

Radon (^{222}Rn) is a colorless, odorless, radioactive gas with a half-life of approximately 3.8 days. It is formed as an intermediate product in the ^{238}U radioactive decay series. ^{222}Rn is one of three radioactive radon isotopes; the other

two (^{219}Rn and ^{220}Rn) are environmentally insignificant because their half-lives are less than one minute; in this report, "radon" refers to ^{222}Rn. Radon is typically reported in units of picocuries per liter (pCi/L), where one picocurie equals 3.7×10^{-2} disintegrations per second.

Radon has been linked to an increased risk of lung cancer (National Research Council, 1988). Research has focused on the contribution of soil-gas radon to indoor air radon levels; however, a significant percentage of indoor radon may be derived from well water (Hess, Korsah, and Einloth, 1987; Lawrence, Wanty, and Nyberg, 1992; Giardino and Hageman, 1996), and this contribution may pose an increased risk of cancer (Mose and others, 1989). Most of the health risk of radon in drinking water is from inhalation of radon that escapes the water once it is exposed to the air, rather than from direct ingestion (Wanty and Nordstrom, 1993). An MCL of 300 pCi/L had been proposed by the USEPA in 1991 but was withdrawn in 1997 because of uncertainty over the amount of increased risk attributable to ground-water radon and because of the potential costs in installing treatment systems in public water-supply systems (Stone, 1993). The American Water Works Association recommended in 1997 that utilities keep radon levels in finished water below 4,000 pCi/L (American Water Works Association, written comm., 1997).

Radon samples were obtained from 110 of the 112 Phase I sites. (One well had insufficient pressure to collect a sample; one spring could not be sampled properly). Radon concentrations in the study area ranged from less than 80 to 13,000 pCi/L (median: 2,450 pCi/L). Twenty-nine percent of radon concentrations were greater than 4,000 pCi/L; 89 percent were greater than 300 pCi/L. The highest median concentrations were in samples from schists (2,900 pCi/L), with lower median concentrations in gneisses (2,600 pCi/L), marble (550 pCi/L), and mafic rocks (540 pCi/L). Ground-water radon concentrations have been found in other studies to be closely associated with rock type; crystalline rocks, especially granites and high-grade metamorphic rocks, tend to have the highest radon values, while low-grade metamorphic rocks and sedimentary deposits tend to have lower values (King, Michel, and Moore, 1982; Hall, Boudette, and Olszewski, 1987; Loomis, 1987). Ground-water radon concentrations in the study area are negatively correlated with pH, alkalinity, calcium, and magnesium (which are related to aquifer lithology).

Dissolved oxygen

Dissolved-oxygen concentrations ranged from less than 1 to 9.8 mg/L (median: 7.4 mg/L). Only three sites had dissolved-oxygen concentrations below detection level. Dissolved oxygen in ground water is derived from atmospheric oxygen, and is consumed by decomposition of organic matter and by oxidation of minerals such as pyrite and siderite. There is little reactive material in the crystalline rocks to consume oxygen.

Total organic carbon

Organic carbon is present in natural waters due to the decomposition of plant and animal material; it also enters ground water through the accidental release of fuels, organic industrial compounds, and sewage. Organic compounds can form complexes that affect metal solubilities, enter into oxidation-reduction reactions, and serve as nutrients for microbiota that are involved in chemical reactions (Hem, 1985). An approximate determination of the amount of organic material in waters can be made by measuring total organic carbon (TOC). TOC concentrations in Baltimore County were generally low, ranging from less than 0.1 to 7.7 mg/L (median: 0.5 mg/L).

Color

The color of a water sample is determined by comparing it to dilutions of a mixture of cobalt chloride and potassium chloroplatinate solutions; color values are reported in platinum-cobalt (p-c) units. Water samples having color values of less than 10 p-c units is barely noticeable; color of some streams draining swamps in the southeastern United States exceeds 200 units (Hem, 1985). In the study area, color values ranged from less than 1 to 50 p-c units (median: 2 p-c units); more than 90 percent were less than 10 p-c units. Color usually results from leaching of organic debris; however, color greater than about 10 p-c units in the study area was more closely associated with high (greater than 1,000 µg/L) unfiltered-iron concentrations than with high TOC concentrations.

Methylene-blue active substances

Methylene-blue active substances (MBAs) include several types of anionic surfactants found in detergents. There are three major types of MBAs, one of which (alkyl benzene sulfonates), is more resistant to biodegradation than the other two. Alkyl benzene sulfonate surfactants were almost entirely discontinued in the mid-1960's in favor of more biodegradable anionic surfactants (Plummer and others, 1993). MBAs may indicate whether seepage from septic fields (which receive household wastewater) is affecting well-water quality. MBAs were detected at only eleven sites; concentrations ranged from less than 0.02 to 0.21 mg/L. Most detections were close to the minimum reporting level (0.02 mg/L); only one site exceeded 0.1 mg/L.

Synthetic Organic Constituents

Pesticides

A pesticide detection is defined for this report as any pesticide or metabolite found at a concentration at or above the MRL specified for each constituent in tables 3 and 4. The term "pesticide" in this report includes both pesticides and metabolites. Pesticide reporting limits vary widely. All detections of triazine herbicides and other pesticides in table 3 were reported by the NWQL, even if concentrations were below MRLs (i.e., qualitative detections). Qualitative detections are not considered "detections" in this report, although they are reported in table A2.

There were many low-level pesticide detections in samples from Phase I wells and springs; at least one pesticide was detected at 79 of 112 (71 percent) of the Phase I sites. Fifteen different pesticides were detected (tabs. 11 and 12). Ninety-eight percent of all detections were less than 1 µg/L, and most were less than 0.1 µg/L. The most frequently detected pesticide was deethyl atrazine (DEA), a metabolite of atrazine and other triazine herbicides, which was detected at 72 sites (64 percent). The next most frequently detected pesticides were: metolachlor, detected at 55 sites (49 percent); atrazine, detected at 48 sites (43 percent); carbofuran, detected at 11 sites (10 percent); and simazine, detected at 9 sites (8 percent). Most of the remaining eleven detected pesticides were found at only one or two sites each. The herbicide 2,4,5-T was also detected in one of the sites analyzed for phenoxy herbicides. More than 75 percent of the sites with pesticide detections had more than one compound present (fig. 11). Of the 72 sites that had detections of either atrazine or DEA, 46 sites had both compounds, 25 had DEA only, and only one site had atrazine but no DEA.

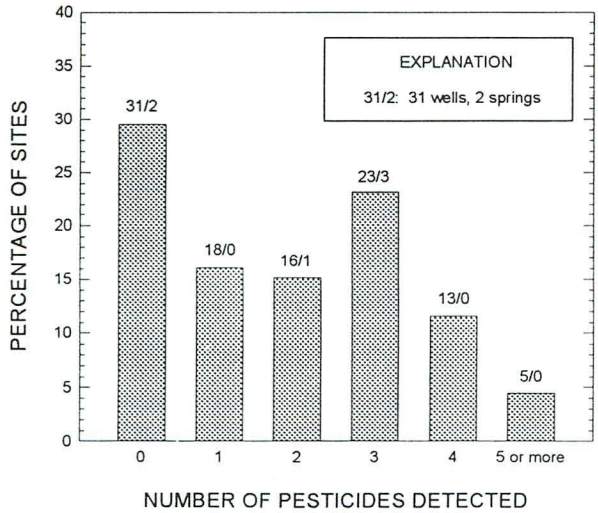


Figure 11. Percent of Phase I sites having a specified number of pesticides detected.

Atrazine, simazine, and other triazine herbicides are used extensively in Maryland on corn and other crops for the control of broadleaf weeds (tab. 13). Reported herbicide use in Maryland declined between 1985 and 1991 and increased between 1991 and 1994, while reported insecticide use decreased between 1985 and 1994 (Maryland Department of Agriculture, 1996b). Several widely used pesticides (including chlorpyrifos, linuron, 2,4-D, pendimethalin, cyanazine, and malathion) were not detected. There could be several reasons for this. (1) The pesticides may not have been used widely in the county. (2) The pesticides may be present at concentrations below MRLs. (3) The chemical properties of the pesticides may not be conducive to transport to the water table. For example, butylate is very volatile, and pendimethalin is very insoluble in water. (4) Pesticides may have been applied too recently to be present in well water.

Volatile organic compounds

VOCs were detected at only three sites. Three different VOCs were detected: methylene chloride (also known as dichloromethane; detected at well Be 36), tetrachloroethylene (detected at well Ca 66), and 1,1,1-trichloroethane (detected at well Dc 446) (tab. 14). Wells Ca 66 and Dc 446 are near known areas of contamination. Low concentrations of trihalomethanes were detected in wells in a subdivision near well Dc 446 prior to this study; the source was suspected to be solvents issuing from a septic system that existed in the area before the subdivision was built. Well Ca 66 is located near Arcadia, where leaking fuel tanks were determined to be a source of ground-water contamination. However, chlorinated solvents such as tetrachloroethylene are not commonly associated with fuel leaks, and the tetrachloroethylene in well Ca 66 may have come from degreasers used in nearby commercial establishments or railroad operations (the well is approximately 300 feet from train tracks) (B. Ensor, Baltimore County Department of Environmental Protection and Resource Management, oral comm., 1998). The source of the methylene chloride detected in well Be 36 is not known. Methylene chloride is often the result of contamination in the laboratory; however, there were no detections of this compound in the laboratory's blank VOC samples. The well is located near the site of a former gas station at the intersection of Troyer and Sheppard Roads. Due to the small number of detections, the VOC data are not published in this report. They are, however, published in the USGS annual reports for Maryland for Water Year 1994 (Smigaj, Saffer, and Tegeler, 1995), Water Year 1995 (Smigaj and Saffer, 1996), and Water Year 1996 (Smigaj and others, 1997).

Table 11.
Summary of detection data and comparison to water-quality standards for triazine herbicides and other pesticides.

[MRL, minimum reporting limit; MCL, Maximum Contaminant Level; HAL, Health Advisory Level; μg/L, micrograms per liter; ≥, greater than or equal to; <, less than; E, estimated. Source: U.S. Environmental Protection Agency (1995)]

			Number of detections:				Water-quality standards	
Pesticide	MRL (μg/L)	Number of samples	≥MRL	<MRL[2]	Number of non-detections	Maximum concentration (μg/L)	MCL (μg/L)	Lifetime HAL (μg/L)
Acetochlor	0.002	101	0	0	101	--	--	--
Alachlor	0.002	112	3	0	109	0.012	2	--
Atrazine	0.001	112	48	0	64	0.80	3	3[4]
Azinphos-methyl[1]	0.001	112	0	0	112	--	--	--
Benfluralin	0.002	112	0	0	112	--	--	--
Butylate	0.002	112	0	0	112	--	--	350
Carbaryl[1]	0.003	112	2	0	110	0.10	--	700
Carbofuran[1]	0.003	112	11	0	101	0.13	40	40
Chlorpyrifos	0.004	112	0	0	112	--	--	20
Cyanazine	0.004	112	0	0	112	--	--	1
DCPA (Dacthal)	0.002	112	0	0	112	--	--	4,000
DDE, *p,p'*-	0.006	112	0	8	104	--	--	--
Deethyl atrazine[1]	0.002	112	72	2	38	1.30	--	--
Diazinon	0.002	112	1	0	111	0.003	--	0.6
Dieldrin	0.001	112	0	0	112	--	--	--
Diethylaniline, 2,6-	0.003	112	0	0	112	--	--	--
Dimethoate[3]	0.004	1	0	0	1	--	--	--
Disulfoton	0.017	112	0	0	112	--	--	0.3
EPTC	0.002	112	2	0	110	0.005	--	--
Ethalfluralin	0.004	112	0	0	112	--	--	--
Ethoprop	0.003	112	1	1	110	0.004	--	--
Fonofos	0.003	112	0	0	112	--	--	10
BHC, *alpha*- (HCH, *alpha*-)	0.002	112	0	0	112	--	--	--
Lindane (HCH, *gamma*-)	0.004	112	0	0	112	--	0.2	0.2

[1] Constituent having poor method performance; all detections reported as estimated
[2] Non-quantifiable detections
[3] Deleted from Schedule 2001 in November 1994
[4] Under review

Table 11, continued.
Summary of detection data and comparison to water-quality standards for triazine herbicides and other pesticides.

[MRL, minimum reporting limit; MCL, Maximum Contaminant Level; HAL, Health Advisory Level; μg/L, micrograms per liter; ≥, greater than or equal to; <, less than; E, estimated. Source: U.S. Environmental Protection Agency (1995)]

			Number of detections:				Water-quality standards	
Pesticide	MRL (μg/L)	Number of samples	≥MRL	<MRL[2]	Number of non-detections	Maximum (μg/L)	MCL (μg/L)	Lifetime HAL (μg/L)
Linuron	0.002	112	0	0	112	--	--	--
Malathion	0.005	112	0	0	112	--	--	200
Methyl parathion	0.006	112	0	0	112	--	--	2
Metolachlor	0.002	112	55	4	53	5.4	--	70
Metribuzin	0.004	112	0	0	112	--	--	100
Molinate	0.004	112	0	0	112	--	--	--
Napropamide	0.003	112	0	0	112	--	--	--
Parathion	0.004	112	1	0	111	0.022	--	--
Pebulate	0.004	112	0	0	112	--	--	--
Pendimethalin	0.004	112	0	0	112	--	--	--
Permethrin, *cis-*	0.005	112	0	0	112	--	--	--
Phorate	0.002	112	1	0	111	0.010	--	--
Prometon	0.018	112	1	1	110	0.047	--	100*
Pronamide	0.003	112	0	0	112	--	--	50
Propachlor	0.007	112	0	0	112	--	--	90
Propanil	0.004	112	0	0	112	--	--	--
Propargite	0.013	112	0	0	112	--	--	--
Simazine	0.005	112	9	1	102	0.061	4	4
Tebuthiuron	0.010	112	1	0	111	0.076	--	500
Terbacil[1]	0.007	112	1	0	111	0.027	--	90
Terbufos	0.013	112	0	0	112	--	--	0.9
Thiobencarb	0.002	112	0	0	112	--	--	--
Triallate	0.001	112	0	0	112	--	--	--
Trifluralin	0.002	112	0	0	112	--	--	5

[1] Constituent having poor method performance; all detections reported as estimated
[2] Non-quantifiable detections

Table 12.
Summary of detection data and comparison to water-quality standards for phenoxy herbicides and carbamate insecticides.

[MRL, minimum reporting limit; MCL, Maximum Contaminant Level; HAL, Health Advisory Level; μg/L, micrograms per liter; ≥, greater than or equal to; <, less than; GC/MS, gas chromatography/mass spectrometry. Source: U.S. Environmental Protection Agency (1995)]

Pesticide	MRL (μg/L)	Number of samples	Number of detections: ≥MRL	Number of detections: <MRL[1]	Number of non-detections	Maximum concentration (μg/L)	Water-quality standards: MCL (μg/L)	Water-quality standards: Lifetime HAL (μg/L)
PHENOXY HERBICIDES:								
2,4-D (by immunoassay)	1	107	0	0	107	--	70	70
2,4-D (by GC/MS)	0.010	13	0	0	13	--	70	70
2,4,5-T	0.010	13	1	0	12	0.010	--	70
2,4-DP	0.010	13	0	0	13	--	--	--
Dicamba	0.010	13	0	0	13	--	--	200
Picloram	0.010	13	0	0	13	--	500	500
Silvex	0.010	13	0	0	13	--	--	--
CARBAMATE INSECTICIDES:								
Aldicarb	0.500	112	0	0	112	--	7	7
Carbaryl	0.500	112	0	0	112	--	--	700
Carbofuran	0.500	112	0	0	112	--	40	40
Methiocarb	0.500	112	0	0	112	--	--	--
Methomyl	0.500	112	0	0	112	--	--	200
1-Naphthol	0.500	112	0	0	112	--	--	--
Propham	0.500	112	0	0	112	--	--	100
Propoxur	0.500	112	0	0	112	--	--	--

[1] Non-quantifiable detections

Water Quality in Relation to Drinking-Water Regulations and Health Advisories

Water-quality data from Phase I samples are considered in reference to MCLs, SMCLs, and Lifetime HALs. A MCL is the maximum permissible level of a contaminant in water which is delivered to any user of a public water system. A SMCL is an unenforceable Federal guideline regarding the taste, odor, color, and other aesthetic aspects of drinking water which do not necessarily present a health risk. A Lifetime HAL is the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure, with a margin of safety (U.S. Environmental Protection Agency, 1994; 1995).

Nitrate concentrations exceeded the MCL of 10 mg/L in samples from 5 wells. Lead concentrations in two wells exceeded the MCL action level of 15 μg/L. Six inorganic constituents exceeded their respective SMCLs. pH levels were below the SMCL range (6.5 to 8.5) for 79 of the 112 (71 percent) Phase I sites. Iron and manganese exceeded the SMCLs (300 μg/L and 50 μg/L, respectively) at 34 and 16 sites (30 and 14 percent), respectively. Five of the samples which exceeded the SMCL for iron also exceeded the MCL for color (15 p-c units). Two wells had TDS concentrations greater than the SMCL of 500 mg/L. These TDS concentrations were associated with high chloride concentrations; one of the sites exceeded the SMCL for chloride (250 mg/L).

Table 13.
Estimated use of selected pesticides in Maryland in 1988, 1991, and 1994.

[P, preservative; H, herbicide; I, insecticide; Ac, acaricide; Fn, fungicide; Fm, fumigant; N, nematicide; Gr, growth regulator; Af, anti-foulant; R, repellent; --, not reported. Source: Maryland Department of Agriculture (1990, 1993, 1996b)]

		1988		1991		1994	
Pesticide name	Type	Pounds of active ingredient used	Usage rank	Pounds of active ingredient used[1]	Usage rank	Pounds of active ingredient used[1]	Usage rank
Chromated copper arsenate	P	480,000	4	3,185,000	1	5,635,000	1
Metolachlor[2]	H	1,810,000	1	1,441,000	2	2,166,000	2
Atrazine[2]	H	1,170,000	2	988,000	3	1,166,000	3
Cuprous oxide	Af	--	--	--	--	1,127,000	4
Glyphosate	H	195,000	14	177,000	9	410,000	5
Alachlor[2]	H	569,000	3	323,000	4	263,000	6
Chlorpyrifos[2]	I	318,000	7	289,000	6	240,000	7
2,4-D[2]	H	345,000	6	187,000	8	226,000	8
Petroleum oils	I,R	128,000	17	140,000	11	222,000	9
Pendimethalin[2]	H	210,000	13	165,000	10	189,000	10
Paraquat	H	250,000	10	130,000	12	176,000	11
Simazine[2]	H	295,000	8	299,000	5	153,000	12
Malathion[2]	I	69,000	20	110,000	15	121,000	13
Metribuzin	H	9,000	70	<1,000	116	89,000	14
Cyanazine[2]	H	225,000	12	112,000	14	85,000	15
Permethrin	Gr, I	172,000	16	28,000	28	83,000	16
Chlorothalonil	Fn	62,000	22	58,000	20	77,000	17
Linuron[2]	H	355,000	5	215,000	7	75,000	18
Acetochlor[2]	H	--	--	--	--	71,000	19
Dicamba	H	54,000	24	56,000	21	52,000	20
Butylate[2]	H	240,000	11	73,000	17	45,000	24
Carbaryl[2]	I,Gr	98,000	19	34,000	26	39,000	26
EPTC[2]	H	64,000	21	11,000	46	29,000	32
Carbofuran[2]	N,I, Fm	260,000	9	22,000	33	18,000	43
Diazinon[2]	I,Fn	40,000	32	14,000	38	10,000	59
Prometon[2]	H	3,600	87	3,000	71	4,000	95
Phorate[2]	I	61,000	23	8,000	51	3,000	100
Parathion[2]	I	14,500	59	5,000	63	1,000	128
Terbacil[2]	H	2,400	96	<1,000	123	<1,000	134
Ethoprop[2]	I,N	--	--	1,000	92	<1,000	145
Tebuthiuron[2]	H	--	--	<1,000	125	<1,000	161

[1] Rounded to the nearest thousand pounds
[2] Sampled during Phase I of the Baltimore County project

Table 14.
Summary of detections of volatile organic compounds.

[No other VOCs were detected above MRLs. See table 6 for list of all VOCs. MRL, minimum reporting limits; MCL, Maximum Contaminant Level; HAL, Health Advisory Level; μg/L, micrograms per liter. Source of MCL and HAL data: U.S. Environmental Protection Agency (1995)]

Constituent	MRL (μg/L)	Detected concentration (μg/L)	MCL (μg/L)	Lifetime HAL (μg/L)	Site with detection
Methylene chloride (dichloromethane)	3	5.1	5	3	BA Be 36
Tetrachloroethylene	3	18	5	3	BA Ca 66
1,1,1-Trichloro-ethane	3	8.9	200	200	BA Dc 446

No Lifetime HALs were exceeded by any inorganic constituent.

MCLs have been established for four of the detected pesticides (alachlor, atrazine, carbofuran, and simazine), and Lifetime HALs have been established for ten of the detected compounds (tabs. 11 and 12). No MCLs or Lifetime HALs were exceeded by any of the detected pesticides. Two of the three VOC detections exceeded both the MCL and Lifetime HAL (methylene chloride and tetrachloroethylene) (tab. 14). No SMCLs have been established for any of the synthetic organic constituents tested in Phase I.

Nitrate and Pesticides in Relation to Other Water-Quality Studies

Nitrate data from the Baltimore County study were compared to nitrate data from the National Pesticide Survey (NPS), the Iowa State-Wide Rural Well-Water Survey (SWRL), the National Alachlor Well-Water Survey (NAWWS), the Maryland Statewide Ground-Water-Quality Network (GWQN), and a study of the Columbia Aquifer (tab. 15). There was a smaller percentage of wells in the Baltimore County study with nitrate concentrations less than 0.1 mg/L and a greater percentage of wells with nitrate concentrations between 0.1 mg/L and 10 mg/L than the other studies. The higher percentage of nitrate above 0.1 mg/L is probably due largely to differences in hydrogeology. The Baltimore County wells are all in unconfined aquifers, which receive recharge from the overlying saprolite, whereas most of the other studies sampled wells in both confined and unconfined aquifers. The relatively small percentage of Baltimore County wells with nitrate concentrations greater than 10 mg/L may be related to well characteristics. The wells are all cased to bedrock, with a median depth of 200 feet (ft); none of the wells derive water solely from the top of the water table. By contrast, 50 percent of the wells in the Iowa SWRL were less than 100 ft deep, and these wells accounted for 89 percent of the nitrate detections above 10 mg/L. In Baltimore County, there is also little widespread irrigation that can cause excess nitrogen to be carried to the water table.

Pesticide detection rates in Phase I samples were compared to data from the USGS Mid-Atlantic Integrated Assessment (MAIA) program (Ator and Ferrari, 1997) (tab. 16). The MAIA data in table 16 only includes data from crystalline-rock aquifers in the mid-Atlantic region. DEA, atrazine, and metolachlor were the most commonly detected pesticides in both studies. Detection rates were comparable for most compounds, although the metolachlor detection rate was higher in Baltimore County (49 percent versus 29 percent).

FACTORS ASSOCIATED WITH GROUND-WATER QUALITY

The water-quality data collected during Phase I were evaluated with respect to aquifer lithology, land use, well characteristics, and other factors. The focus of this section is on major ions, nutrients, radon, and pesticide detections; constituents with low detection rates or low concentrations, including trace elements and VOCs, are not discussed in detail.

The data were evaluated using several statistical tests. Because none of the water-quality constituents was normally distributed (Kolmorogov-Smirnov test, $P<0.05$), nonparametric statistical tests were used. The Mann-Whitney rank sum test was used to test for significant differences in the concentrations of water-quality constituents between two groups (such as shallow versus deep wells). When more than two groups were being compared, the Kruskal-Wallis rank sum test was used to determine if a significant differ-

Table 15.
Comparison of nitrate data from the National Pesticide Survey (NPS), the Iowa State-Wide Rural Well-Water Survey (SWRL), the National Alachlor Well-Water Survey (NAWWS), the Maryland Ground-Water-Quality Network (GWQN), the Columbia aquifer, and the Baltimore County well data.

[Percentages do not add to 100 percent due to rounding errors. mg/L, milligrams per liter; <, less than; >, greater than ≥, greater than or equal to;]

Range of concentrations (mg/L as N)	Percent of all wells					
	NPS[1]	Iowa SWRL[2]	NAWWS[3]	Maryland GWQN[4]	Columbia aquifer[5]	Baltimore County
<0.1	43.0%	42.2%	47.7%	31%	28%[9]	6.7%
0.1-3.0	54.6[6]	20.4	28.7	33	18[10]	44.8
3.1-10		19.1	18.7[8]	21	35[8]	43.8
>10	2.4[7]	18.3	4.9	15	19	4.8

[1] Source: U.S. Environmental Protection Agency (1990)
[2] Source: Kross and others (1990)
[3] Source: Holden and others (1992)
[4] Source: Bolton (1996)
[5] Source: Bachman (1984)
[6] Percent of samples 0.1-10 mg/L
[7] Percent of samples ≥10 mg/L
[8] Percent of samples 3.0-10 mg/L
[9] Percent of samples <0.2 mg/L
[10] Percent of samples 0.2-3.0 mg/L

Table 16.
Comparison of selected pesticide detection rates between Baltimore County sites and crystalline-rock aquifers from the USGS Mid-Atlantic Integrated Assessment (MAIA) program.

[Source of MAIA data: Ator and Ferrari (1997). <, less than]

Pesticide	MAIA: Percentage of samples with detections	Baltimore County: Percentage of samples with detections
Deethyl atrazine	55	64
Metolachlor	29	49
Atrazine	43	43
Simazine	9	8
Prometon	0	<1

ence existed between any of the groups; if so, comparisons between all pairs of groups were subsequently performed using Dunn's test. Contingency-table (χ^2) analysis and the z-test were used to test for significant differences in pesticide-detection frequencies and proportions between various groups of wells (Glantz, 1992). The null hypothesis for all tests was that no significant differences existed between the groups. For all tests, the null hypothesis was rejected for $P<0.05$; that is, the differences between groups were deemed significant if there was less than a 5-percent chance of incorrectly concluding that the values came from different populations. The Spearman rank order test was used to measure the strength of the association between two variables (i.e., to test for trends). The Spearman correlation coefficient (r_s) can vary between +1 (a strong positive correlation) and -1 (a strong negative correlation). Correlations determined from the Spearman rank order test were considered significant for $r_s>0.250$ and $P<0.05$. Statistical tests were performed on data from wells only; the six springs sampled in Phase I represent a different target population of ground-water sites, and therefore cannot be evaluated with the well data. Statistical tests were performed using SigmaStat© for DOS (SPSS, Inc., Chicago, IL).

Aquifer Lithology

Dissolved solids in ground water are derived primarily from dissolution of aquifer minerals. Ground water in the study area is derived from infiltrating precipitation, which in the Maryland Piedmont is acidic (pH less than 4.5) and low in dissolved solids (tab. 17). As precipitation water infiltrates the soil and moves through the unsaturated zone, evapotranspiration (the process by which water is returned to the air by direct evaporation or uptake by plants) concentrates the dissolved solids in the remaining water, although some solutes (including nitrogen and potassium) may be taken up by plants. In the Baltimore County area, evapotranspiration rates (calculated as a percentage of precipitation) range from 60 to 78 percent (Dingman and Ferguson, 1956; Cleaves, Godfrey, and Bricker, 1970). Recharge water also becomes more acidic due to acquisition of carbon dioxide in the soil zone. The acidic water reacts with aquifer minerals to acquire additional dissolved materials. The types and concentrations of acquired solutes are a function of aquifer mineralogy, reaction kinetics, sorption processes, and other factors.

Table 17.
Major-ion chemistry of precipitation samples.

[Values are annual precipitation-weighted mean concentrations measured at the Finksburg (Carroll County, Maryland) station of the National Atmospheric Deposition Network/National Trends Network. Concentrations are in milligrams per liter except for pH and specific conductance (microsiemens per centimeter at 25 degrees C.)]

Analyte	Concentration	
	1994	1995
Ca	0.09	0.08
Mg	0.019	0.022
K	0.014	0.016
Na	0.105	0.153
NH_4-N	0.21	0.19
NO_3-N	0.35	0.29
Cl	0.24	0.26
SO_4	2.23	1.55
pH	4.31	4.45
Specific conductance	25.9	19.7

Schist and gneiss aquifers

Schists and gneisses, which underlie about 85 percent of the study area, are composed primarily of silicate and aluminosilicate minerals. The chief silicate mineral is quartz (SiO_2), which is relatively unreactive and has little effect on ground-water quality. Aluminosilicate minerals (chiefly plagioclase, potassium feldspar, biotite, and muscovite) are abundant, and have a significant influence on the major-ion chemistry of ground water. When aluminosilicate minerals react with acidic ground water, hydrogen ions are consumed and cations (notably calcium, magnesium, potassium, and iron) are released. Although aluminum is abundant in these aquifers, aluminum concentrations in ground water are usually very low except in waters with very low pH levels. This is because aluminum released during aluminosilicate mineral dissolution is usually reprecipitated as clay minerals, a process called incongruent dissolution (Freeze and Cherry, 1979). For example, aluminum is conserved in the incongruent-dissolution reaction between albite (sodium feldspar) and kaolinite, which can be shown as

$$NaAlSi_3O_8 + H^+ + 9/2\,H_2O = 1/2\,Al_2Si_2O_5(OH)_4 + Na^+ + 2\,H_4SiO_4$$

(modified from Freeze and Cherry, 1979, p. 270)

Incongruent-dissolution reactions and thermodynamic data can be used to construct diagrams for selected aluminosilicate minerals that indicate which minerals are stable for specified silica concentrations and cation/pH ratios (fig. 12). A general scheme of chemical evolution can be discussed for ground water in crystalline rocks containing these minerals. Recharge water from precipitation is acidic and is low in dissolved cations and silica (expressed as H_4SiO_4, the dominant silica species in Baltimore County ground water). Initially, the water composition plots in the gibbsite stability field (fig. 12). As the water reacts with the aquifer minerals, the cation/pH ratio and silica content both increase, and the water composition evolves toward the kaolinite field, at which point gibbsite is no longer stable, and kaolinite forms. Increasing dissolution of silicate minerals causes the water composition to move further along this path.

The chemical composition of selected Phase I samples from different aquifer lithologies are shown in relation to aluminosilicate mineral stability fields in figure 12. In order to examine the natural system as closely as possible, samples were selected that had low (usually less than 10 mg/L) chloride concentrations. (Higher chloride concentrations are usually associated with human activity, and may also have artificially high sodium and calcium concentrations.) Most of the samples from the schist and gneiss aquifers plot in the kaolinite stability field. The vast majority of near-surface ground waters in igneous rocks follow this pattern (Freeze and Cherry, 1979). The samples are supersatu-

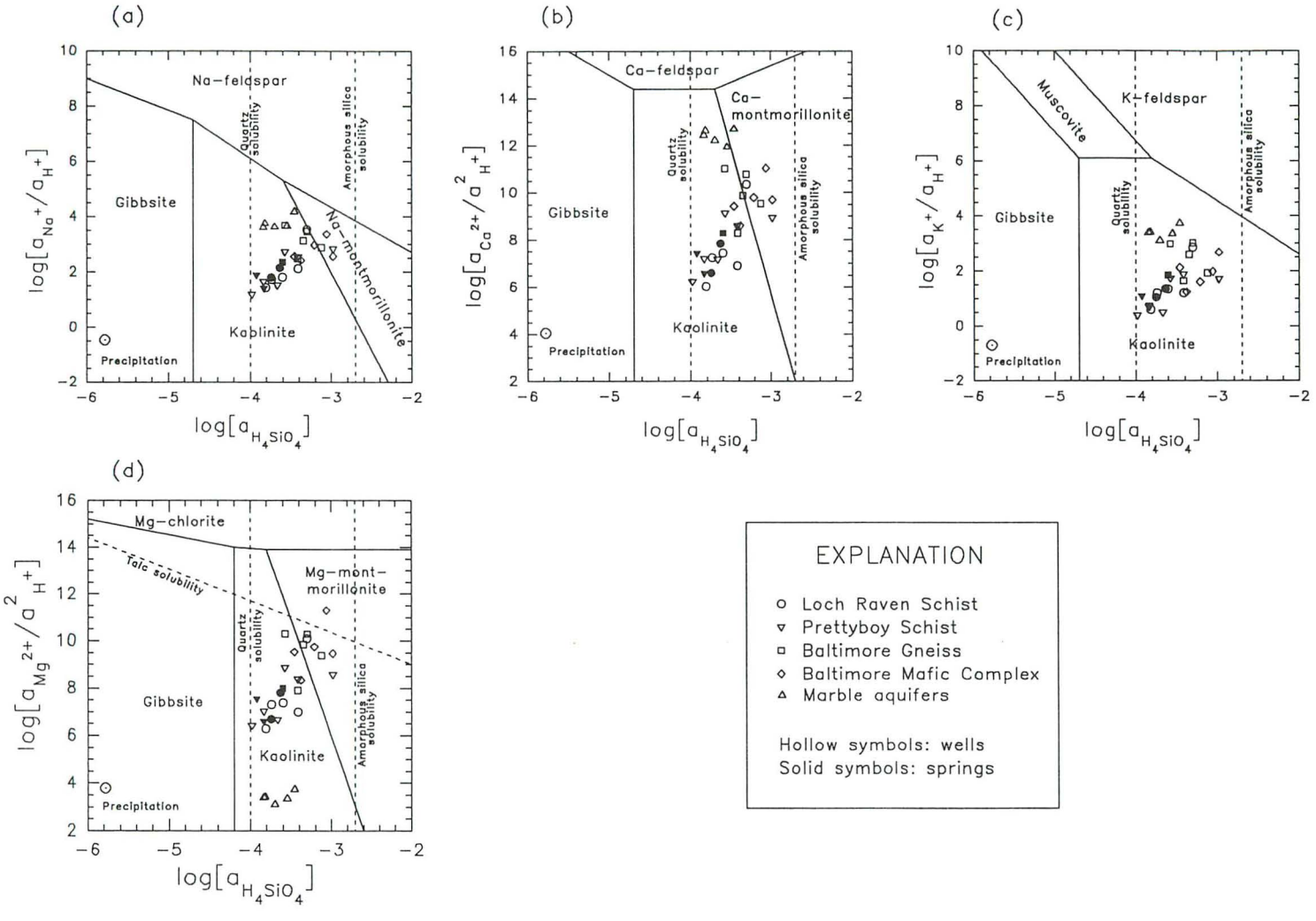


Figure 12. Stability fields for selected silicate minerals in the system K_2O-CaO-Na_2O-MgO-Al_2O_3-SiO_2-H_2O. Figures a, b, and c modified from Stumm and Morgan (1981); figure d modified from Cleaves, Fisher, and Bricker (1974). Precipitation data from Cleaves, Godfrey, and Bricker (1970). Activities were calculated using the WATEQ4F speciation code (Ball and Nordstrom, 1992).

rated with respect to quartz, indicating that quartz does not control silica solubility in the study area. Amorphous silica represents the upper limit of dissolved aqueous silica (Stumm and Morgan, 1981).

Seventy-five of the Phase I sites (71 wells and 4 springs) are located in schist. Most of these are in either the Prettyboy Schist or the Loch Raven Schist, which underlie about 39 percent and 29 percent, respectively, of the study area. Samples from schists had the lowest median alkalinity, calcium, magnesium, hardness, TDS, and pH of all four aquifer types (fig. 13).

Most samples from the Prettyboy Schist and the Loch Raven Schist had a mixed-cation composition (no single cation making up more than 50 percent of the milliequivalents per liter) (figs. 14 and 15). Calcium and magnesium together made up more than 50 percent of cation milliequivalents in almost all samples. Magnesium made up more than 50 percent of cations in two wells (Ea 92 and Bd 231); these wells are located in zones of ultramafic rock within the Loch Raven Schist. Anion composition was more variable; bicarbonate, chloride, or nitrate were dominant anions in several wells. Trilinear diagrams from samples in other schist aquifers show a similar pattern (fig. 16).

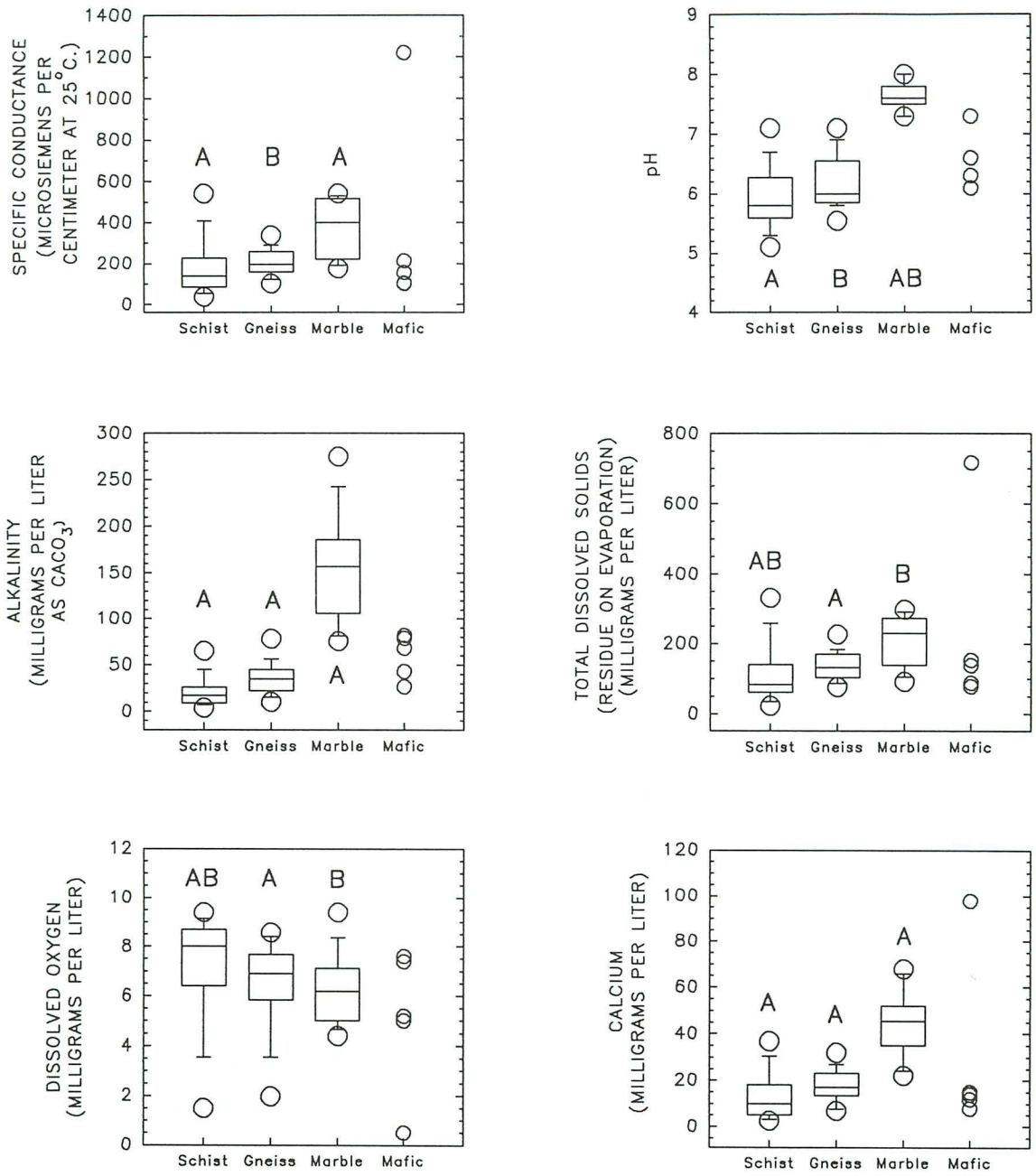
Differences in absolute concentrations of water-quality constituents were observed between samples from the Prettyboy Schist and the Loch Raven Schist. Potassium was significantly higher, and radon and dissolved oxygen were lower, in the Loch Raven Schist than in the Prettyboy Schist (fig. 17). Median magnesium and sulfate concentrations were higher and pH was lower in the Loch Raven Schist than in the Prettyboy Schist, although the differences were not statistically significant. The Loch Raven Schist is a biotite-plagioclase-muscovite-quartz schist, locally enriched in biotite and feldspar; the Prettyboy Schist is a plagioclase-chlorite-muscovite-quartz schist (Crowley, Reinhardt, and Cleaves, 1976). The higher magnesium and potassium concentrations in samples from the Loch Raven Schist may be related to the incongruent dissolution of biotite, which releases magnesium, iron, and potassium. Biotite, which is more abundant in the Loch Raven than the Prettyboy Schist (tab. 18) was found to be the primary source of magnesium and potassium in a small watershed in the Loch Raven Schist near Cockeysville (Bricker, Godfrey, and Cleaves, 1968; Cleaves, Godfrey, and Bricker, 1970).

Median nitrate concentrations were significantly higher in samples from the Prettyboy Schist than the Loch Raven Schist (Mann-Whitney rank sum test), as was the pesticide detection frequency. These differences likely reflect the percentage of each formation that is mapped as agricultural land, rather than differences in susceptibility to ground-water contamination: more than half of the wells in the Prettyboy Schist are in agricultural areas, whereas fewer than one-quarter of the wells in the Loch Raven Schist are in agricultural areas.

Radon concentrations in water samples in all schists ranged from less than 80 to 8,400 pCi/L (median: 2,900 pCi/L), and concentrations varied considerably between individual schist formations (tab. 19). Radon was significantly higher in samples from the Prettyboy Schist (median concentration 3,200 pCi/L) than in samples from the Loch Raven Schist (median concentration 1,200 pCi/L) (Mann-Whitney rank sum test). The two samples from the Loch Raven Schist with radon concentrations below 100 pCi/L were from ultramafic zones within the formation. Samples from the Piney Run Formation and Pleasant Grove Schist (median radon concentrations 5,250 pCi/L and 4,800 pCi/L, respectively) tended to have higher radon concentrations than samples from either the Prettyboy or Loch Raven Schists. These formations underlie a relatively small part of the study area, and the small sample size precludes any meaningful statistical comparison to the other schists.

Twenty-one sites (20 wells and one spring) are in gneiss: 17 wells and one spring are in the Baltimore Gneiss; two wells are in the Slaughterhouse Gneiss; and one well is in the gneiss member of the Sykesville Formation. Samples from the Baltimore Gneiss either had a mixed-cation composition or were enriched in calcium relative to other cations (fig. 18). There was less variability in calcium-plus-magnesium percentage among the Baltimore Gneiss water samples than among samples from either the Loch Raven or Prettyboy Schists. As with samples from the schists, anion composition was variable.

TDS, alkalinity, calcium, sodium, potassium, sulfate, and silica were all significantly higher in samples from gneiss aquifers than from schist aquifers; dissolved oxygen was lower (fig. 13). There were no significant differences between all schists and gneisses for pH, magnesium, hardness, chloride, TOC, nitrate, radon, or frequency of pesticide detections. Samples from the Baltimore Gneiss had significantly higher TDS, alkalinity, calcium, magnesium, sodium, potassium, silica, and sulfate than samples from the Prettyboy Schist. Many of these differences may result from the greater percentage of plagioclase (the weathering of which releases calcium, sodium, magnesium, and silica) and biotite (which releases magnesium, potassium, and silica) in the Baltimore Gneiss relative to the Prettyboy Schist (tab. 18). Potassium feldspar is more prevalent in the Baltimore Gneiss than the Prettyboy Schist, but tends to weather more slowly than biotite or plagioclase (Hem, 1985, p. 104). Both the Prettyboy and Loch Raven Schists have higher percentages of muscovite (which is relatively unreactive) than the Baltimore Gneiss. In general, water samples from the Baltimore Gneiss were more similar to samples from the Loch Raven Schist than to samples from the Prettyboy Schist, although calcium, sodium, and silica were significantly higher in the Baltimore Gneiss than the Loch Raven Schist, which probably reflects differences in the percentage of plagioclase (tab. 18). Sulfate was also higher in the Baltimore

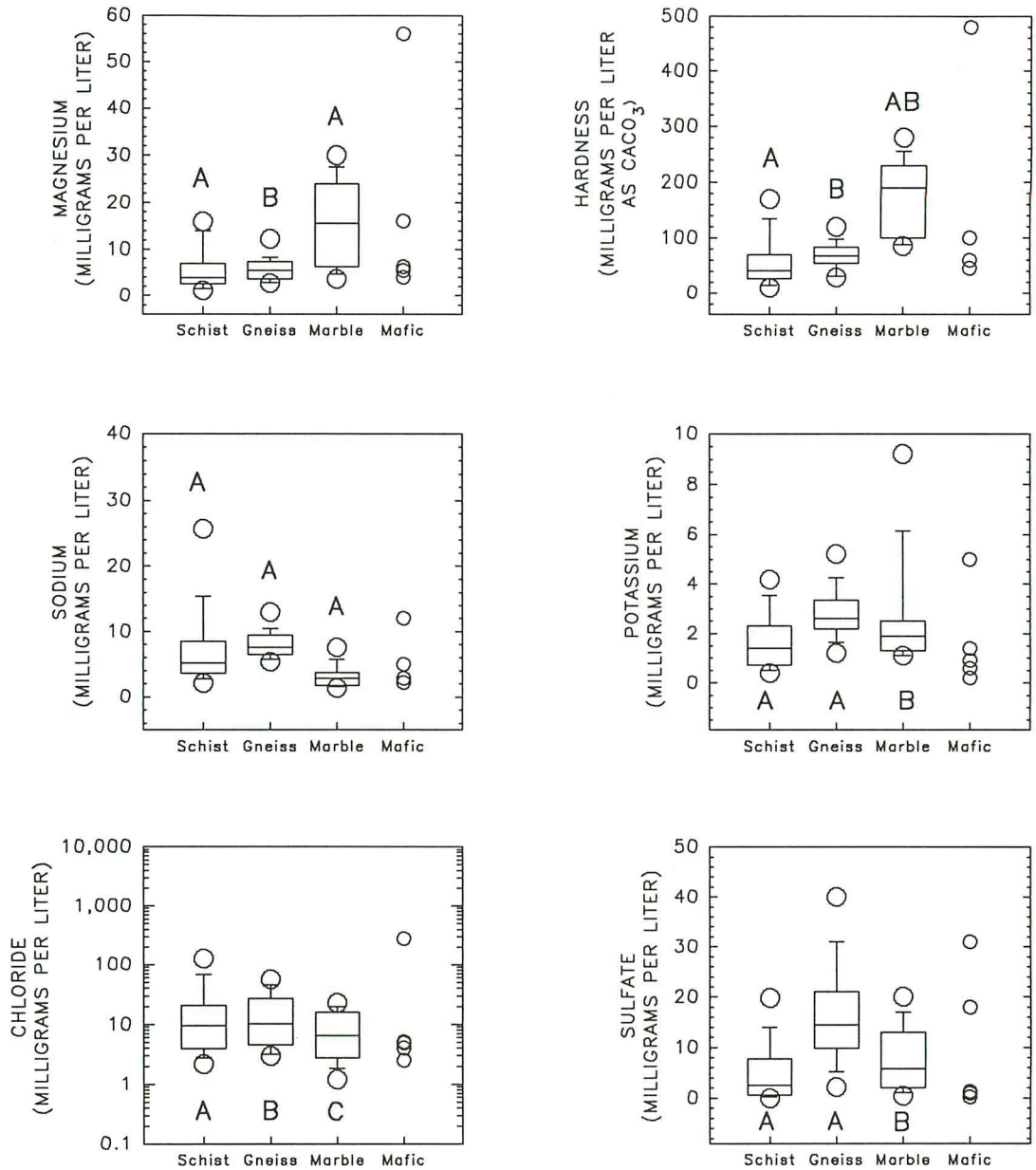


EXPLANATION

Lithologies having letters in common (A or B) were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Samples from mafic rocks were not included in the statistical tests. Spring data not plotted.

n(schist)=71
n(gneiss)=20
n(marble)=10
n(mafic)=5

Figure 13. Box-and-whisker plots of selected inorganic constituents in relation to aquifer lithology. See figure 7 for explanation of box-and-whisker plots.

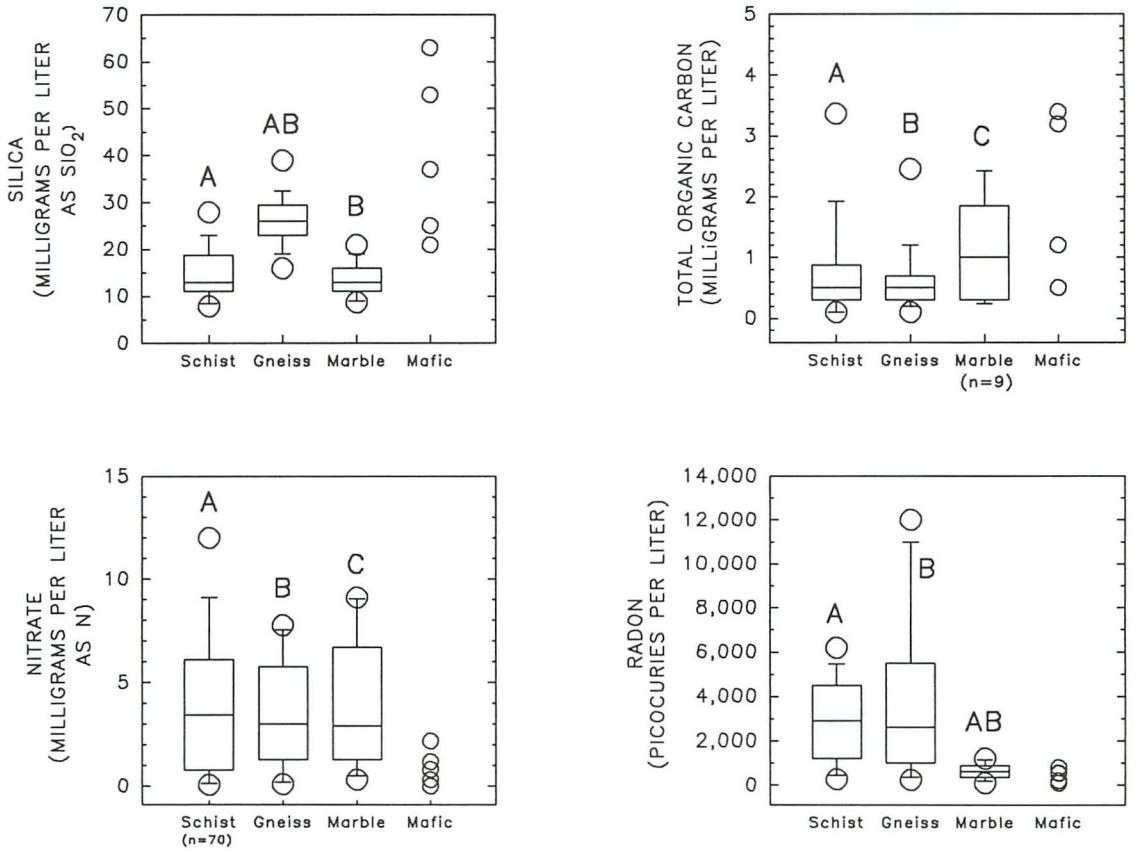


EXPLANATION

Lithologies having letters in common (A or B) were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Samples from mafic rocks were not included in the statistical tests. Spring data not plotted.

n(schist)=71
n(gneiss)=20
n(marble)=10
n(mafic)=5

Figure 13, continued. Box-and-whisker plots of selected inorganic constituents in relation to aquifer lithology. See figure 7 for explanation of box-and-whisker plots.



EXPLANATION

Lithologies having letters in common (A or B) were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Samples from mafic rocks were not included in the statistical tests. Spring data not plotted.

n(schist)=71
n(gneiss)=20
n(marble)=10
n(mafic)=5

Figure 13, continued. Box-and-whisker plots of selected inorganic constituents in relation to aquifer lithology. See figure 7 for explanation of box-and-whisker plots.

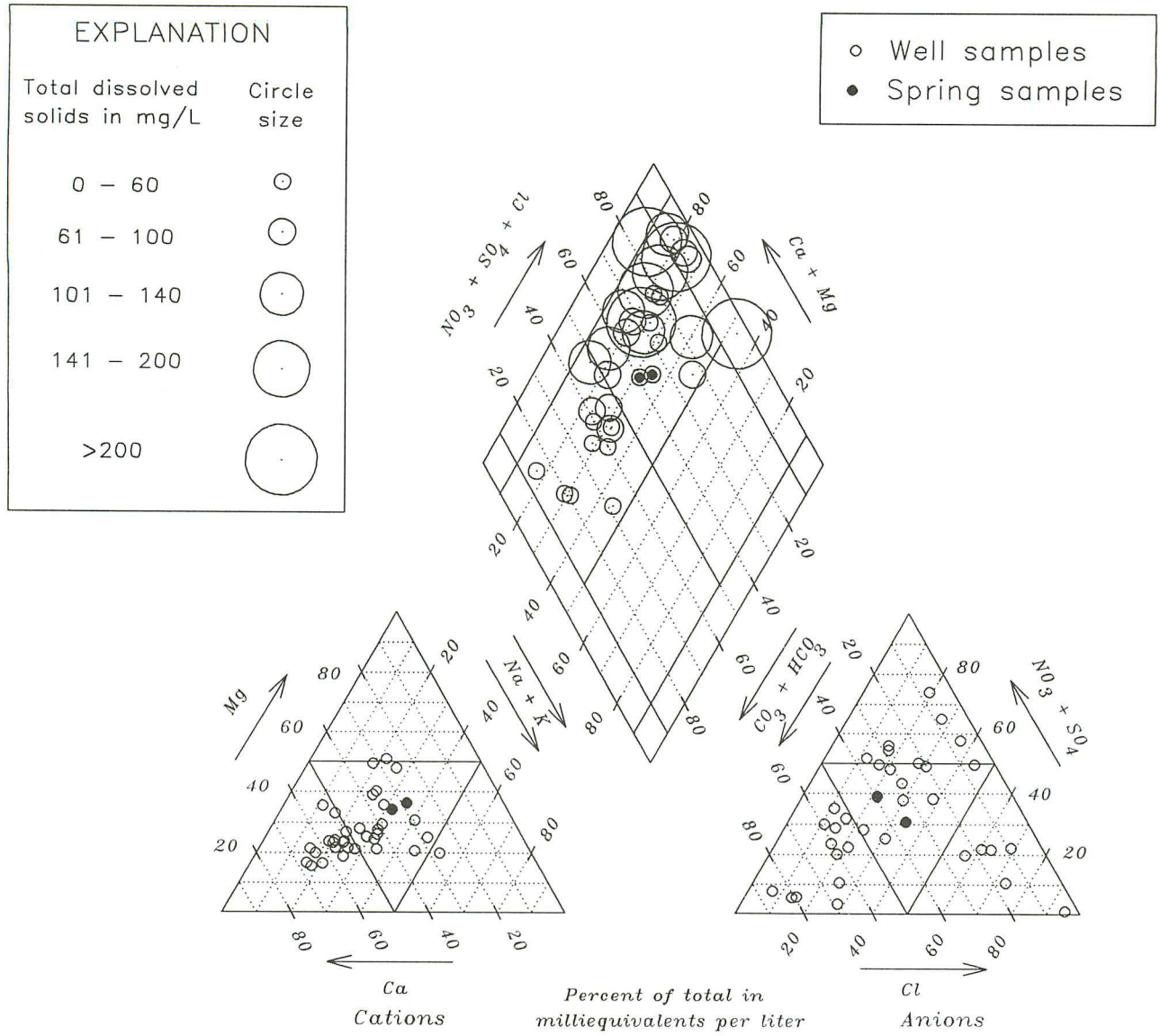


Figure 14. Percentages of major ions in water samples from wells and springs in the Prettyboy Schist.

Gneiss. There is very little pyrite in the Baltimore Gneiss that would explain the sulfate concentrations.

Radon concentrations varied widely in water samples from gneiss formations (range: 180 to 13,000 pCi/L). Radon concentrations from the Baltimore Gneiss (median value: 2,600 pCi/L) were not significantly different from either the Prettyboy Schist or the Loch Raven Schist. The three highest radon concentrations in the study were from a well in the Baltimore Gneiss (13,000 pCi/L) and two wells in the Slaughterhouse Gneiss (both 11,000 pCi/L). The Slaughterhouse Gneiss underlies a small area just west of Towson, and most of this area is serviced by public water supply. In the crystalline rocks of adjacent Howard County, most of the radon concentrations greater than 7,000 pCi/L were located in the general outcrop area of the Baltimore Gneiss (Dine, Adamski, and Duigon, 1995). In a study of selected areas of the Lower Susquehanna and Potomac River Basins, Lindsey and Ator (1996) found that the highest median radon concentration in ground water (3,100 pCi/L) was from an area mostly underlain by igneous and metamorphic rocks of granitic composition. They attributed differences in radon concentrations to uranium content of the rocks. Both studies found large variations in radon concentrations within similar geologic settings.

Marble aquifers

Approximately 10 percent of the study area is underlain by marble. Eleven sites (10 wells and one spring) are

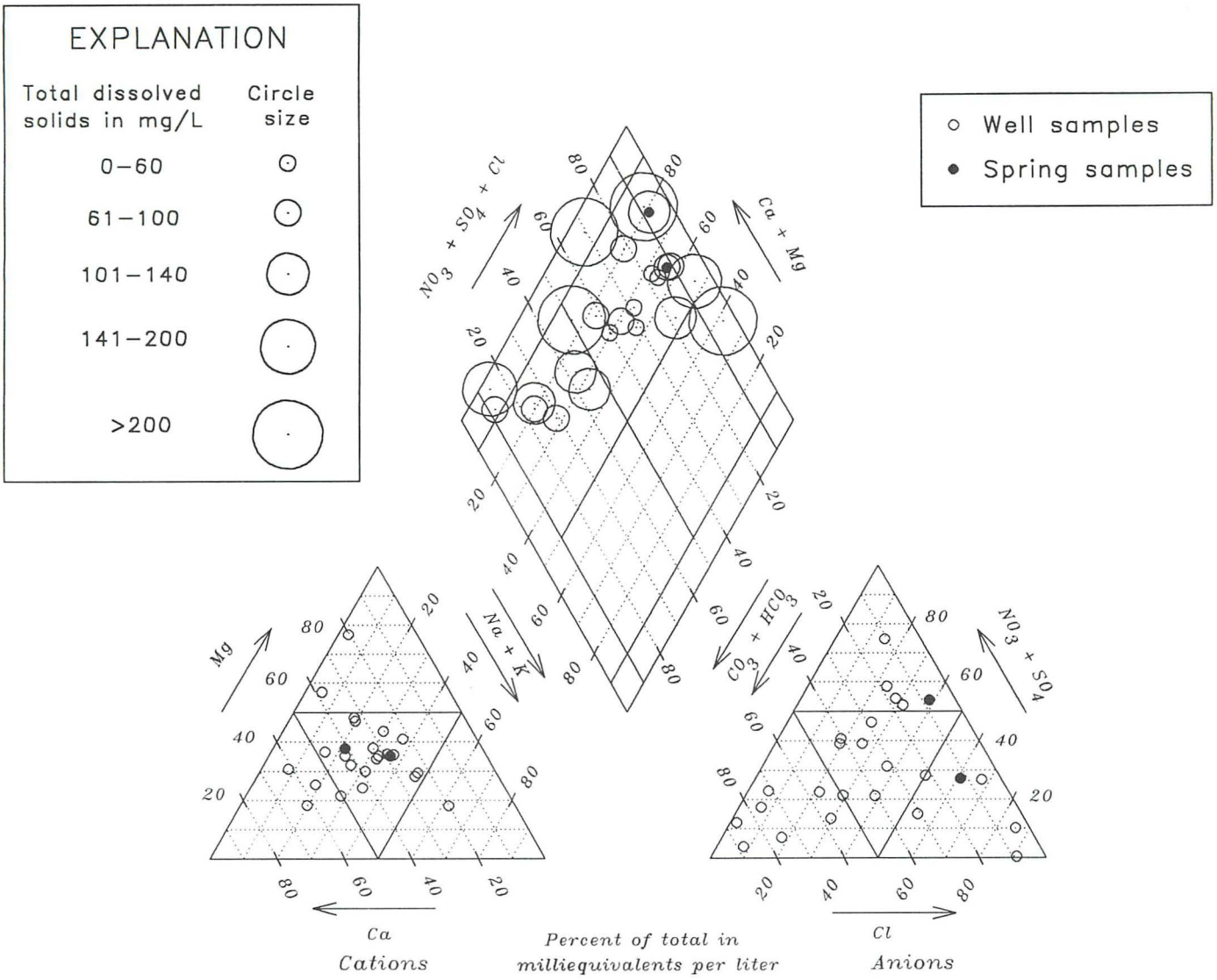


Figure 15. Percentages of major ions in water samples from wells and springs in the Loch Raven Schist.

located in marble aquifers; 10 are in the Cockeysville Marble, and one is in the Hydes Marble Member of the Loch Raven Schist. The Cockeysville Marble and Hydes Marble Member are mainly composed of metamorphosed limestone and dolostone, and are often enriched in silicate minerals (Choquette, 1960; Crowley, 1976). The mineralogic compositions of rock samples from the Cockeysville Marble, which is more areally extensive than the Hydes Marble Member, are shown in table 20.

Water samples from the marble aquifers were all calcium-bicarbonate waters (fig. 19), and were characterized by high TDS. All samples were at or near saturation with respect to calcite, whereas samples from other aquifers were undersaturated with respect to calcite. Alkalinity, pH, calcium, and hardness were significantly higher in samples from marble than samples from either the schists or gneisses (fig. 13). TDS and magnesium were higher in samples from marble than from schists, but were not significantly different than samples from gneiss aquifers. Most of the dissolved solids in the samples from marble aquifers result from dissolution of carbonate minerals. Radon and sodium concentrations were lower in the samples from marble than from samples in either schists or gneisses. The median silica concentration from samples in carbonate-rock aquifers (12 mg/L) was similar to the median value from schists (13 mg/L), reflecting the presence of silicate minerals in several members of the Cockeysville Marble (Crowley, 1976). There were no significant differences between water samples from marble and samples from either gneiss or schist for chloride, TOC, potassium, or sulfate. There were also no significant differences in nitrate concentrations or frequency of pesticide detections between samples from the marble,

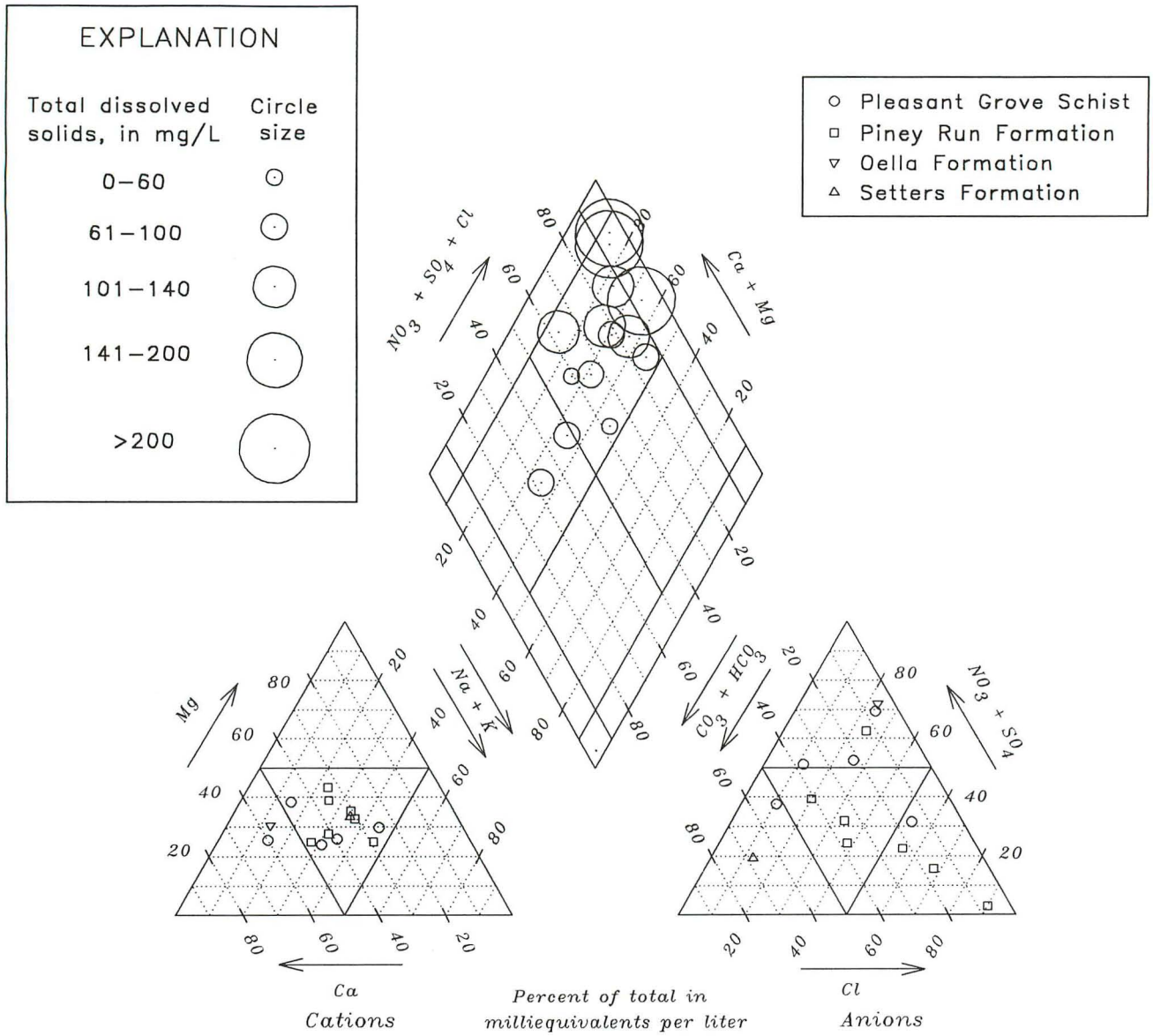


Figure 16. Percentages of major ions in water samples from wells and springs in the Pleasant Grove Schist and the Piney Run, Oella, and Setters Formations.

schist, or gneiss aquifers. Ground-water samples from carbonate aquifers in the mid-Atlantic region were found to have significantly higher nitrate concentrations and pesticide detection frequencies than samples from crystalline, unconsolidated, or siliciclastic aquifers (Ator and Ferrari, 1997). The lack of difference in nitrate concentrations and pesticide detections between samples from marble and from other crystalline-rock aquifers in the study area suggests that ground water in marble aquifers may be no more susceptible to contamination than ground water in non-carbonate crystalline rocks. However, only 11 wells were sampled in marble aquifers, and more data are needed to evaluate this hypothesis.

Mafic-rock aquifers

Mafic rocks, which underlie approximately 5 percent of the study area, are composed predominantly of amphibole (chiefly hornblende) and plagioclase (tab. 21) (Crowley, 1976). Water samples were collected from five wells in mafic rocks. Four of the five samples were calcium-magnesium-bicarbonate waters (fig. 20); one was a calcium-magnesium-chloride water that had been affected by road salt. The small sample size precludes any meaningful statistical comparison; however, some contrasts can be seen between the mafic-rock water samples and those from other rock types. The mafic-rock samples tended to have smaller

Table 18.
Mineralogic compositions of samples from the Prettyboy Schist, the Loch Raven Schist, and the Baltimore Gneiss.

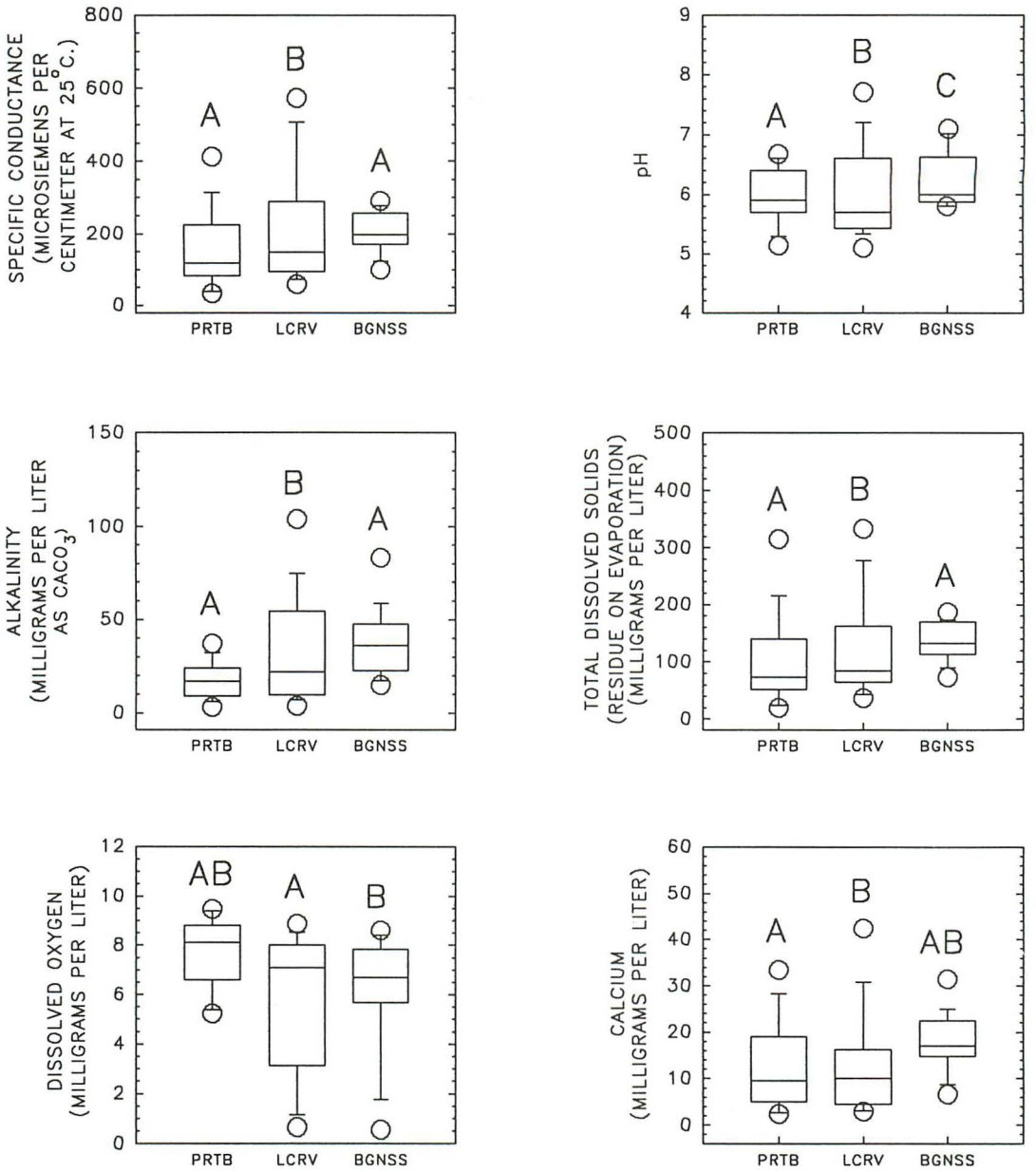
[Values are in percent. --, not reported; t, trace. Source: Southwick (1969).]

	Prettyboy Schist sample number			Loch Raven Schist sample number		Baltimore Gneiss sample number		
	9	10	11	1	2	1	2	3
Quartz	35.3	22.9	11.1	35.9	37.2	30.0	26.1	28.6
Plagioclase	14.6	12.9	17.0	23.4	27.6	31.2	39.4	37.8
Microcline	--	t	--	--	--	12.4	21.0	9.8
Muscovite	27.4	44.9	51.7	24.5	16.6	1.1	1.8	1.4
Biotite	--	--	--	13.9	13.7	23.3	10.3	18.3
Chlorite	16.9	9.3	16.5	0.1	--	--	0.1	t
Epidote	1.0	4.4	1.0	0.1	0.1	0.1	t	2.1
Other	4.8	5.6	2.7	2.1	4.8	1.9	1.3	2.0
Total	100	100	100	100	100	100	100	100

Table 19. Summary of radon data by geologic formation.

[pCi/L, picocuries per liter; <, less than]

Geologic formation	Number of samples	Median radon concentration (pCi/L)	Range of radon concentrations (pCi/L)
Prettyboy Schist	35	3,200	110—8,400
Pleasant Grove Schist	5	4,800	2,800—5,200
Piney Run Schist	6	5,250	2,700—6,200
Loch Raven Schist	25	1,200	<80—5,300
Other schists	2	4,300	1,700—6,900
Baltimore Gneiss	18	2,600	180—13,000
Slaughterhouse Gneiss	2	11,000	11,000
Sykesville Formation (Gneiss Member)	1	2,100	2,100
Cockeysville Marble	10	625	<80—1,200
Loch Raven Schist (Hydes Marble Member)	1	260	260
Baltimore Mafic Complex	5	540	110—790

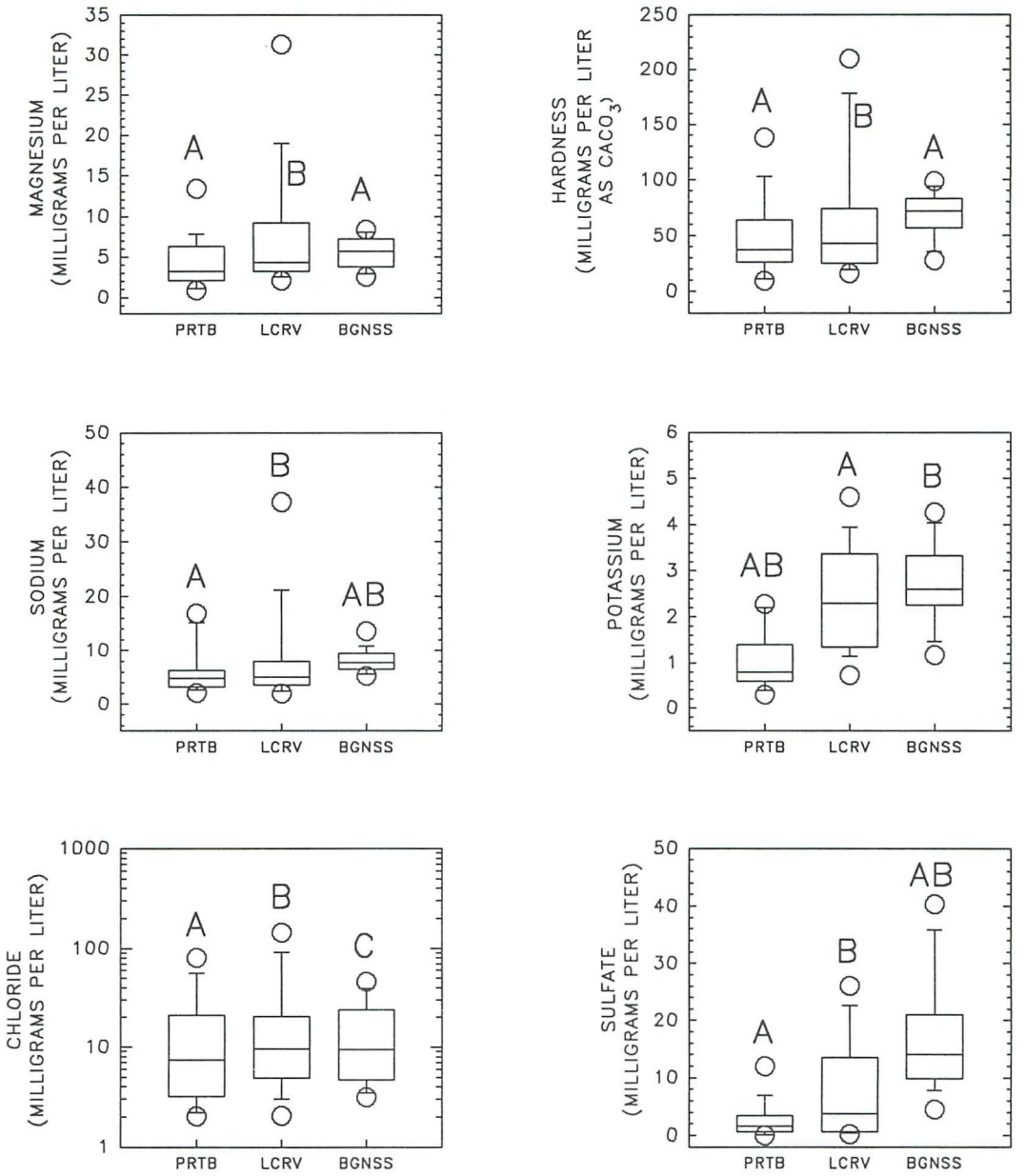


EXPLANATION

Formations having letters in common (A or B) were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Spring data not plotted.

PRTB: Prettyboy Schist (n=34)
LCRV: Loch Raven Schist (n=23)
BGNSS: Baltimore Gneiss (n=17)

Figure 17. Box-and-whisker plots of selected inorganic constituents in water samples from the Prettyboy Schist, the Loch Raven Schist, and the Baltimore Gneiss. See figure 7 for explanation of box-and-whisker plots.



EXPLANATION

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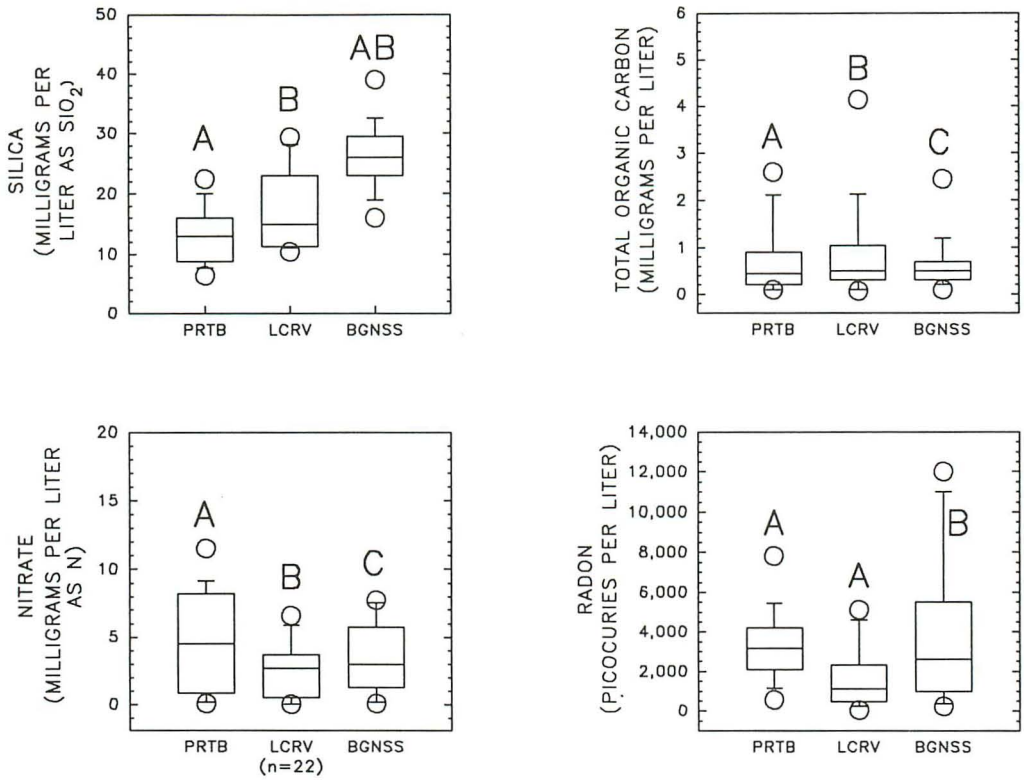
Figure 17, continued. Box-and-whisker plots of selected inorganic constituents in water samples from the Prettyboy Schist, the Loch Raven Schist, and the Baltimore Gneiss. See figure 7 for explanation of box-and-whisker plots.



EXPLANATION

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PRTB: Prettyboy Schist (n=34)
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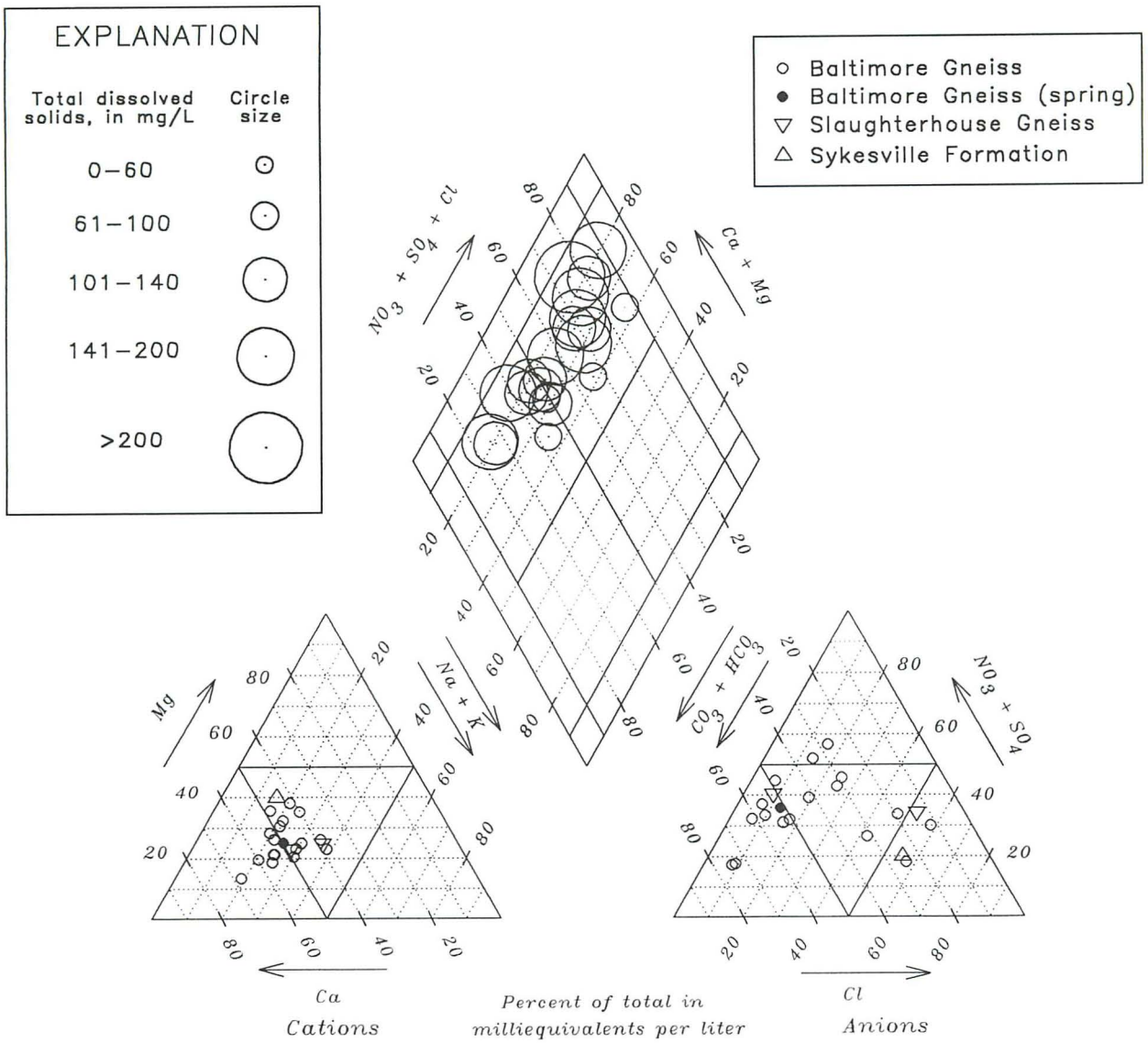


Figure 18. Percentages of major ions in water samples from wells and springs in the Baltimore Gneiss and other gneiss formations.

percentages of sodium and potassium than samples from schist or gneiss aquifers. Alkalinity and pH tended to be higher in the mafic-rock water samples than in samples from either schists or gneisses, and silica concentrations in mafic-rock samples tended to be higher than in samples from all other rock types (fig. 13). The higher concentrations of these constituents in samples from mafic rocks is likely due to the weathering of hornblende and other amphiboles, which are more susceptible to chemical weathering than plagioclase and other framework silicates (Hem, 1985). Areas of the county that are underlain by mafic rocks often lack saprolite because the rocks are deficient in aluminosilicate minerals; this promotes the removal of weathering products in solution by ground water rather than reprecipitation as clay minerals (Cleaves, Fisher, and Bricker, 1974). Potassium, which is not a major constituent of amphibole, tended to be lower in mafic-rock water samples than in samples from other rocks. The mafic-rock water samples straddle the boundaries between kaolinite and sodium, calcium, and magnesium montmorillonite fields (fig. 12), indicating that these phases are stable under the observed ground-water-quality conditions. Kaolinite and montmorillonite have been observed as weathering products of plagioclase and hornblende, respectively, in mafic rocks in Baltimore and Harford Counties (Cleaves, 1968; 1974).

Small amounts of chromium were detected in three of the five water samples from mafic rocks, whereas chromium detection rates in samples from the other rock types were

Table 20.
Mineralogic compositions of samples from the Cockeysville Marble in Baltimore County.

[Values are in percent. --, not reported. Source: Choquette (1960, p. 1040)]

	Sample number		
	3	11	4
Calcite	35.0	13.6	90.2
Dolomite	--	83.0	--
Quartz	20.3	1.9	4.0
Phlogopite	13.1	1.5	1.0
Muscovite	23.9	--	2.8
Microcline	2.3	--	0.3
Plagioclase	1.5	--	0.7
Other	3.9	--	1.0
Total	100	100	100

much lower. Chrome deposits were mined in the 19th century in the Soldiers Delight and Bare Hills areas of Baltimore County, which are underlain by mafic rocks (Mathews and Watson, 1929). Chromite (the chief chrome ore) is associated with ultramafic rocks in areas of land with thin soils and sparse vegetation (commonly referred to as barrens). Radon concentrations in mafic-rock water samples (range: 110 to 790 pCi/L) were similar to samples from marble aquifers, and were lower than samples from the schists and gneisses.

Land Use

Land use at the Phase I sites was determined from Maryland Office of Planning 1990 land use/land cover data for Baltimore County. Minimum land-use resolution was 10 acres; the data were collected at a scale of one inch equals one mile. The land-use classifications were condensed into four broad categories: residential, agricultural, commercial, and forest (tab. 22). Using latitude-longitude data and the digital land-use coverage, two land-use assignments were given to each site: (1) land use at the site, and (2) predominant land use within a 1,000-ft radius of the site. Within the 1,000-ft radius, the areas of all Maryland Office of Planning classifications included in a single category (as defined for this project) were summed, and then the total acreage of each category was used to determine predominant land use. The relationship between ground-water quality and land use for the two different methods of land-use determination was very similar; unless otherwise indicated, land use refers to the predominant land use within a 1,000-ft radius around each well.

Land-use determination by this method resulted in the following distribution of wells per category: agricultural, 48 wells; residential, 27 wells; forest, 30 wells; commercial, 1 well. There was a bias toward wells in residential areas (tab. 23). Comparisons were made between agricultural, residential, and forested land use; the one well in a commercial area was not included in the statistical analysis.

For most inorganic constituents and indicators (including alkalinity, TDS, calcium, magnesium, hardness, sodium, potassium, chloride, sulfate, and nitrate), median concentrations in samples from wells in forested areas were lower than those from residential or agricultural areas; in most cases the differences were not significant (fig. 21). Calcium and hardness in samples from agricultural-area wells were significantly higher than in samples from forest-area wells, but were not significantly different from residential-area well samples. Lime, which is applied periodically to most cropland in the county (D. Martin, Baltimore County Cooperative Extension Service, oral comm., 1997), may be the source of the higher calcium concentrations (and therefore hardness) in the agricultural-area wells. Lime is also applied to lawns in residential areas; another possible source of calcium in ground water in residential areas is from ion exchange of soil calcium for sodium derived from road salt.

Nitrate concentrations from wells in agricultural areas (median concentration: 5.3 mg/L) were significantly higher than wells in either forested (1.15 mg/L) or residential (2.9

Table 21.
Mineralogic compositions of samples from the Baltimore Mafic Complex in Baltimore County.

[Values are in percent. --, not reported. Sources: sample numbers 6 and 10, Hopson (1964); sample number 64-95, Cleaves (1974)]

	Sample number		
	6	10	64-95
Quartz	0.2	--	14.6
Plagioclase	33.1	48.6	21.8
Hornblende	62.6	50.6	45.1
Epidote	3.0	--	--
Kaolinite	--	--	12.9
Other	1.1	0.8	5.6
Total	100	100	100

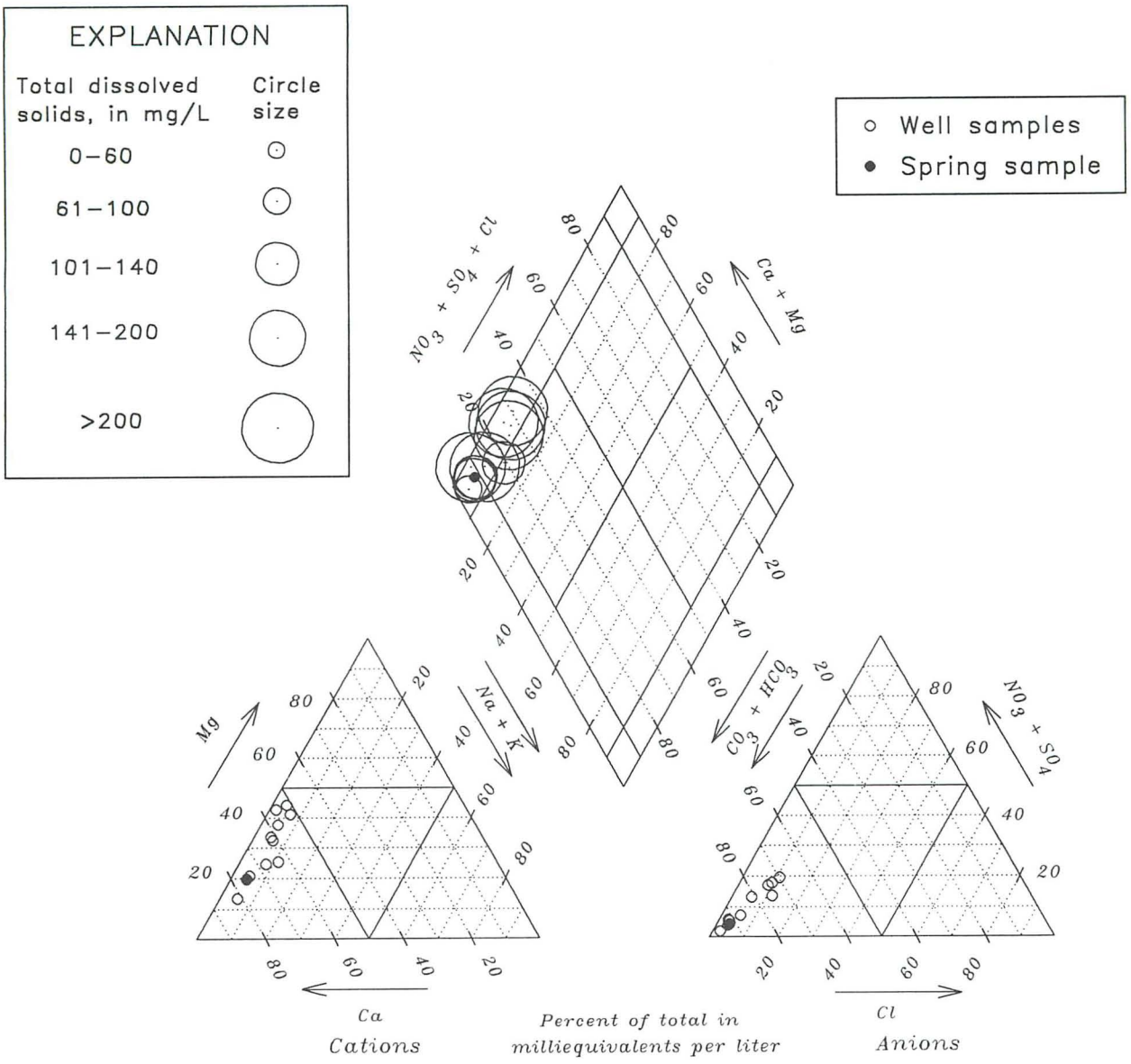


Figure 19. Percentages of major ions in water samples from wells and springs in the marble aquifers.

mg/L) areas (fig. 21). Four of the five wells with nitrate concentrations greater than 10 mg/L are in agricultural areas. The location of the fifth well is mapped as forest; however, the area immediately around the well is all row-crop acreage. Nitrate concentrations from wells in forested and residential areas were not significantly different. Nitrate concentrations were significantly higher in wells with at least one pesticide detection than in wells with no pesticide detections (fig. 22). This suggests that nitrates in well water are more closely associated with agricultural activity than residential inputs from septic systems.

Pesticide detections were significantly related to land use. The proportion of agricultural-area wells with at least one pesticide detection (83 percent) was significantly different from that of residential-area wells (52 percent); there was no significant difference between the frequency of pesticide detections in forest-area wells (67 percent) and either agricultural-area or residential-area wells (fig. 23). DEA had the highest detection rate of any pesticide in all land-use categories. DEA exceeded the atrazine concentration in 82 percent of the agricultural-area wells, 89 percent of the forest-area wells, and 80 percent of the residential wells; there were no significant differences between these proportions.

The high detection rate in the forest and residential land-use categories is related to several factors. In the forest-area wells with pesticide detections, there is some agricultural land (usually cropland) currently located upgradient

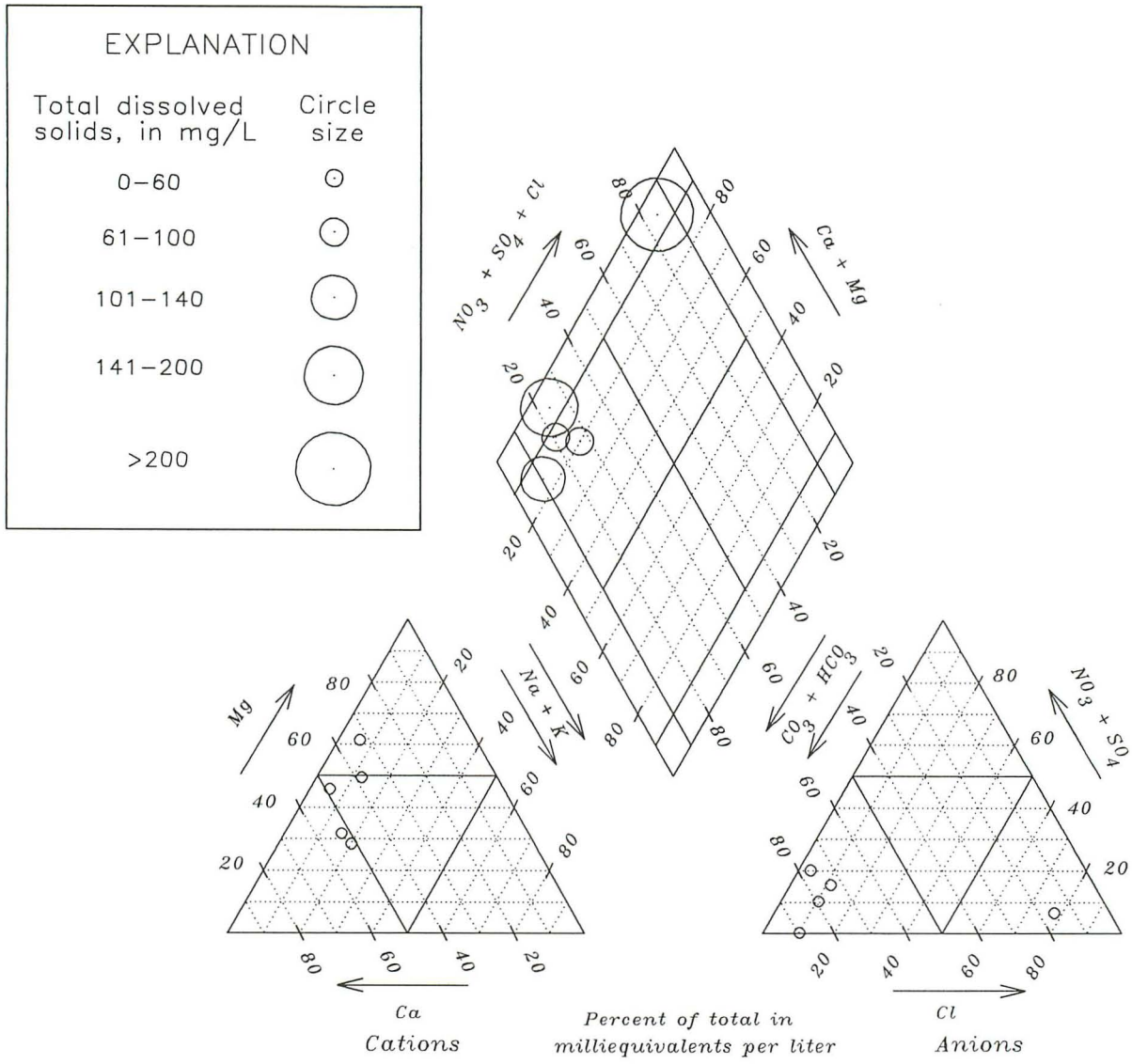


Figure 20. Percentages of major ions in water samples from wells in mafic-rock aquifers.

or within 1,000 ft of the sites, although it does not constitute the majority land use. Many of the wells in residential and forested areas are located in or downgradient from former cropland. Atrazine, metolachlor, simazine, and other pesticides have been detected in low concentrations in the atmosphere in Maryland (Wu, 1981; Glotfelty and others, 1990), and precipitation cannot be ruled out as a source of low-level pesticide detections in the study area. However, little research has been conducted on the contribution of pesticides in the atmosphere to pesticides in ground water (Majewski and Capel, 1995).

Septic systems

Although only about one-quarter of the Phase I sites were classified as being in residential land-use areas, almost all of the wells are water supplies for individual residences. Most of the wells were near septic systems (private on-site disposal systems for water-carried household wastes). Ground water affected by septic-system effluent has been shown to have greater-than-background concentrations of most major ions, nitrate, ammonium, phosphorus, total and dissolved organic carbon, specific conductance, and lower pH (Viraraghavan and Warnock, 1975; Robertson, Cherry, and Sudicky, 1991; Harman and others, 1996), although all of these effects were not seen in each study. Septic-system effluent is perhaps the most significant source of pathogenic bacteria and viruses in the subsurface (Yates and Yates, 1993). Septic systems consist of two major components: (1) a tank that provides treatment of solid wastes, and (2) a seepage system that allows for the infiltration of the waste water into the subsurface. The two most common types of

Table 22.
Land-use classifications used in the study area.

[--, no sites in the category. Source: Maryland Office of Planning (1991)]

Maryland Office of Planning			Land-use category used in this report
Classification	Definition	Land use code	
Very low-density residential	Large lot subdivisions with lot sizes of 5–20 acres, with dominant land cover of open fields or pasture	191	Residential
	Large lot subdivisions with lot sizes of 5–20 acres, with dominant land cover of deciduous, evergreen, or mixed forest	192	
Low-density residential	Residential areas, 0.2 dwelling units to 2 dwelling units per acre	11	
Medium-density residential	Residential areas, 2 dwelling units to 8 dwelling units per acre	12	
High-density residential	Residential areas with more than 8 dwelling units per acre	13	--
Commercial/Industrial	Retail and wholesale service	14	Commercial
	Manufacturing and industrial parks	15	--
Institutional/open	Educational facilities, military installations, churches, government facilities	16	--
	Open urban areas, golf courses, cemeteries, parks, recreation areas	18	
Bare ground	Areas of exposed ground caused naturally, by construction or other cultural processes	73	--
Agricultural	Cropland	21	Agricultural
	Pasture, grassland	22	
	Orchards, vineyards	23	--
	Row and garden crops	25	
	Feeding operations	241	
	Agricultural buildings, training facilities, storage facilities	242	
Forest	Deciduous forest	41	Forest
	Evergreen forest	42	
	Mixed deciduous and evergreen forest	43	
	Brush, cut-over timber stands, abandoned fields and pasture	44	--
Extractive/barren	Surface mining activities	17	--
	Beaches	71	
	Bare exposed rock	72	
Wetlands	Forest or non-forested wetlands, including tidal flats, tidal and non-tidal marshes, upland swamps, and wet areas	60	--
Water	Rivers, waterways, reservoirs, ponds, bays, estuaries, and ocean	50	--

Table 23.
Land-use distribution in the study area and among Phase I wells.

[Land use at each site was determined from the predominant land use within 1,000 ft of each site. Source: Maryland Office of Planning (1991)]

Land-use category	Percent of study area	Phase I wells	
		Percent	Number of wells
Agricultural	41.0	45.3	48
Forest	42.2	28.3	30
Residential	13.4	25.5	27
Commercial/ Industrial	0.5	0.9	1
Other	2.9	0	0
Total	100	100	106

seepage systems are absorption trenches and seepage pits, which are connected to the septic tank by a distribution box. Since 1972, septic systems in Baltimore County have been required to have a 10,000-ft^2 septic reserve area in which the absorption trenches are located. The septic reserve area must be at least 100 ft (and preferably downgradient) from the homeowner's well.

Water-quality constituents were evaluated with respect to distance from the well to the nearest septic reserve area. Subdivision plans and site maps were obtained from DEPRM files for 48 of the Phase I wells; wells for which these maps were not available were not used in the analysis. The distance from the well to the nearest septic reserve area was determined from the maps. For most sites, the nearest septic reserve area was on the same property as the sampled well; occasionally, the septic reserve area on the adjacent property was closer. There were no significant correlations between any of the constituents and distance to the septic reserve area (Spearman rank order test). TDS, nitrate, chloride, sodium, and TOC are plotted against distance to the septic reserve area (fig. 24).

There are several possible reasons why there was little correlation between water-quality constituents and distance to septic reserve areas:

- Only two of the 48 wells were less than 100 ft from the septic reserve area; there may be a strong correlation between water-quality constituents and distance to the septic reserve area for distances between zero and 100 ft.
- Septic reserve areas are usually downslope from wells on the same property; septic reserve areas located upgradient but farther away may have a greater impact on water quality.
- The impact of septic-system effluent may correlate with fracture orientation. Septic systems close to a well may have a smaller impact than septic systems farther away whose effluent enters a fracture system that is hydraulically connected to the well.
- Septic-system effluent may be diluted by pristine water entering another part of the well bore from fractures that do not transmit septic effluent.
- Current soil evaluation practices and proper septic system design have resulted in better quality septic effluent.

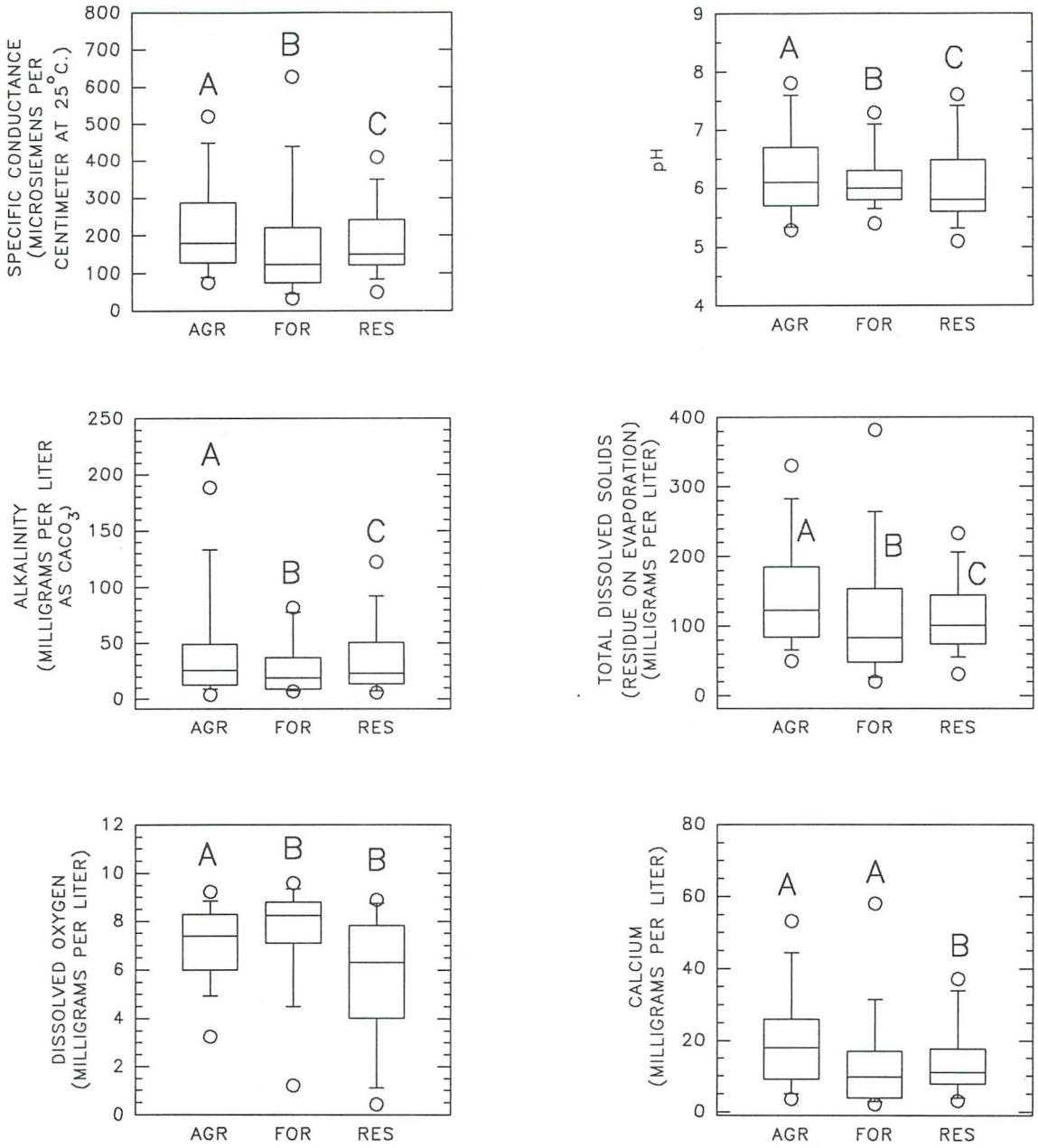
Sources of nitrate

In an attempt to identify sources of ground-water nitrate in the study area, several Phase I sites were resampled and the water samples analyzed for the proportion of ^{15}N (a stable isotope of nitrogen) in nitrate. Nitrogen isotopes have been used in several ground-water studies to distinguish between sources of nitrate (Kreitler, 1975; Spalding and others, 1982; Aravena, Evans, and Cherry, 1993; Komor and Anderson, 1993; Rivers and others, 1996). Isotopes are atoms of the same element which have the same number of protons but different numbers of neutrons in the nucleus. Because isotopes have different masses, physical and chemical processes that are mass-dependent can result in the partitioning, or fractionation, of isotopes. Nitrogen has five isotopes, two of which (^{14}N and ^{15}N) are stable; the other three are unstable and have half-lives of ten minutes or less (Kreitler, 1975). Over 99 percent of atmospheric nitrogen is ^{14}N; the percentage of ^{14}N in other nitrogen-containing compounds varies due to fractionation. The amount of ^{15}N in a sample is reported in standard isotopic terminology as:

$$\delta^{15}N\ (‰, \text{or per mil}) = [(^{15}N/^{14}N)_{sample}/(^{15}N/^{14}N)_{standard} - 1] \times 1{,}000$$

where the standard is atmospheric nitrogen. Samples with positive $\delta^{15}N$ values are enriched in ^{15}N relative to atmospheric nitrogen standard, while samples with negative values are depleted relative to the standard.

Three potential sources of nitrogen in the study area are commercial fertilizers, animal wastes (including septic-system effluent), and soil nitrogen. Nitrate in commercial fertilizer is usually derived from atmospheric nitrogen by processes involving little isotopic fractionation; $\delta^{15}N$ from these sources is usually between -4 and +4 per mil (Heaton, 1986). Most of the nitrogen in animal wastes is in urea, which is transformed to ammonia. Ammonia is easily volatilized, and the ammonia that remains is enriched in ^{15}N. Ammonia can then be oxidized microbially to nitrite and then to nitrate. Nitrate from animal wastes typically has a $\delta^{15}N$ of +10 to +20 per mil. Soil nitrogen is derived from conversion of organic nitrogen to ammonium and ultimately



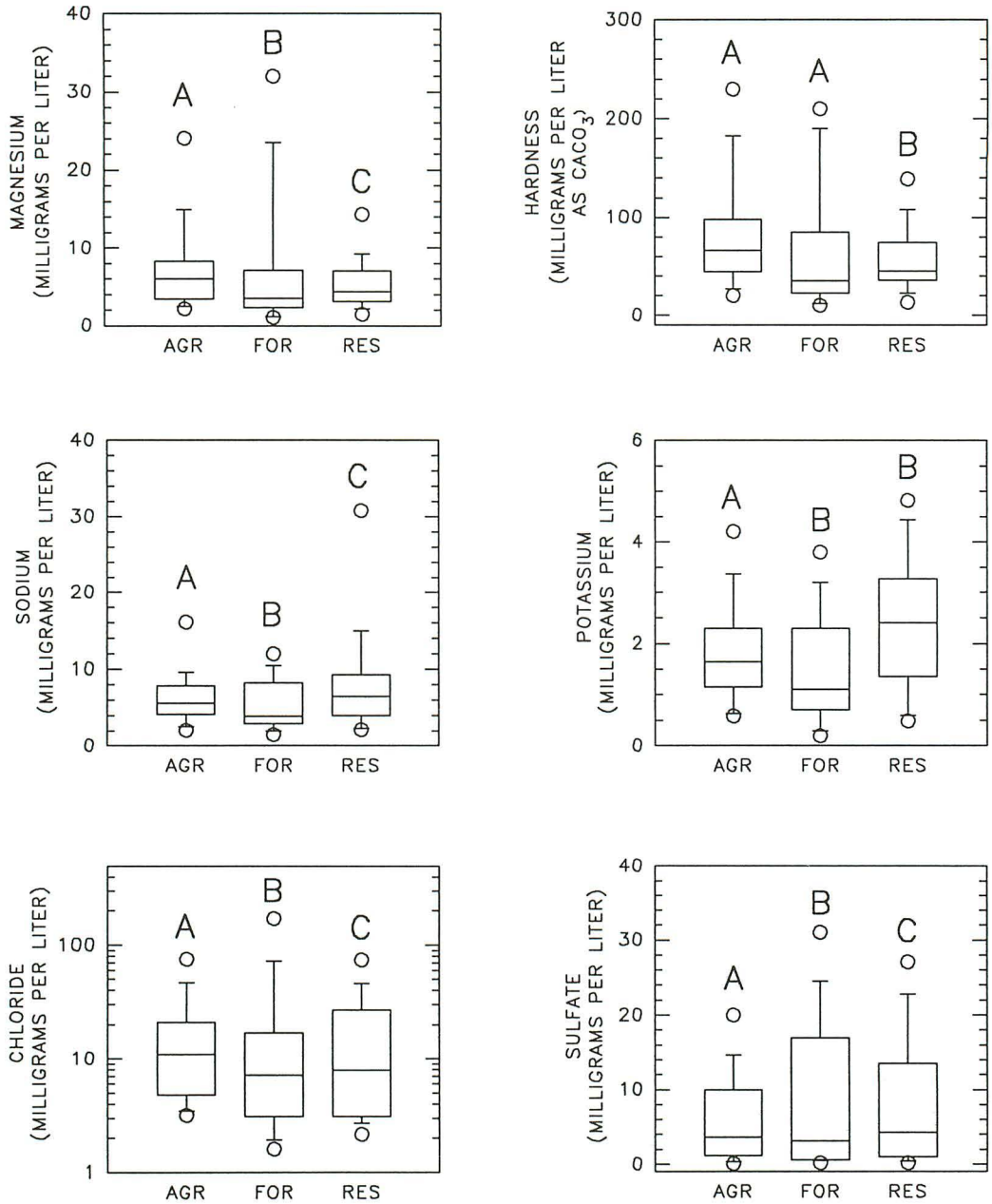
EXPLANATION

Land–use categories having letters in common were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Spring data not plotted.

AGR: Agricultural (n=48)
FOR: Forest (n=30)
RES: Residential (n=27)

BA Bc 275 (commercial land use) not included

Figure 21. Box-and-whisker plots of selected inorganic constituents in relation to land-use categories. See figure 7 for explanation of box-and-whisker plots.



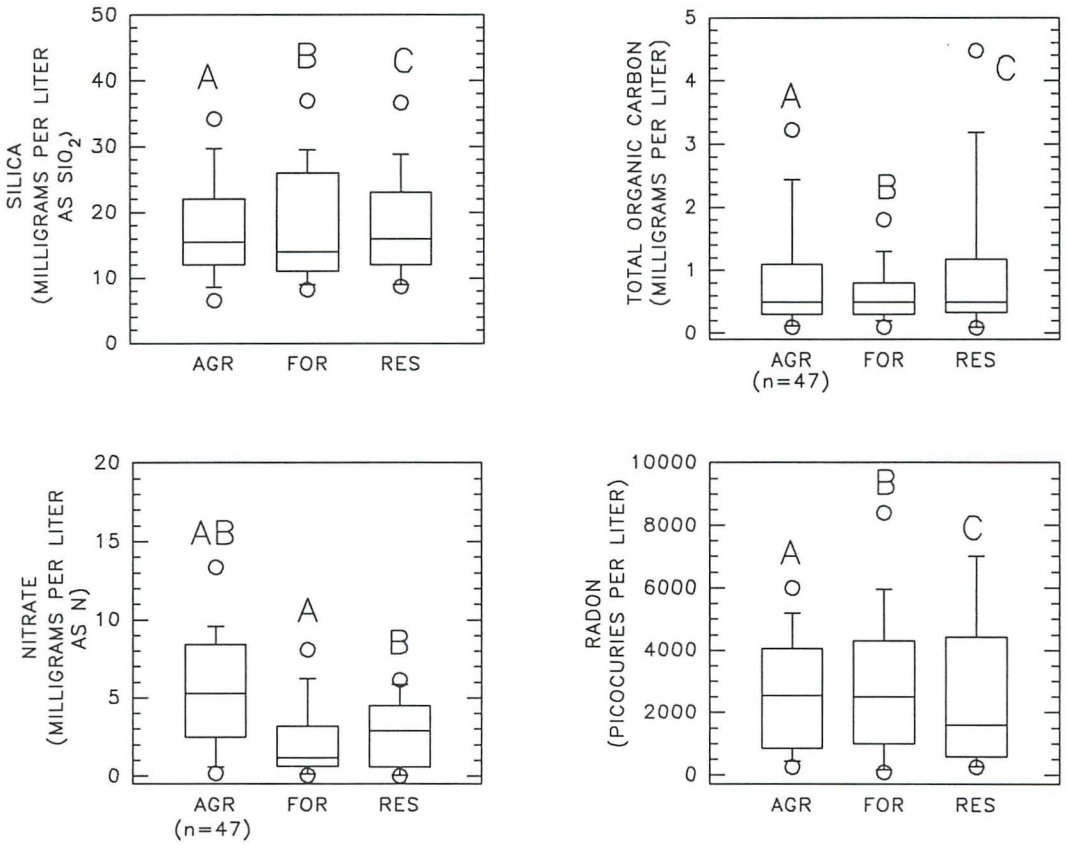
EXPLANATION

Land-use categories having letters in common were significantly different from each other (Kruskal-Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Spring data not plotted.

AGR: Agricultural (n=48)
FOR: Forest (n=30)
RES: Residential (n=27)

BA Bc 275 (commercial land use) not included

Figure 21, continued. Box-and-whisker plots of selected inorganic constituents in relation to land-use categories. See figure 7 for explanation of box-and-whisker plots.



EXPLANATION

Land–use categories having letters in common were significantly different from each other (Kruskal–Wallis rank sum test, with Dunn's test for pairwise comparison; $P<0.05$). Spring data not plotted.

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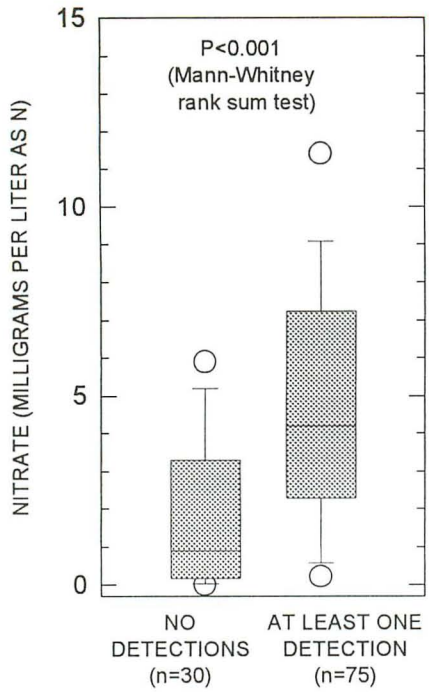


Figure 22. Box-and-whisker plot of nitrate concentrations in wells with and without pesticide detections. See figure 7 for explanation of box-and-whisker plots.

to nitrate. Fractionation during this process results in $\delta^{15}N$ values typically from +4 to +9 per mil (Heaton, 1986). There is some overlap in boundaries between the different sources (e.g., Komor and Anderson, 1993), and there are many other processes occurring that fractionate the nitrogen isotopes; however, these sources and processes provide a framework within which the ^{15}N data can be evaluated.

Samples from 23 sites (22 wells and one spring) were analyzed for ^{15}N in nitrate (designated as $^{15}N_{NO3}$) as part of Phase II of the study. Eight wells each were selected in areas that were downgradient (as inferred from topographic position) from agricultural and non-agricultural land. Most of the agricultural wells were downgradient from cropland, and all had at least one pesticide detection from earlier samples taken during Phase I. The non-agricultural wells were located mostly in low-density residential areas; only one of these wells had a pesticide detection in the earlier Phase I samples. The one spring that was sampled was located in a forested area. Six additional samples were collected from wells located in one residential development (Coachmans Field, located one mile south of Parkton). This development, built within the last five years, is located on former agricultural land that is now entirely residential. Nitrate concentrations from most of the 23 samples were greater than 5 mg/L, and all except the spring sample were greater than would be expected if nitrate in precipitation had been the sole nitrate source.

The range of $\delta^{15}N_{NO3}$ values for each group (fig. 25) was: agricultural wells, +2.0 to +5.1 per mil (median: +2.9 per mil); non-agricultural wells (excluding the Coachmans Field wells), +3.5 to +10.9 per mil (median: +4.7 per mil); spring in forest, +2.9 per mil; Coachmans Field wells, +0.4 to +2.6 per mil (median: +2.0 per mil). Most of the samples from the agricultural areas were within the upper range of values associated with commercial fertilizers (-4 to +4 per mil), while most of the samples downgradient from non-agricultural areas (excluding Coachmans Field) were in the lower range reported for soil nitrogen. Landowners were not interviewed about farming practices for this project; however, most of the fertilizers used on crops in the county are reported to be commercial nitrate fertilizers, with only small amounts of ammonium-based commercial fertilizers or manure used (D. Martin, Baltimore County Cooperative Extension Service, oral comm., 1997). The highest $\delta^{15}N_{NO3}$ value from the agricultural sites (+5.1 per mil) was from well Bc 267, which is located next to a cornfield and is within several hundred feet of a livestock pen. The high $\delta^{15}N_{NO3}$ value may reflect the influence of both fertilizers and animal wastes. Only one site (De 636) had a $\delta^{15}N_{NO3}$ greater than +10 per mil; this well, which is located on a hilltop in a residential area, had relatively low dissolved oxygen (1.5 mg/L), which may facilitate denitrification of nitrate to N_2 gas (there was no detectable ammonia). Isotopic fractionation associated with denitrification results in ^{15}N enrichment in the remaining nitrate (Heaton, 1986). In general, however, denitrification is probably not a major factor in the study area because the vast majority of water samples were well-oxygenated. The non-agricultural well having the highest nitrate value (13 mg/L) had a $\delta^{15}N_{NO3}$ value slightly higher than the other non-agricultural samples. This well, located several hundred feet away and upgradient from the owner's septic field, is in a garden next to a compost pile, which may be the source of the high nitrate and $\delta^{15}N_{NO3}$ values. The spring sample was low in nitrate (1 mg/L), and the $\delta^{15}N_{NO3}$ value (+2.9 per mil) fell within the upper range for fertilizer. The low $\delta^{15}N_{NO3}$ value may reflect precipitation $\delta^{15}N_{NO3}$, which is usually less than 0 per mil (Heaton, 1986). There is some agricultural activity several hundred feet uphill from the spring; however, the low nitrate, specific conductance, and pesticide concentrations in the spring water suggest very little agricultural impact.

The overall closeness of the agricultural-well $\delta^{15}N_{NO3}$ values to the boundary between commercial fertilizer and soil nitrogen suggests that the well water represents a mix of ground water containing nitrate from these and other sources. The low $\delta^{15}N_{NO3}$ values from the residential wells suggest that there is little input of septic-effluent nitrogen in these samples. This is in agreement with the evaluation of nitrate with respect to land use. The $\delta^{15}N_{NO3}$ data show that, collectively, differences can be seen in $\delta^{15}N_{NO3}$ values

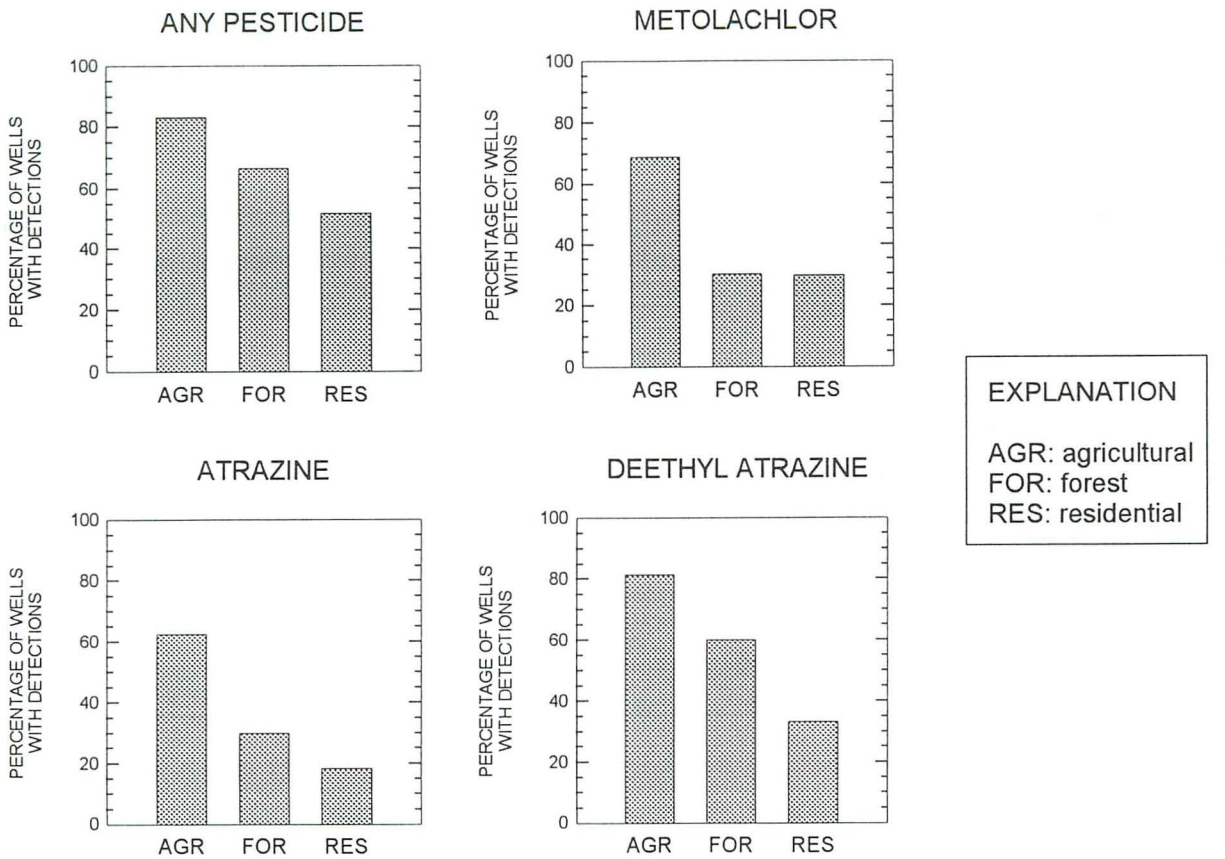


Figure 23. Percentage of wells with pesticide detections in agricultural, forested, and residential areas.

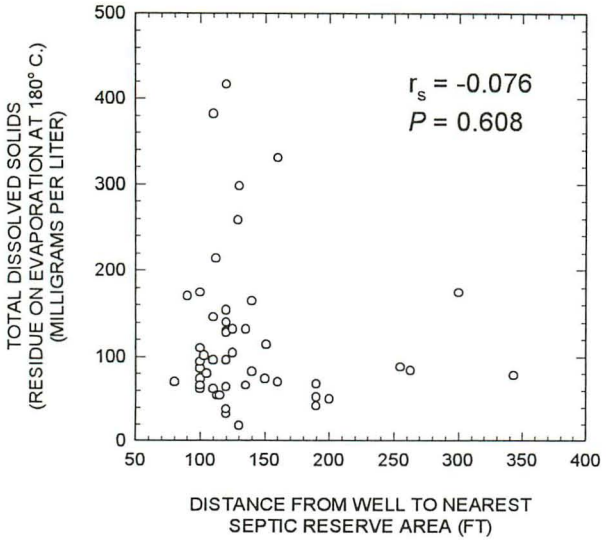
from different land uses. Because of the overlap of ranges, however, nitrogen isotope data would be insufficient in most cases to identify nitrate sources for individual wells.

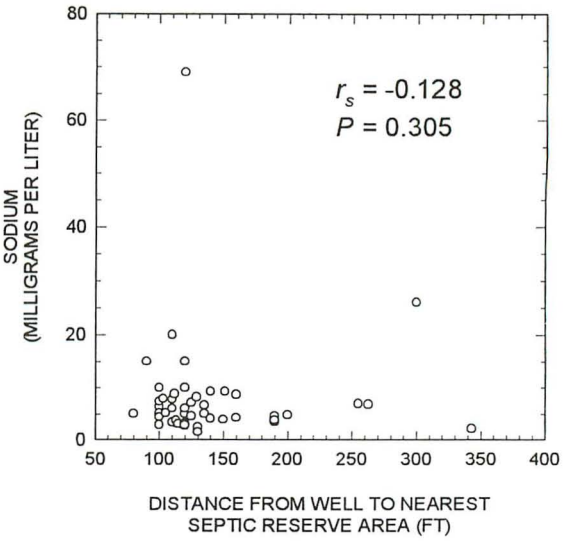
Sources of chloride

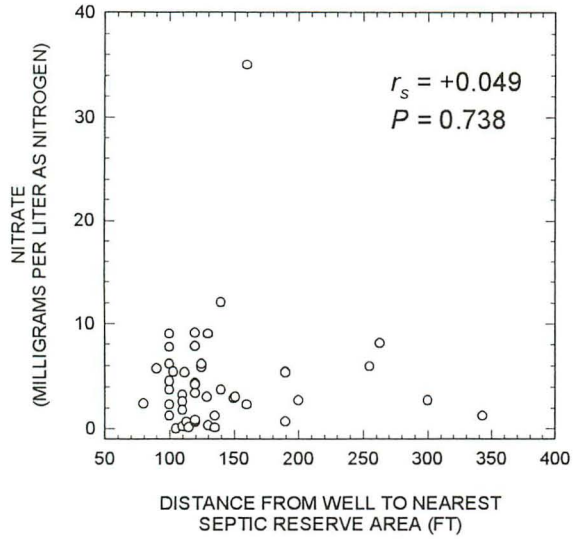
Ground-water chloride concentrations of more than a few milligrams per liter are usually the result of human activity. Precipitation probably contributes very little to chloride in ground water in the study area; a three-fold concentration by evapotranspiration would result in chloride of less than 1 mg/L. Potential chloride sources in the study area include deicing salts, septic-system effluent, brine from rejuvenation of water-treatment systems, and agricultural activities. There are no evaporite minerals such as halite in the study area, and there are no deep confined aquifers which might contain connate water (seawater trapped in the pore spaces of sediments at the time of deposition). Salt- or brackish-water intrusion from overpumping of aquifers has resulted in increased chlorides in some coastal and tidal areas in Maryland (Drummond, 1988; Hiortdahl, 1990; Fleck, Andreasen, and Smith, 1996), but is not a factor in the study area.

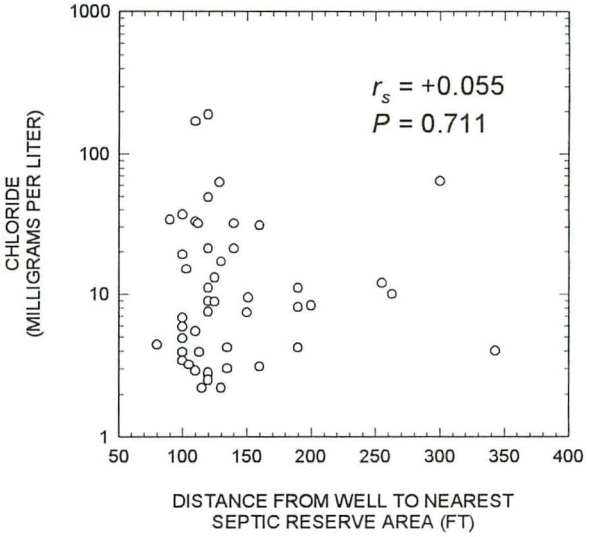
For "area" land use (determined by the predominant land use within 1,000 ft of the site), there were no significant differences between chloride concentrations among any of the land uses (Kruskal-Wallis rank sum test). For "site" land use (determined from land use at each site), chloride concentrations were significantly higher in wells from residential sites than in wells from forested sites. The lack of correlation between chloride and area land use may reflect the localized impact of chloride. If land use at a site is forest or agricultural but the dominant land use within 1,000 ft is residential, the well may be too far away from roads and other chloride sources to be affected by them. The lack of significant differences for chloride concentrations between forested and agricultural land uses at both scales of land-use definition suggests that there is little impact of potassium chloride fertilizer and other agricultural sources of chloride on well water in the study area.

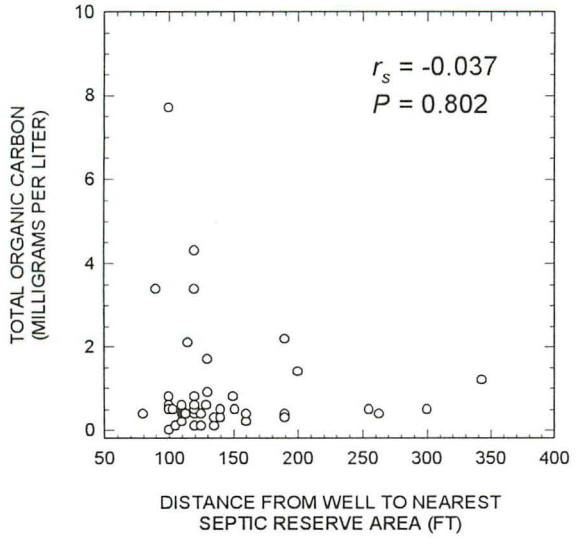
Chloride concentrations appear to be related to the use of deicing salts. The county uses sodium chloride as the primary road-deicing chemical (G. Courtney, Baltimore County Department of Public Works, oral comm., 1996). The highest chloride concentrations were from wells close to paved roads (fig. 26). Ten of the 11 sites with more than











EXPLANATION OF SPEARMAN RANK ORDER CORRELATION

The Spearman correlation coefficient (r_s) is a measure of the strength of the association between the two variables. r_s varies between +1 and -1. A correlation coefficient near +1 indicates a strong positive relationship; a correlation coefficient near -1 indicates a strong negative relationship.

The P value is the probability of incorrectly concluding that there is a true association between the variables. The smaller the P value, the greater the probability that the variables are correlated.

Figure 24. Relationship of total dissolved solids, chloride, nitrate, total organic carbon, and sodium to distance from the well to the nearest septic reserve area.

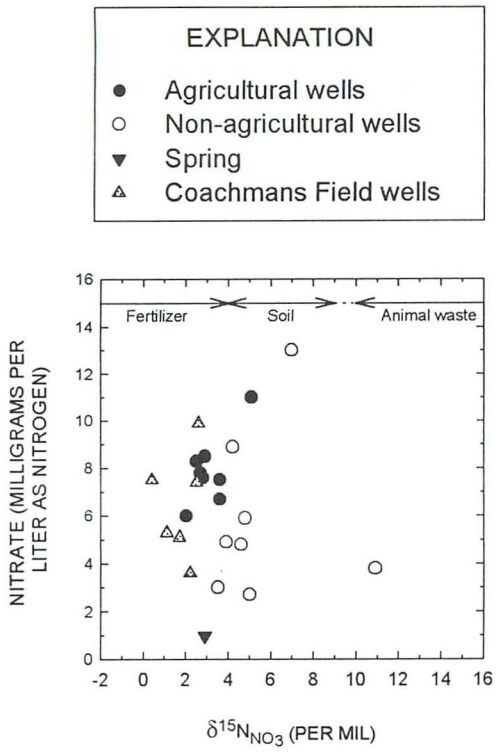


Figure 25. Relationship of nitrate to $\delta^{15}N_{NO3}$. Ranges of $\delta^{15}N_{NO3}$ are from Heaton (1986).

50 mg/L chloride are less than 100 ft from a paved road. There was a significant (negative) correlation between chloride concentrations and distance to the nearest paved road, with the sharpest decrease in chloride concentrations within 200 ft of roads (the median distance to the nearest paved road); the rate of decrease is smaller for wells more than 200 ft from a paved road (fig. 26). Chloride concentrations were significantly higher in wells located within 200 ft of a paved road than in wells located farther away (Mann-Whitney rank sum test), although the median concentrations (12 and 7.1 mg/L, respectively) were both well below chloride's SMCL (250 mg/L). The highest chloride (280 mg/L) was from a relatively shallow well (Fb 81; 125 ft deep) located less than 50 ft from a steep curve on a county-maintained road that is reported by the well owner to be heavily salted in winter. Well Bc 275, which had 230 mg/L chloride, is located in a parking lot within the State Highway Administration compound in Hereford. The well is near several potential chloride sources, including a covered salt-storage dome, a shopping center parking lot, Interstate 83, and Mt. Carmel Road. Well Bc 267 is within several hundred feet of a livestock pen on a dairy farm, and the well also had high nitrate; some of the chloride may be due to animal waste rather than road salt. The relatively low chloride concentrations of many wells located near paved roads are probably related to such factors as the amount of salt applied to roads, direction of ground-water flow, and differences in soil permeability.

Septic systems are another potential source of chloride to ground water. Chloride has been used as an indicator of septic-system effluent. Chloride in septic effluent is derived from human consumption of salt, disposal of water-softener brine, and other sources (Walker, 1969; Alhajjar, Chesters, and Harkin, 1990). There was no significant correlation between chloride concentrations and distance to septic reserve areas in the study area (fig. 27), and there was no significant difference in chloride concentrations between "closer" wells (wells within 120 ft of the septic reserve area) and wells that are farther away (Mann-Whitney rank sum test).

Another potential source of chloride to ground water is brine water used to rejuvenate water-softening systems. Almost half of the well owners reported using water-treatment systems, the majority of which are neutralizer/softener systems for treating acidic ground water. Most neutralizers use crushed limestone as a neutralizing agent, which increases the hardness of the water. The hard water may be softened by running it through an ion-exchange system which removes calcium from the water and replaces it with sodium. The sodium on the ion-exchange material must be replenished periodically by flushing a brine solution through the softener. This produces a sodium-calcium-chloride brine, which is often disposed of through the septic system. Situations where this process has severely impaired well-water quality in the study area have usually occurred when brine

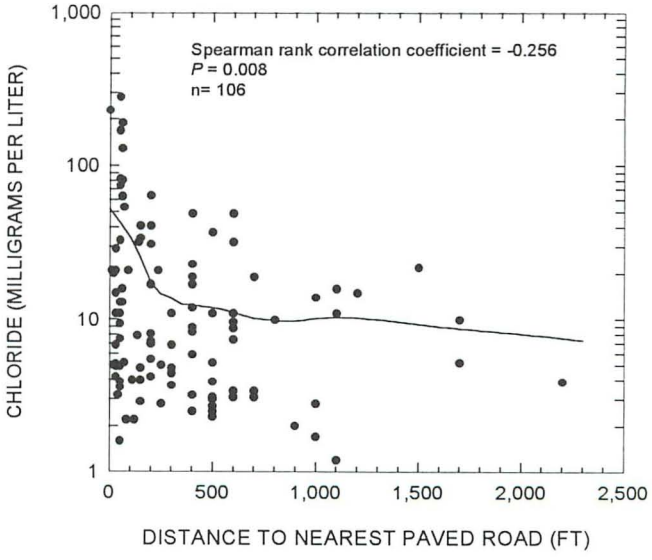


Figure 26. Relationship of chloride concentration to distance to the nearest paved road. The line is a LOWESS (LOcally WEighted Scatterplot Smoother) curve.

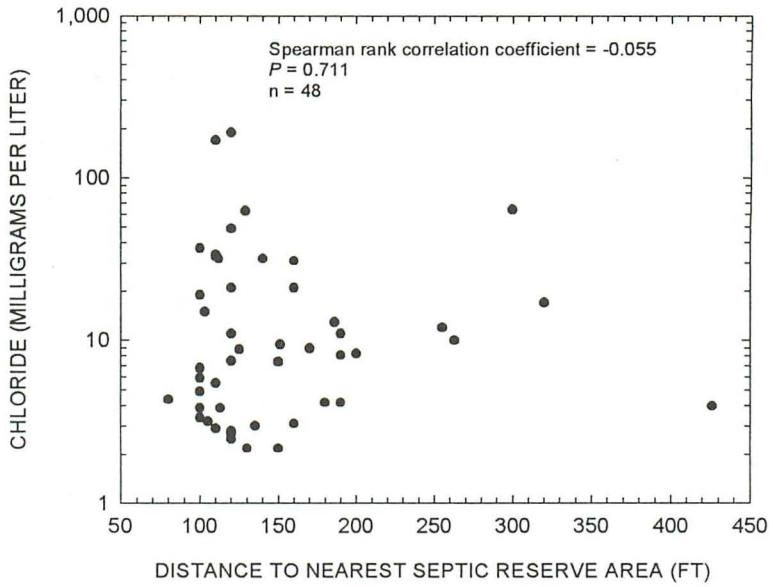


Figure 27. Relationship of chloride to distance to the nearest septic reserve area.

was discharged very close to an older well (B. Gallup, Bruce H. Gallup, Inc., oral comm., 1996). Chloride concentrations in samples from wells with and without treatment systems (fig. 28) showed no significant difference (Mann-Whitney rank sum test). This suggests that the overall impact of softener brine on well water in the study area is small, but this is not definitive because factors such as ground-water flow directions were not investigated.

Chloride is a conservative ion in ground water; it is relatively unaffected by chemical processes in ground water (oxidation-reduction reactions, adsorption, complexing, precipitation), and is not involved in many significant biochemical roles (Hem, 1985). Therefore, if road salt (sodium chloride) is the dominant source of chloride in ground water, and if no other reactions involving sodium are occurring, there should be at least as much sodium (in milliequivalents per liter, or meq/L) as chloride. However, for all chloride concentrations above about 30 mg/L (about 0.8 meq/L) and for many samples below this amount, there is less sodium than chloride (fig. 29a). For wells with more than 100 mg/L chloride, sodium makes up only 5 to 60 percent of cation milliequivalents per liter; calcium or magnesium are the dominant cations in three of these five wells.

Excess chloride relative to sodium (attributable to ion exchange) is a common characteristic of ground-water contamination by road salt (Howard and others, 1993). Calcium, magnesium, and potassium on the mineral surfaces are exchanged for sodium via the exchange reactions

$$2Na^+ + Ca_{(adsorbed)} \leftrightarrows Ca^{2+} + 2Na_{(adsorbed)}$$

$$2Na^+ + Mg_{(adsorbed)} \leftrightarrows Mg^{2+} + 2Na_{(adsorbed)}$$

$$Na^+ + K_{(adsorbed)} \leftrightarrows K^+ + Na_{(adsorbed).}$$

Sodium and calcium together are sufficient to account for all but the highest chloride concentrations (fig. 29b), and when magnesium and potassium are added (fig. 29c), all the chloride can be accounted for. It is unlikely that the high calcium and magnesium concentrations from well-water samples that also had high chloride concentrations are due to carbonate mineral dissolution because the corresponding alkalinities are fairly typical for non-carbonate aquifers.

An alternate hypothesis for sodium depletion relative to chloride is that calcium-sodium-chloride-enriched brine water from rejuvenation of water-softening systems is influencing the water quality. However, the well with the highest chloride (Fb 81; 230 mg/L) does not have a treatment system, and there are no nearby houses upgradient from the well (as inferred from topographic position) that might be contributing brinewater; in this well, sodium makes up only about 5 percent of total cation milliequivalents per liter.

Well Characteristics

Well depth

Wells were classified as either shallow (less than or equal to 200 ft deep) or deep (greater than 200 ft deep) wells, based on median well depth. There were no significant dif-

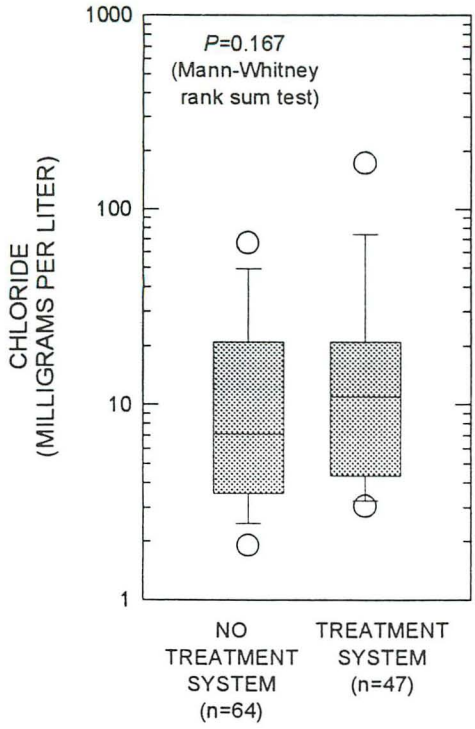


Figure 28. Box-and-whisker plot of chloride concentrations in wells with and without water-treatment systems. See figure 7 for explanation of box-and-whisker plots.

ferences in the concentrations of most major ions or in the proportions of pesticide detections between samples from shallow and deep wells (tab. 24, located in the appendix; fig. 30). Dissolved oxygen was higher and potassium was lower in shallow wells (Mann-Whitney rank sum test); however, only dissolved oxygen showed a significant (negative) correlation with well depth (Spearman rank order test). These data suggest that there is generally little impact on water quality from ground water entering wells via deeper fractures.

Casing depth

In the study area, well casing must be at least 20 ft in length and must be set at least two feet into bedrock; the rest of the well is an open hole in bedrock. Casing depth is therefore an approximate measure of saprolite thickness for casing lengths greater than 20 ft. Cement or bentonite grout is required to be pumped into the space between the well casing and the drilled hole in order to protect the well water from surface contamination. Wells were grouped into categories of shallow (less than or equal to 40 ft) or deep (greater than 40 ft) casing depth, based on the median casing length. There was little relationship between water-quality constituents and casing depth (fig. 31, tab. 24 [in appendix]). Sodium and sulfate were significantly lower and pH was significantly higher in wells with deeper casing (Mann-Whitney rank sum test); only sulfate showed a significant (negative) correlation with casing depth (Spearman rank order test). There was no significant difference in the proportion of pesticide detections between wells with deep or shallow casing depth.

Water level

Water levels were measured at 57 of the Phase I wells; measurements were not obtained from the other wells due to inability to remove the well cap, non-consent of the well owner, or other factors. Wells were grouped into categories of shallow (less than 39 ft below land surface) or deep (greater than or equal to 39 ft below land surface) water levels, based on the median water level. The water-level measurements probably did not record true "static" water levels because of fluctuations due to homeowner use. Furthermore, seasonal fluctuations of true static water levels of 20 ft or more have been recorded in the area (Smigaj and Saffer, 1996).

Alkalinity, calcium, and silica were significantly lower, and dissolved oxygen was significantly higher in samples from wells with deeper water levels (Mann-Whitney rank sum test) (fig. 32). Alkalinity and silica showed a significant negative correlation and dissolved oxygen showed a significant positive correlation with depth to water (Spearman rank order test). Two-way analysis of variance indicated that for alkalinity and calcium, there was a statistically significant interaction between water level and topographic position. Lower concentrations of some constituents in wells with deeper water levels may reflect the shorter flowpaths of ground water in hilltop wells compared to hillside or valley wells. The differences were not related to lithology, the distribution of which is almost identical between the shallow and deep water-level wells. There was no statistically significant difference in number of wells with pesticide detections in any category.

Relative position of the water table

Water levels at 39 of the 57 wells where water levels were measured were in the casing (i.e., the water table was in the saprolite); water levels in the other 18 wells were below the casing (i.e., in bedrock). Unfiltered-iron concentrations were significantly higher in samples from wells where the water level was in the casing than in samples from wells with water levels below the casing (fig. 33). A possible source of the iron to the well water is iron oxidation products that may form inside the well casing. There were no other significant differences in water-quality constitu-

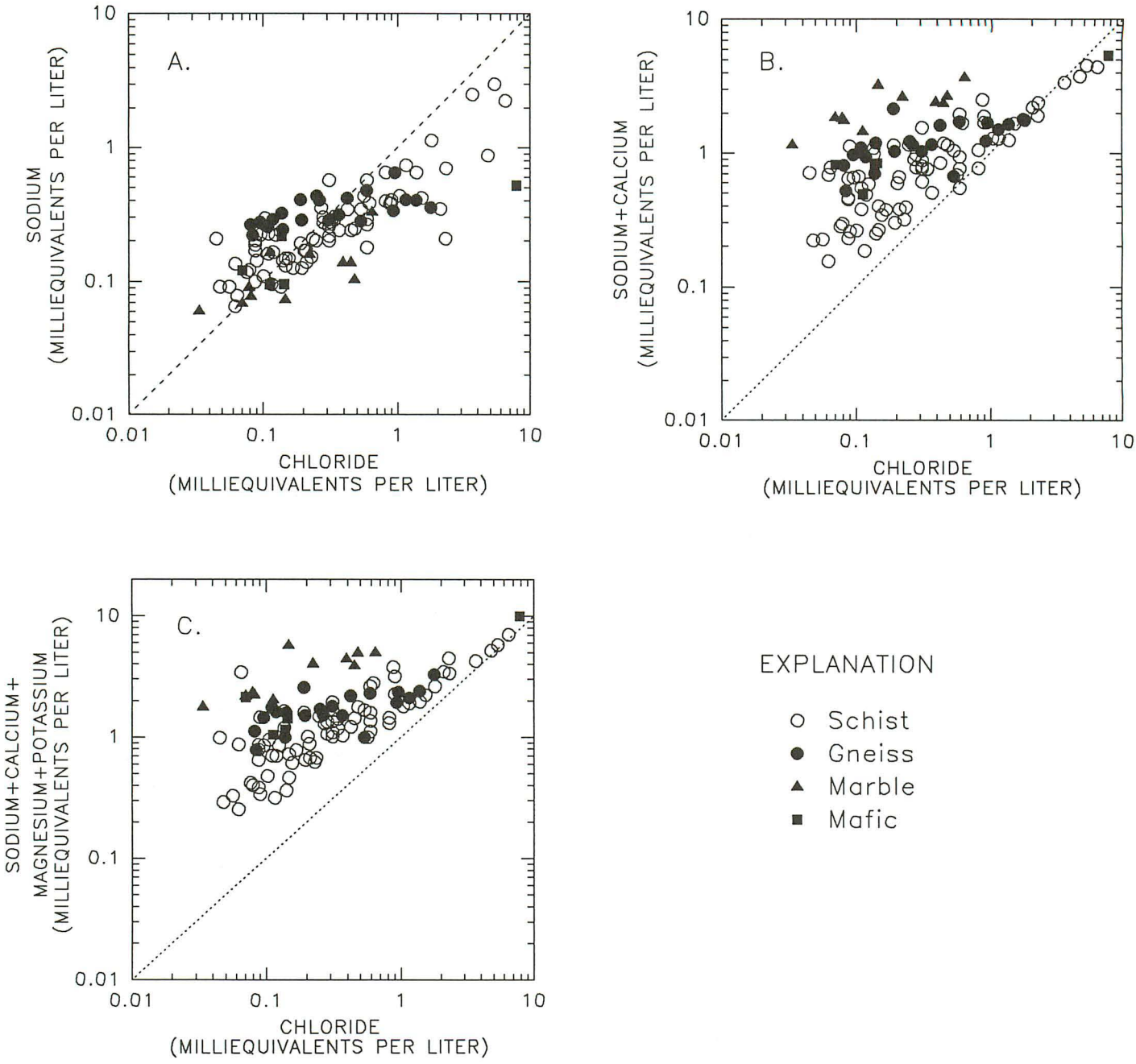


Figure 29. Relationship of chloride to (a) sodium; (b) sodium plus calcium; and (c) sodium plus calcium plus magnesium plus potassium.

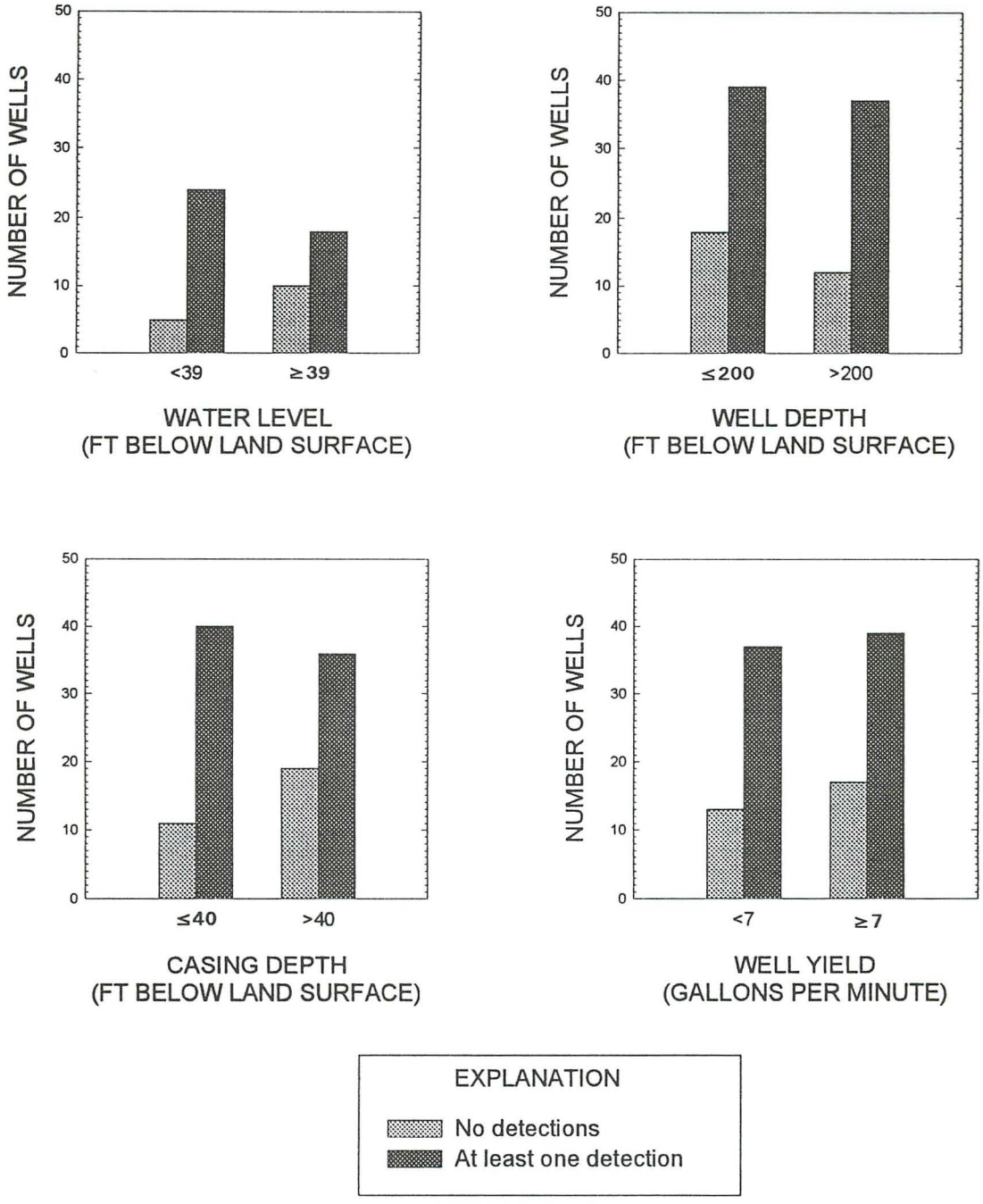


Figure 30. Relationship of selected well characteristics to pesticide detections.

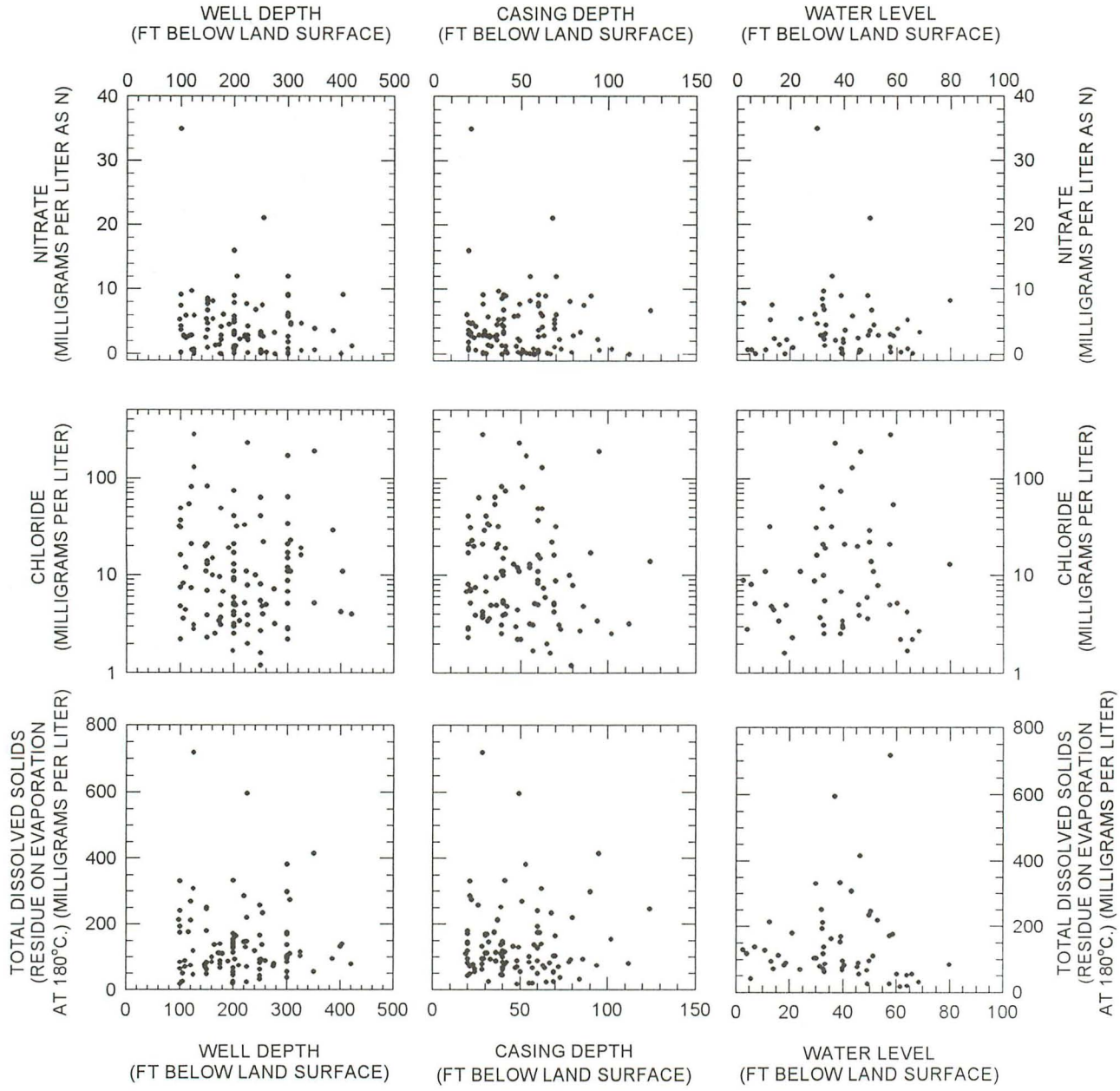


Figure 31. Relationship of nitrate, chloride, and TDS to selected well characteristics. (Nitrate concentrations below the minimum reporting limit [0.05 mg/L] were plotted at 0.025 mg/L.)

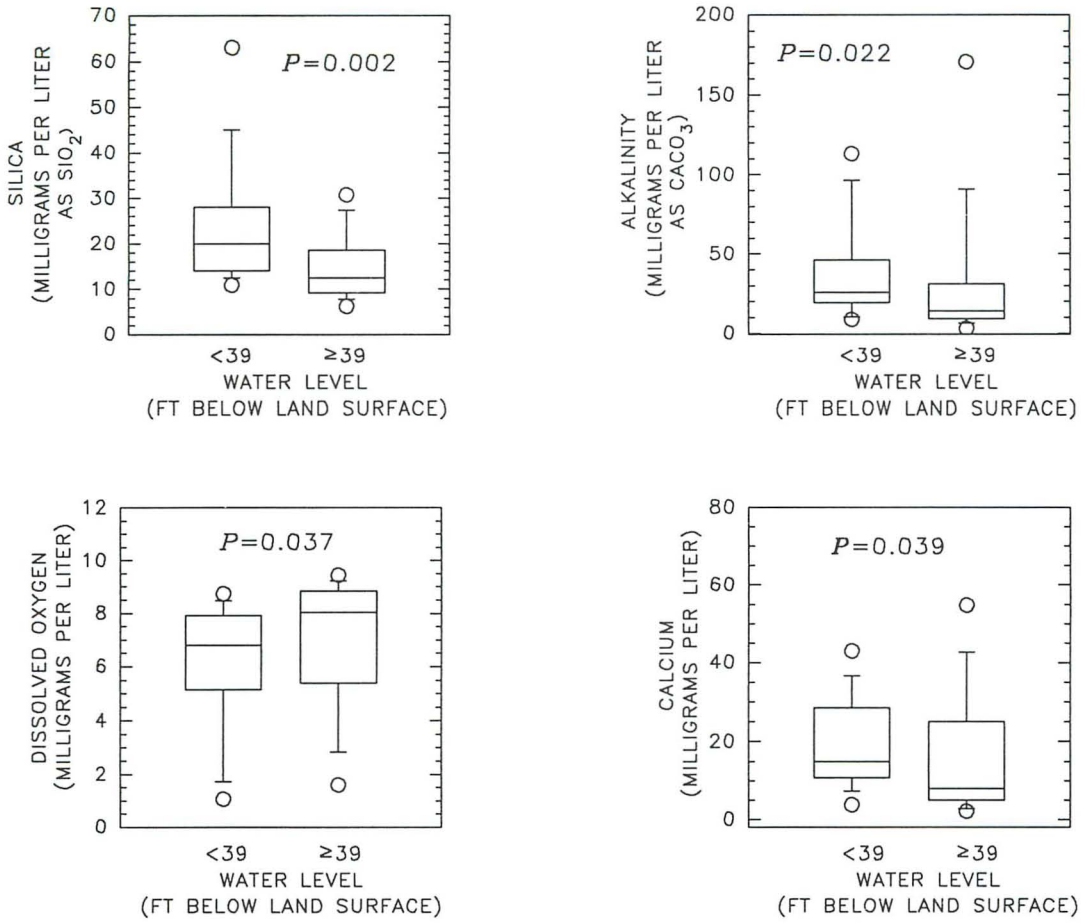


Figure 32. Box-and-whisker plots of selected inorganic constituents with respect to water level. P-values are from Mann-Whitney rank sum test. See figure 7 for explanation of box-and-whisker plots.

ents or proportions of wells with pesticide detections between the groups.

Well yield

There was little relationship between well yield and water quality. TOC was greater in wells with yields less than 7 gallons per minute (gpm) than in higher-yielding wells. There was a slight negative correlation between well yield and radon both for all Phase I samples and for samples from the Loch Raven Schist; however, neither correlation was statistically significant (Spearman rank order test). An inverse relationship between well yield and radon concentration has been observed in some fractured-rock terrains (Wanty and Schoen, 1991). Increased yields have been attributed to increased fracture apertures, which transmit greater volumes of water without a corresponding increase in surface area of the rock-water interface; therefore radon concentrations may be diluted in higher-yielding wells. Well yields reported in this study were obtained from well completion reports which may not accurately reflect maximum yield; almost all of the wells were domestic wells, which may not have been tested at their maximum capacity by the drillers.

Age of wells

There was very little correlation between the age of wells and any water-quality constituent. However, wells drilled prior to 1972 were not sampled during the study, and many older wells may not meet the current construction criteria (i.e., the well casings may not have been grouted).

Topographic Position

Wells were classified into one of three topographic positions: hilltop, hillside, and valley (tab. 25). The classifications are somewhat subjective; for example, wells located on or near ridgetops, although not located at the absolute

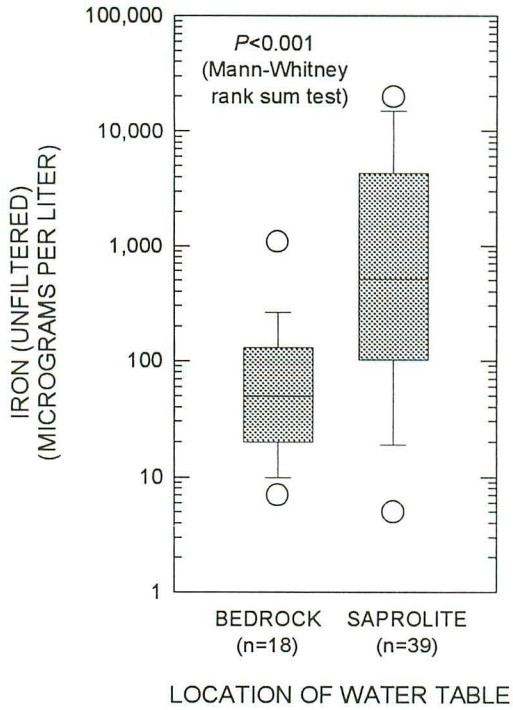


Figure 33. Box-and-whisker plot of unfiltered-iron concentrations with respect to the location of the water table. See figure 7 for explanation of box-and-whisker plots.

tops of hills, were classified as hilltop wells; wells located in flat areas and floodplains were classified as valley wells. Alkalinity and pH were significantly higher in water samples from valley wells than in samples from hilltop wells (Kruskal-Wallis rank sum test). These differences reflect the relationship between topographic position and geology: most wells on hilltops and hillsides are in schist or gneiss, while a disproportionate percentage of wells in valleys are in the more soluble marble aquifers (tab. 25). Sodium was significantly lower in the valley wells than in both the hillside and hilltop wells (Kruskal-Wallis rank sum test). The higher sodium concentrations in hillside and hilltop wells are attributed to incongruent dissolution of the aluminosilicate minerals.

Radon concentrations were significantly higher in hilltop wells than in both hillside and valley wells (Kruskal-Wallis rank sum test). In samples from the Prettyboy Schist, radon concentrations from hilltop wells were significantly higher than those from hillside wells (none of the Prettyboy Schist wells were located in valleys) (Mann-Whitney rank sum test); there were insufficient data to examine this relationship for other geologic units. Lower radon concentrations in samples from valley wells than from hilltop wells are probably related to lower concentrations of parent radionuclides in the marble aquifers that underlie many of the valleys. However, the difference in ground-water radon concentrations between hilltop and hillside wells does not appear to be related to aquifer lithology, the distribution of which is similar between Phase I wells in the two topographic settings. The differences also do not appear to be related to differences either in well yield or saprolite thickness (as indicated by casing length), which do not differ significantly between hillside and hilltop wells.

Temporal Variation in Ground-Water Quality

Water quality in unconfined aquifers may vary through time at different rates, depending upon precipitation patterns, evapotranspiration rates, land use, saprolite properties, and other factors. Ground-water recharge is seasonal; water levels tend to be lowest in the fall and rise through the winter and early spring. Seasonal variations and long-term trends in ground-water quality, particularly for nitrate and pesticides, have been documented in several studies (Montgomery, Loftis, and Harris, 1987; Kross and others, 1990; Bjerg and Christensen, 1992; Burkart and Kolpin, 1993; Barbash and Resek, 1996). In Phase II of this study, 10 wells were sampled at monthly intervals for nitrate, chloride, atrazine, pH, and specific conductance between May 1995 and April 1996. These wells were selected from Phase I wells for which results of water-quality analyses were available as of April 1995. The selected wells had relatively high concentrations of either nitrate, chloride, or atrazine (tab. 26). Nitrate and chloride were analyzed at the NWQL; atrazine was analyzed by immunoassay by project personnel. Water levels were not measured at the monthly sampled wells; however, water levels measured at USGS observation wells in Baltimore County declined gradually from May through October 1995 and then rose, reaching their shallowest levels in winter or early spring of 1996 (fig. 34).

Table 25.
Percentage of Phase I wells within each topographic position that are in each lithologic group.

Lithologic group	Percentage of wells in: Hilltop (n=30)	Hillside (n=60)	Valley (n=16)
Schist	73	73	31
Gneiss	17	20	19
Marble	3	5	38
Mafic	7	2	12
Total	100	100	100

Table 26.
Summary statistics for specific conductance, chloride, nitrate, and atrazine for monthly samples collected between May 1995 and April 1996.

[μS/cm, microsiemens per centimeter; mg/L, milligrams per liter; μg/L, micrograms per liter; <, less than]

Well	Specific conductance			Chloride		
	Mean (μS/cm)	Range (μS/cm)	Standard deviation	Mean (mg/L)	Range (mg/L)	Standard deviation
BA Bc 267	442	424-467	14.7	85	75-92	5.3
BA Cb 136	304	294-313	5.7	51	50-53	1.1
BA Cb 137	133	131-135	1.4	11	10-11	0.5
BA Cb 138	282	259-290	10.3	33	30-35	1.4
BA Cb 142	200	181-234	14.1	10	6.9-15	2.3
BA Cc 253	619	583-648	19.3	158	140-170	8.3
BA Dc 445	528	516-536	6.3	17	16-18	0.7
BA De 633	139	127-153	9.2	11	9.7-13	1.2
BA Ea 93	495	481-514	11.2	74	70-80	3.2
BA Fb 81	1460	1090-1660	194.6	382	260-450	55.1

Well	Nitrate			Atrazine (immunoassay)		
	Mean (mg/L as N)	Range (mg/L as N)	Standard deviation	Mean (μg/L)	Range (μg/L)	Standard deviation[1]
BA Bc 267	9.5	2-11	2.5	0.7	0.5-1.1	0.2
BA Cb 136	8.0	7.2-10	0.8	1.2	1.0-1.3	0.1
BA Cb 137	8.0	5.8-9	0.8	1.5	1.1-1.9	0.2
BA Cb 138	11.1	9.9-12	0.8	0.1	<0.05-0.2	0.1
BA Cb 142	6.4	5.4-7.8	0.7	<0.05	<0.05-0.2	0.1
BA Cc 253	0.2	0.2-0.3	<0.1	<0.05	<0.05-0.1	<0.1
BA Dc 445	8.7	5.8-9.9	1.0	1.0	0.8-1.3	0.2
BA De 633	5.3	4.4-5.9	0.5	<0.05	<0.05	<0.1
BA Ea 93	0.7	0.5-0.9	0.1	<0.05	<0.05-0.1	<0.1
BA Fb 81	0.5	0.3-0.6	0.1	<0.05	<0.05-0.1	<0.1

[1] Concentrations below minimum reporting limits were set equal to zero to calculate mean and standard deviation

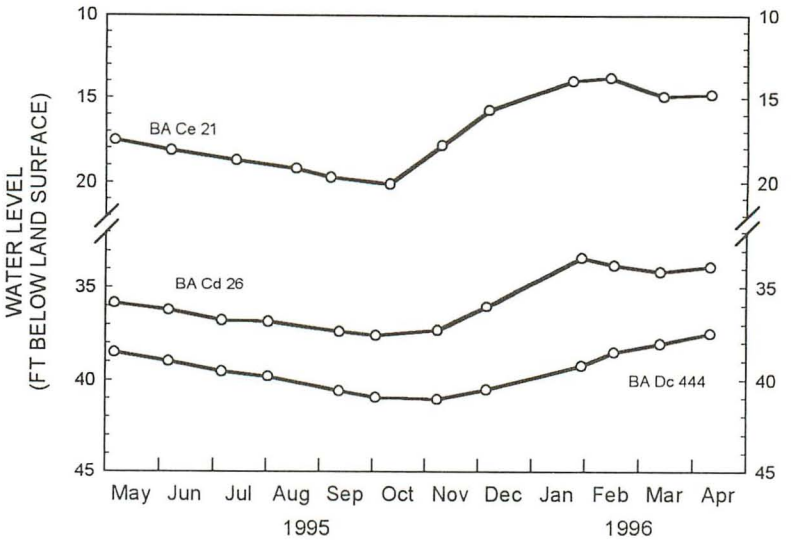


Figure 34. Ground-water levels in observation wells in the study area. Source: U.S. Geological Survey, Baltimore, Maryland.

There was little change throughout the year in specific conductance (which is highly correlated with TDS) or chloride in most of the monthly sampled wells (fig. 35). Chloride concentrations varied less than 20 mg/L in 8 of the 10 wells. Well Fb 81, which had the highest chloride and TDS of any site sampled during the study, had the widest range of monthly chloride concentrations (260 to 450 mg/L). Specific conductance in this well fluctuated considerably in purge measurements during several sampling events, sometimes continually decreasing, other times fluctuating over several hundred microsiemens per centimeter. Purge measurements from samples taken from October 1995 through January 1996 did not show these large fluctuations.

Three of the four wells with more than 60 mg/L chloride (Cc 253, Ea 93, and Fb 81) are less than 100 ft from roads that are treated with deicing salts in winter (as reported by well owners). The high sodium and calcium concentrations in the earlier Phase I samples from these wells are consistent with the effects of road salt. The three wells had low (less than 1 mg/L) nitrate concentrations, which suggests that septic-system effluent is not the chloride source. There appeared to be little relationship between time of year and chloride concentrations (fig. 35). The lack of higher concentrations in winter when salt is applied may be due to several factors. Seasonal effects may be muted if only a small part of the contributing area to a well is being treated with road salt. There may not have been much salt applied to the roads near the wells during the period of monthly sample collection. Evapotranspiration may concentrate chloride during the summer months, offsetting higher winter chloride concentrations from salt application (Davis, 1982). Chloride may also be retained in the unsaturated zone by water adhering as films on the surfaces of mineral grains (Toler and Pollock, 1974); upon loss of soil moisture, chloride may precipitate on the mineral grains and subsequently be transported to the water table after recharge events.

Average nitrate concentrations exceeded 5 mg/L at seven of the monthly sampled wells (tab. 26). Two of these (Cb 142 and De 633) are downgradient from low-density residential developments; the other five are domestic wells downgradient from cropland. Three wells (De 633, Cb 142, and Cb 138) had peak nitrate concentrations in mid- to late summer, followed by generally decreasing concentrations through the fall and winter (fig. 36). Two of these wells are downgradient from residential areas; the third (Cb 138) is downgradient from cropland, suggesting that other factors beside land use are related to the temporal changes. The range of nitrate concentrations at most wells was less than 3 mg/L throughout the year. Three wells (Bc 267, Cb 137, and Dc 445) show anomalous decreases in nitrate in the July 1995 samples. All three are downgradient from agricultural areas; the other monthly sampled wells near cropland do not show corresponding decreases in nitrate.

Atrazine was tested by immunoassay on all monthly samples. Atrazine concentrations determined by immunoassay have been shown to be highly correlated (r=0.96) with atrazine concentrations determined by GC/MS, with no false negatives and few false positives. The immunoassay method tends to slightly overestimate atrazine concentrations, probably due to cross-reactivity with atrazine metabolites such as DEA (Gruessner, Shambaugh, and Watzin, 1995).

Atrazine concentrations were all less than 2 µg/L, and the range of values at most sites was less than 0.5 µg/L. Four sites had mean atrazine concentrations greater than 0.5 µg/L; the others were near or below the minimum reporting limit (0.05 µg/L). Atrazine levels increased through the sum-

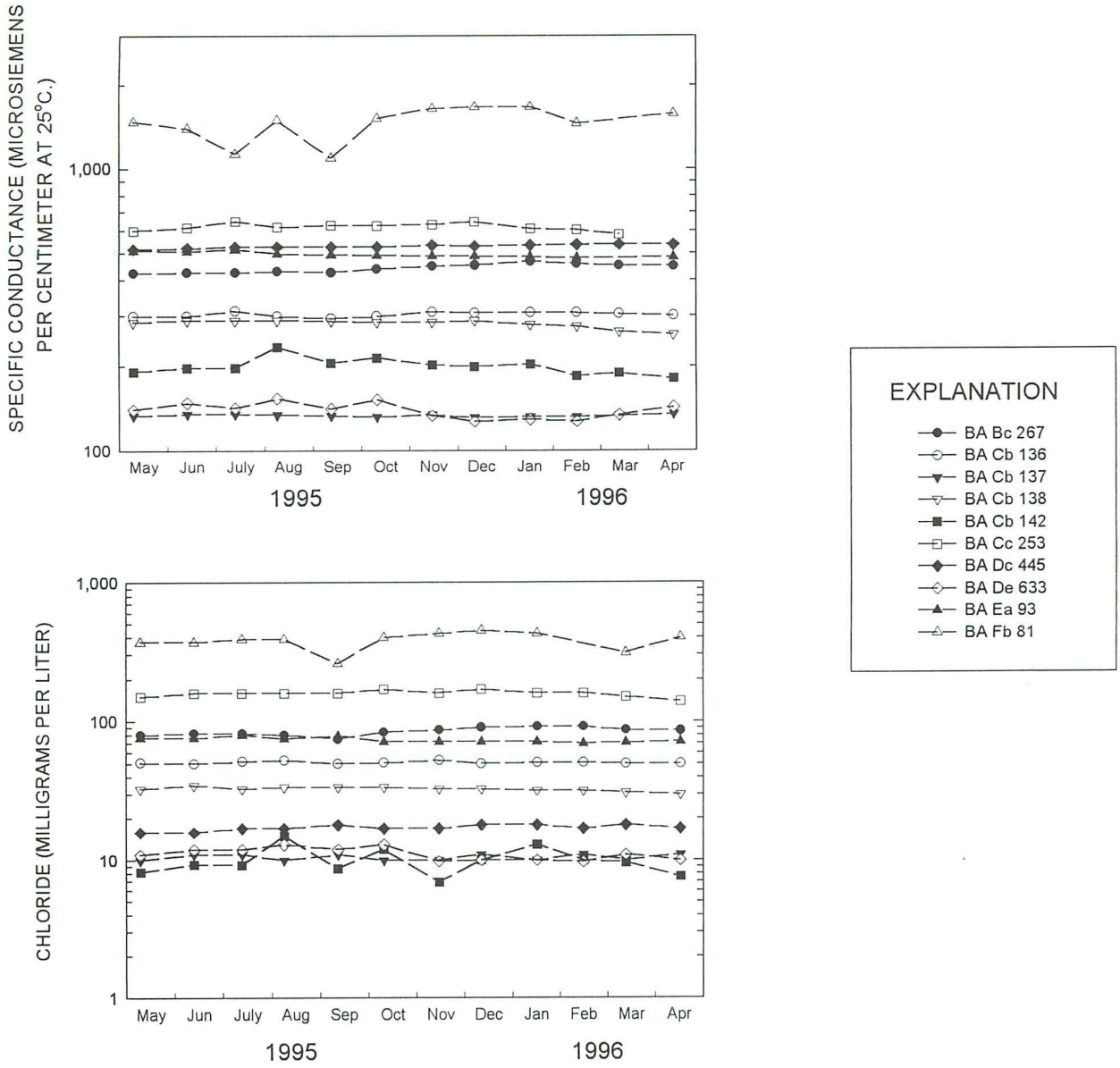


Figure 35. Specific conductance and chloride concentrations in monthly samples collected between May 1995–April 1996.

mer, reaching their peaks in the late summer and early fall (fig. 36). Several sites with no detections in May through July had detections recorded in August through October. There was a general decrease in concentrations through the fall and early winter, with the lowest values recorded in January; no consistent trend among all the wells was seen in February through April 1996. The highest atrazine concentrations were observed during the period of lowest water levels (as determined by water-level data in several USGS observation wells in the county). The relative amounts of atrazine and DEA in the monthly samples were not determined; however, for three of the four wells with the highest monthly atrazine levels, DEA exceeded atrazine in the Phase I samples, and the fourth (Bc 267) had approximately equal amounts of atrazine and DEA. Typically, pesticide detection frequencies and median concentrations are lowest in the winter and are highest in the late spring and summer; the temporal variability tends to decrease with increasing well depth (Barbash and Resek, 1996).

Local Variation in Ground-Water Quality

Six wells within one residential development (Coachmans Field) were sampled for Phase I constituents. These wells were sampled in order to: (1) observe the ex-

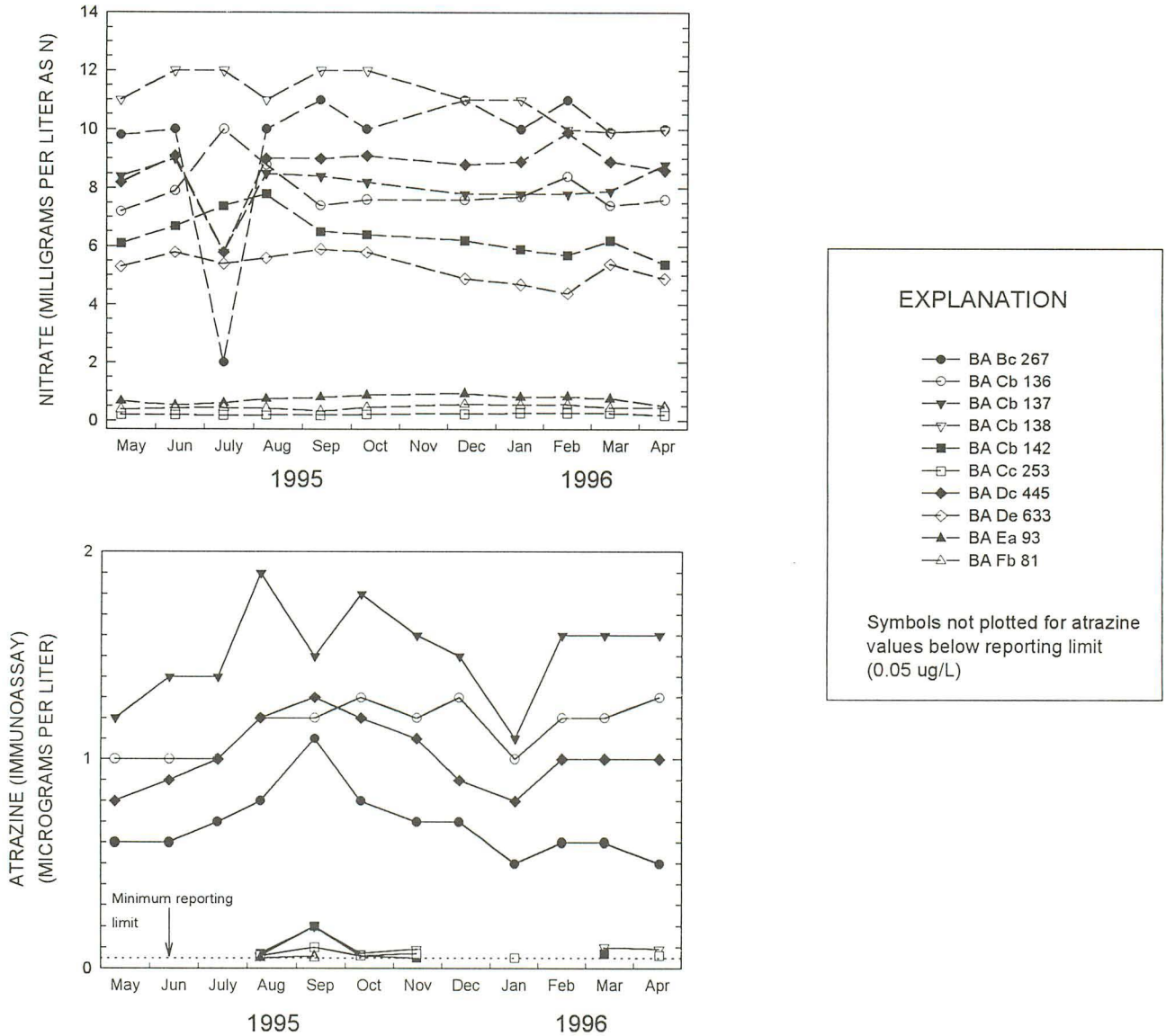


Figure 36. Nitrate and atrazine concentrations in monthly samples collected between May 1995–April 1996.

tent of local variation in ground-water quality and compare this to regional variation; and (2) document ground-water quality in a relatively new residential development built on former cropland. The Coachmans Field development, located 1 mile south of Parkton in northern Baltimore County, was selected because: (1) it is located on a ridgetop, and ground-water quality should show little effect of upgradient activities; (2) it is developed on former cropland; and (3) the wells have similar construction characteristics and were drilled by the same driller. The development consists of 39 lots ranging in size from 1 to 10 acres; most are 1- to 2-acre lots. Not all lots had been developed, and not all houses in the development were inhabited at the time of sampling. The sampled wells were drilled between November 1992 and October 1993. The bedrock in the area is the Pleasant Grove Schist near the contact of the Prettyboy Schist (Crowley, Reinhardt, and Cleaves, 1976).

Samples from the six wells (Bd 233–238) had a mixed-cation composition; anions tended to be mixed or slightly enriched in nitrate relative to the other anions (figs. 37 and 38). Samples fell within the compositional range of samples from other wells in the Pleasant Grove Schist. Median concentrations of most inorganic constituents in Coachmans Field were similar to those of Phase I wells in the Pleasant Grove Schist, although the concentration ranges of major ions were smaller at Coachmans Field (tab. 27). The coefficient of variation (the standard deviation divided by the mean, expressed as a percent) for most major inorganic constituents was smaller for samples from wells in Coachmans Field than for samples from elsewhere in the Pleasant Grove and Prettyboy Schists. Dissolved oxygen, pH, and sulfate had wider ranges in samples from this development than in

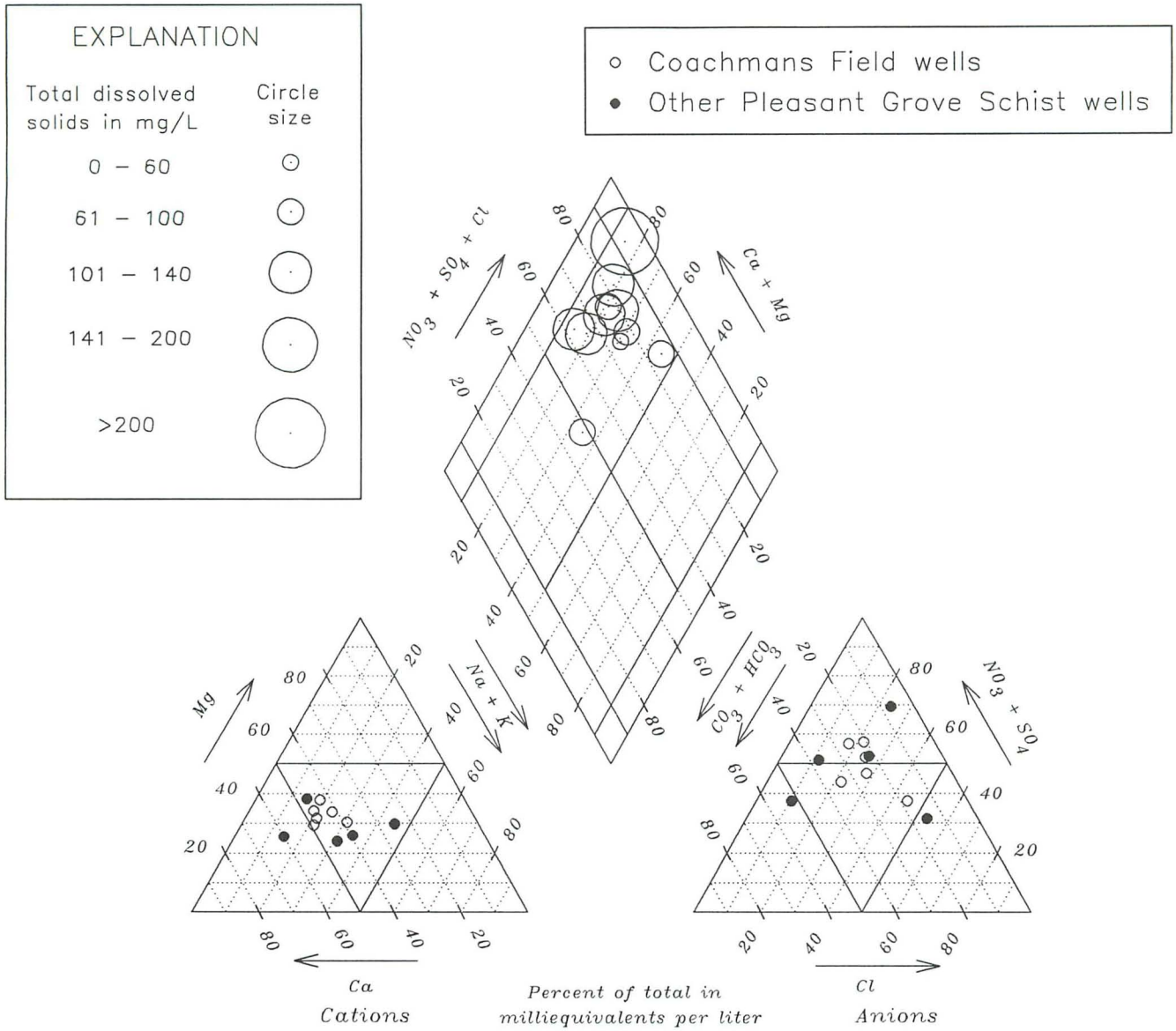


Figure 37. Percentages of major ions in water samples from wells in the Coachmans Field development and other wells in the Pleasant Grove Schist.

samples from other wells in the Pleasant Grove Schist. Radon concentrations were lower in the Coachmans Field samples (median: 2,050 pCi/L) than in samples from other Pleasant Grove Schist wells (median: 4,800 pCi/L), although the coefficients of variation were similar.

There was no obvious spatial pattern to the major inorganic constituents (fig. 38). Well Bd 238, which is the most isolated of the six wells, had the lowest concentrations of almost all major constituents. Nitrate concentrations ranged from 3.6 to 9.9 mg/L. $\delta^{15}N_{NO3}$ values (+0.4 to +2.6 per mil) were within the range of values for commercial fertilizers (fig. 25). There is little evidence from the water-quality data that indicate septic-effluent contamination (all nitrates less than 10 mg/L; low $\delta^{15}N_{NO3}$ values; no MBAs detected; little or no ammonium; low TOC). Most wells are uphill from septic reserve areas in the development.

Small amounts of five pesticides (atrazine, DEA, metolachlor, carbofuran, and simazine) were detected in the Coachmans Field wells. Atrazine, DEA, metolachlor, and carbofuran were detected in all six wells; only one sample of one constituent exceeded 1 µg/L (DEA; 1.9 µg/L). The concentration of DEA exceeded atrazine in all samples, although the concentrations of these two pesticides were very close in wells Bd 235 and Bd 238. None of the pesticide detections exceeded MCLs or Lifetime HALs.

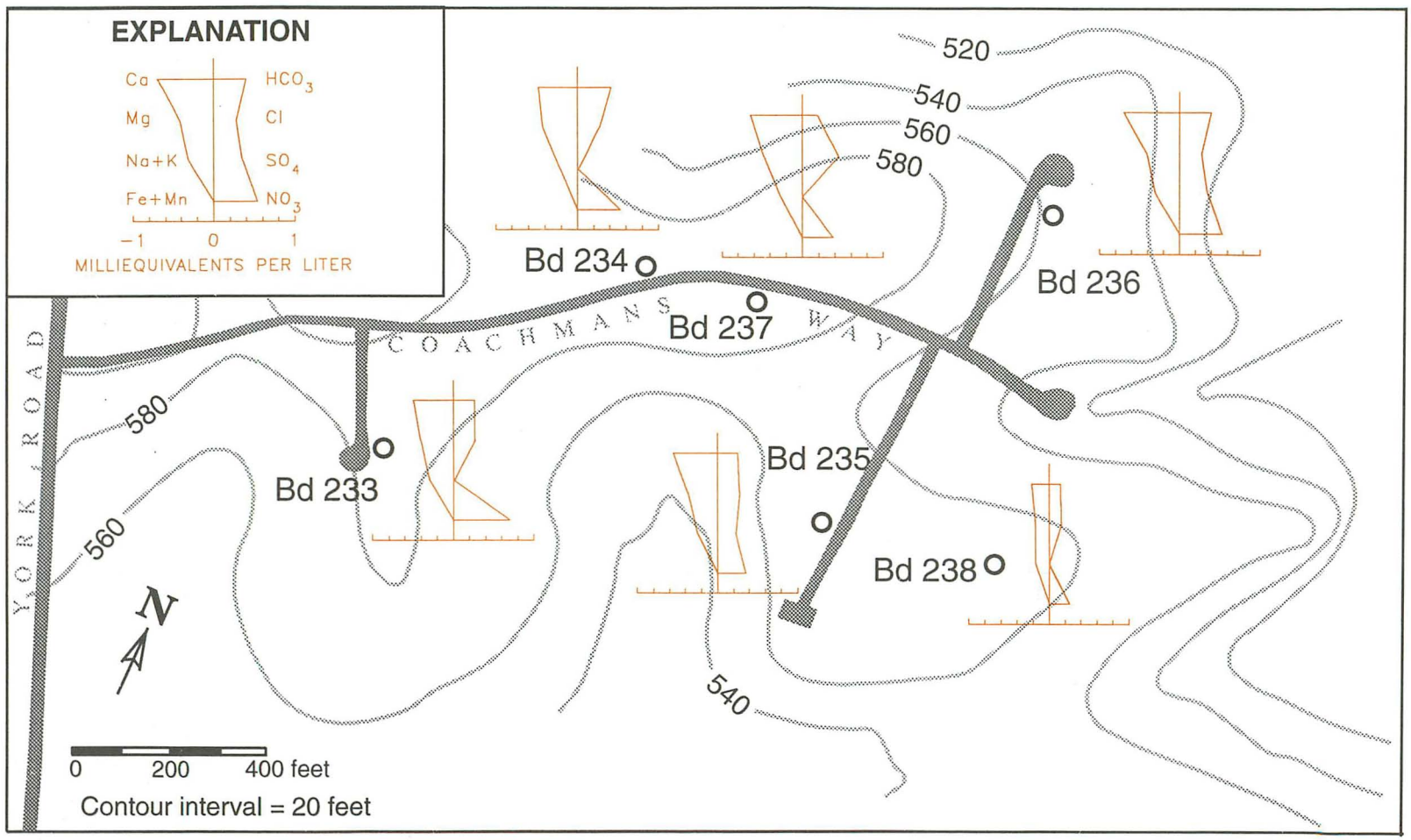


Figure 38. Stiff diagrams of samples from wells in the Coachmans Field development.

Table 27.
Summary of selected inorganic water-quality data from wells in the Coachmans Field development, the Pleasant Grove Schist, and the Prettyboy Schist.

[Median and range values are in milligrams per liter unless otherwise noted. pCi/L, picocuries per liter; <, less than]

Constituent	Coachmans Field wells (n=6)			Other Pleasant Grove Schist wells (n=5)			Prettyboy Schist wells (n=34)		
	Median	Range	Coefficient of variation (percent)[1]	Median	Range	Coefficient of variation (percent)[1]	Median	Range	Coefficient of variation (percent)[1]
TDS[2]	106	52-116	25.2	84	76-234	57.7	74	18-416	84.1
pH	5.95	5.5-6.3	4.5	6	5.8-6.1	2.3	5.9	5.1-6.7	7.6
Dissolved oxygen	8.7	4.7-9.6	21.6	8.6	8.2-9.8	7.7	8.1	4.8-9.6	18.0
Calcium	10.45	4.4-14	32.6	9.5	5-26	65.8	9.5	1.8-37	78.4
Magnesium	5	2.1-5.8	28.2	3.6	3-13	77.0	3.25	0.75-15	80.7
Sodium	5.25	3.6-6.5	21.0	6.9	4.4-10	29.0	4.85	1.5-69	149.1
Potassium	0.9	0.7-1.1	14.5	1.4	0.6-1.6	32.0	0.8	0.2-2.5	62.4
Alkalinity (as $CaCO_3$)	13	7-21	41.0	12	8-31	61.5	17	3-40	57.3
Chloride	9.7	5.5-16	33.4	10	3.7-22	64.8	7.45	1.7-190	174
Sulfate	0.45	<0.10-17	152.1	8	<0.10-20	75.9	1.55	<0.10-14	124.7
Nitrate (as N)	6.35	3.6-9.9	34.7	6.1	2.5-21	93.1	4.5	<0.05-16	82.3
Silica (as SiO_2)	12.5	11-15	11.5	14	8.8-21	31.8	13	5.7-63	67.4
Radon (pCi/L)	2,050	1,400-2,600	21.7	4800	2,800-5,200	22.4	3150	110-8,400	56.0

[1] Coefficient of variation = (standard deviation × 100) / mean
[2] Total dissolved solids (residue on evaporation at 180 degrees C.)

Water Quality in Adjacent Deep and Shallow Wells

Well De 640 (1,050 ft deep) and an adjacent shallower well (De 641; 400 ft deep) were sampled to observe differences in water quality that might be due to deep circulation of ground water. The two wells are located in Manor Woods, a low-density residential development 2 miles south of Long Green in northeastern Baltimore County. The shallow well is a domestic water-supply well; the deep well provides water for outdoor use and serves as a back-up domestic water supply. The deep and shallow wells are cased and grouted to similar depths (42 ft and 37 ft, respectively). The wells are located in an area mapped as the Loch Raven Schist; however, they are completed in different geologic formations. The well completion report for the shallow well describes the bedrock as gray mica rock (i.e., Loch Raven Schist). The bedrock for the deep well is also described as gray mica rock to a depth of 460 ft; from 460 to 1,050 ft, the rock is described as white limestone, which is interpreted as Cockeysville Marble (J. Edwards, Maryland Geological Survey, oral comm., 1998).

Water samples from the two wells had different chemical compositions. TDS was four times higher in the deep well than the shallow well (300 mg/L versus 70 mg/L) (tab. 28). The deep well also had a sodium-calcium-chloride water type, with a chloride concentration of 110 mg/L; the shallow well had a mixed cation-bicarbonate water type, with 8 mg/L chloride (tab. 28). The deep well had higher alkalinity, calcium, magnesium, sodium, potassium, sulfate, iron, and manganese concentrations and a lower radon concentration than the shallow well, and has characteristics both of schist

(higher silica than most water samples from marble aquifers) and marble (higher pH, alkalinity, and calcium than most samples from schist aquifers). Tritium concentrations in the deep and shallow wells (10.8 and 13.0 tritium units, respectively) indicate that both wells have at least some component of post-bomb water. (Tritium is discussed in more detail in the section of the report entitled "Age of Ground Water.")

Based on the differences in water chemistry, and because the open interval of the deep well includes the same open interval of the shallow well, there appears to be a significant chemical contribution from water entering the deep well below 400 ft. There is no chemical indication of septic contamination in either well (less than 1 mg/L nitrate in both wells; no detections of ammonium or MBAs). In fact, the nitrate concentration in the deep well (0.060 mg/L) was close to the minimum reporting limit. The low chloride in the shallow well (8 mg/L) suggests that sodium chloride that may have been applied to the adjacent road (located less than 50 ft from the wells) has not significantly affected the water quality.

Table 28.
Summary of selected inorganic water-quality data from adjacent deep (1,050 ft) and shallow (400 ft) wells.

[Values are in milligrams per liter unless otherwise noted. pCi/L, picocuries per liter]

Constituent	BA De 641 (400 ft deep)	BA De 640 (1,050 ft deep)
Total dissolved solids[1]	70	300
pH	5.8	6.4
Dissolved oxygen	8.8	6.7
Calcium	8.8	37
Magnesium	3.0	11
Sodium	7.1	44
Potassium	1.7	3.8
Alkalinity (as $CaCO_3$)	29	68
Chloride	8.0	110
Sulfate	6.1	21
Nitrate (as N)	0.870	0.060
Silica (as SiO_2)	23	29
Radon (pCi/L)	5,700	1,800

[1] Residue on evaporation at 180 degrees C.

One explanation for the difference in chloride concentrations is that water in the deep well has been affected by road salt applied in the recharge area near the drainage divide. The chloride concentration in the deep well was similar to those in other study-area wells that appear to have been affected by road salt. Some of the calcium, magnesium, and potassium (which are higher in the deeper well) may be due to ion exchange. The source of the chloride may be Manor Road (which is located near the topographic divide) or other roads located upgradient of the well. Under this scenario, the recharge area for the deeper well is near the topographic divide, where the ground-water flow direction is close to vertical. Solutes such as sodium and chloride are transported downward in the recharge area through the fractures in the Loch Raven Schist to the more permeable marble and are transported toward Cowen Run and the Gunpowder River to the east and southeast. The higher dissolved iron and sulfate in the deep well may be due to oxidation of pyrite in the Loch Raven Schist.

If deicing salts near the ground-water divide are the source of the high chloride, this indicates that in some areas of the county, contaminants introduced near ground-water divides may enter a deep-flow system, and may affect deep ground-water quality in lower parts of the drainage basins without affecting shallow ground-water quality. These situations are probably not common in the study area, and may be limited to areas where formations such as the Cockeysville Marble and the Hydes Marble Member of the Loch Raven Schist underlie non-carbonate aquifers.

Age of Ground Water

Water samples collected from 27 sites were analyzed for tritium (^3H, a radioactive isotope of hydrogen) in order to investigate the relative age of ground water in the study area. The age of a ground-water sample is the amount of time since the sample has been isolated from the atmosphere (Coplen, 1993). Tritium has been used in Maryland and elsewhere to help determine the age of ground water (Stone, Chapman, and Oldham, 1989; Dunkle and others, 1993; Böhlke and Denver, 1995; Rice and Bricker, 1995; Wilson and Achmad, 1995). Chlorofluorocarbon analysis was considered for dating water samples but was not done because of potential contamination of the water sample from contact with the polyvinyl chloride (PVC) pipe, pressure-tank bladder, and other plumbing materials.

Prior to the early 1950's, atmospheric tritium was produced by cosmic-ray bombardment of nitrogen in the upper atmosphere. Beginning in about 1953, tritium concentrations in precipitation began to increase due to atmospheric testing of hydrogen bombs, with huge increases in tritium occurring in 1963-64 (Plummer and others, 1993). Tritium is a minor component of atmospheric water; tritium abundance has seldom been more than one tritium atom for every 10^{14} hydrogen atoms even during maximum atmospheric

concentrations (Hem, 1985). Tritium is reported in tritium units (TU), where 1 TU equals 1 ^{3}H atom in 10^{18} atoms of hydrogen, or 3.24 pCi/L (Plummer and others, 1993).

Tritium's usefulness in hydrologic studies is due to its relatively short half-life (12.43 years) and its intensive production over a relatively short time. In its simplest application, tritium can be used to determine whether a water sample has any component of "pre-bomb" water. When recharge water reaches the water table, there is no additional input of atmospheric tritium, and the tritium concentration will decrease in accordance with the radioactive decay law (Coplen, 1993). A decay-corrected curve can be constructed that indicates what the present tritium concentrations would be for a specified atmospheric concentration at a specified time. This assumes that there is no mixing with other ground water. Measurements of pre-1953 atmospheric tritium concentrations ("background" concentrations) are limited; Robertson and Cherry (1989) estimated background levels at 3 to 5 TU. Radioactive decay would have reduced these concentrations to less than 1 TU by the early 1990s. The detection limit for the Baltimore County samples was 0.3 TU (1 pCi/L).

Tritium samples were collected in Phase II from 19 Phase I sites (18 wells and one spring). Additional samples were collected from the adjacent shallow and deep wells (400 and 1,050 ft deep, respectively) in the Manor Woods development and from the six wells in the Coachmans Field development. Sites in different topographic positions were sampled because wells located on hilltops (recharge areas) might be expected to have younger waters than wells on hillsides or in valleys, whereas ground water in topographically lower areas might contain both young water (derived from recharge near the well) and older water (derived from recharge near the ground-water divide). Deep and shallow wells were sampled because deeper wells may be intercepting deeper fractures that transmit older water than the shallower wells. Wells without pesticide detections were sampled to investigate whether or not the wells were producing pre-bomb water that would have pre-dated the advent of widespread pesticide use (particularly triazine herbicides).

Tritium values from the Baltimore County sites ranged from 7.4 to 18.5 TU (tab. 29), which indicates that all samples contain at least some component of post-1953 water (fig. 39). The range of values is similar to the range of decay-corrected atmospheric tritium concentrations from the past 20 years, suggesting that most of the ground water was recharged within this time period. There is considerable overlap in the range of tritium values between groups of wells with different topographic positions and depths, and between wells with and without pesticide detections. Tritium values from the six Coachmans Field wells varied from 11.9 to 13.5 TU. The variation in ground-water tritium concentrations reflects the contribution of different waters entering long open intervals of wells with various depths, seasonal variation in tritium content of recharge waters, and other factors.

Table 29.
Summary of tritium data from Baltimore County sites.

[Data from BA De 640 and 641 (adjacent deep and shallow wells) and Coachmans Field wells are not included. ≤, less than; >, greater than; TU, tritium units]

Factor	Category	Number of samples	Range (TU)	Mean (TU)
Topographic position	Hilltop	7	11.1—15.4	12.9
	Hillside	9	7.4—16.0	12.1
	Valley	3	13.6—18.5	16.2
Well depth	≤200 ft[1]	11	10.2—15.4	12.6
	>300 ft	8	7.4—18.5	13.7
Pesticide detections	No detections	4	10.2—18.5	14.5
	One or more detections	15	7.4—16.4	12.8

[1] Includes one spring

SUMMARY

A ground-water-quality study was conducted in the portion of the Piedmont region of Baltimore County that is not serviced by public water supply. The study, conducted in 1994 through 1996, was undertaken to characterize ground-water quality, evaluate factors affecting ground water, and provide baseline data that can be compared to future water-quality data. In Phase I of the study, 112 sites (106 wells and 6 springs) were sampled for major ions, nutrients, trace elements, radon, and approximately 55 pesticides and 60 volatile organic compounds. In Phase II of the study, additional samples were collected to provide data on temporal and local variation in ground-water quality, age of

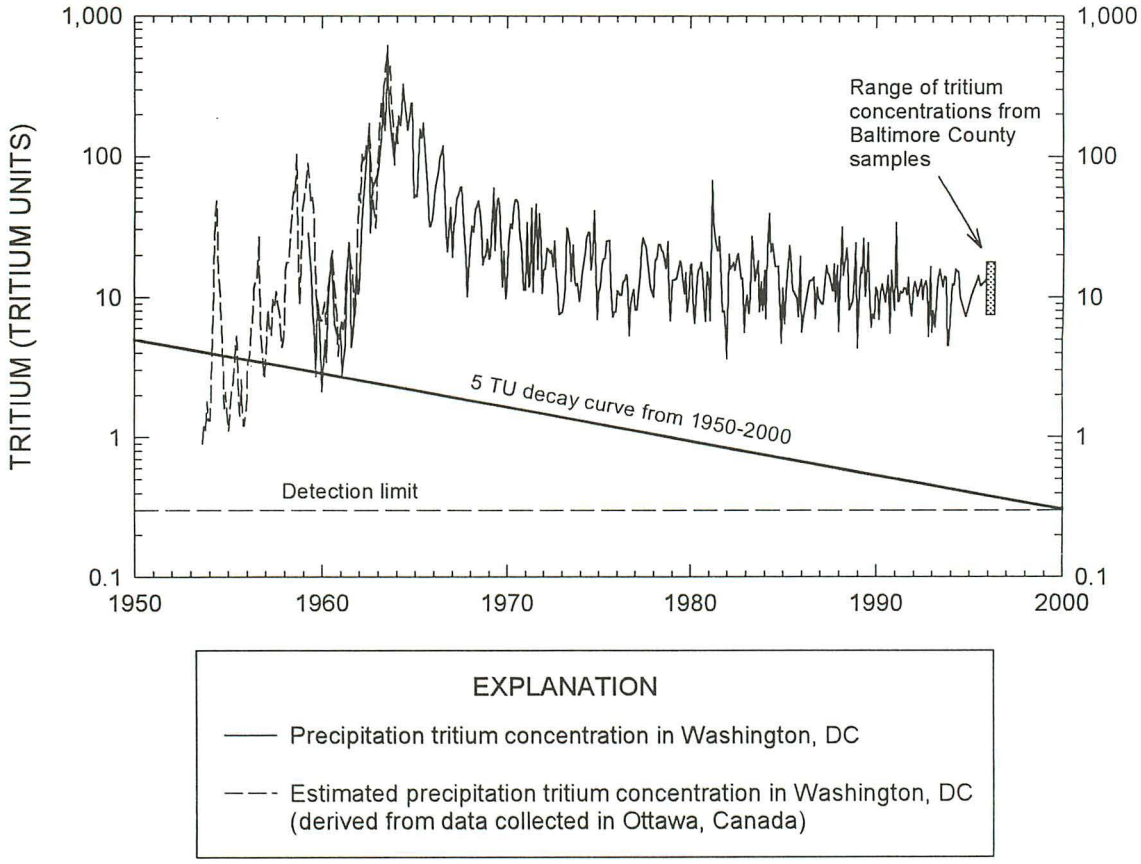


Figure 39. Tritium concentrations in precipitation and in samples from Baltimore County sites. Atmospheric tritium is decay-corrected to June 1, 1996. Source: International Atomic Energy Agency (1969, 1970, 1971, 1973, 1975, 1979, 1983, 1986, 1989, 1990) and R. Michel (U.S. Geological Survey, written comm., 1997).

ground water, and sources of nitrate to ground water. Seventy-five of the 112 wells and springs were in schist; 21 were in gneiss; 11 were in marble; and 5 were in mafic rocks. Over 90 percent of the wells were domestic water-supply wells; the others were commercial, standby, or unused wells.

Ground water in the study area was low in total dissolved solids (median TDS: 104 mg/L), acidic (median pH: 6.0), and oxygenated (median dissolved oxygen: 7.4 mg/L). Nitrate concentrations ranged from less than 0.05 to 35 mg/L as nitrogen (median: 2.9 mg/L). Chloride concentrations ranged from 1.2 to 280 mg/L (median concentration: 8.6 mg/L). Iron, manganese, and barium were the most frequently detected trace elements. Many wells had low-level detections of lead, nickel, copper, and zinc. Most of the trace elements with known adverse health effects (arsenic, antimony, beryllium, cadmium, cyanide, mercury, selenium, and thallium) were not detected; the occasional detections were at or close to MRLs. Radon concentrations ranged from less than 80 to 13,000 pCi/L (median: 2,450 pCi/L). Twenty-nine percent of radon samples exceeded 4,000 pCi/L; 89 percent of samples exceeded 300 pCi/L.

Seventy-one percent (79 of 112) of Phase I sites had one or more detections of pesticides or pesticide breakdown products. Ninety-eight percent of the pesticide detections were less than 1 µg/L; most were less than 0.1 µg/L. Fifteen different pesticides were detected. The most frequently detected were deethyl atrazine, metolachlor, atrazine, carbofuran, and simazine. Most of the other detected pesticides were found at only one or two sites each. More than 75 percent of the sites with detections had two or more pesticides present. Three VOCs (methylene chloride, tetrachloroethylene, and 1,1,1-trichloroethane) were detected, each at a different site.

Samples from five wells exceeded the MCL for nitrate (10 mg/L as N). Samples from two wells exceeded the MCL action level for lead (15 µg/L). No other MCLs were exceeded for inorganic constituents. Secondary MCLs were exceeded for pH (71 percent of sites with pH less than 6.5), iron (30 percent greater than 300 µg/L), manganese (14 percent greater than 50 µg/L), color (five sites greater than 15 color units), TDS (two sites greater than 500 mg/L), and chloride (one site greater than 250 mg/L). None of the MCLs

that have been established for four of the detected pesticides (alachlor, atrazine, carbofuran, and simazine) were exceeded. No Lifetime Health Advisory Levels (HALs) were exceeded for any of the inorganic constituents or pesticides. Two of the three detections of volatile organic compounds (methylene chloride and tetrachloroethylene) exceeded both the MCL and Lifetime HAL.

Concentrations of most inorganic water-quality constituents were closely related to aquifer lithology. Water samples from wells in schist had the lowest median TDS, alkalinity, pH, calcium, magnesium, and hardness of the four lithologic groups (schist, gneiss, marble, and mafic rocks). Most of these samples had a mixed-cation composition, with calcium plus magnesium making up more than 50 percent of cation milliequivalents per liter in almost all samples; anion composition was more variable. Radon concentrations in water samples from all schists ranged from less than 80 to 8,400 pCi/L (median: 2,900 pCi/L). Radon concentrations in water samples from the Piney Run Formation and Pleasant Grove Schist (median concentrations 5,250 pCi/L and 4,800 pCi/L, respectively) tended to be higher than in water samples from the Loch Raven and Prettyboy Schists (median concentrations 1,200 pCi/L and 3,200 pCi/L, respectively).

Water samples from gneisses had a mixed-cation composition or were enriched in calcium relative to other cations; anion composition was variable. TDS, alkalinity, calcium, sodium, potassium, sulfate, and silica concentrations were all significantly higher and dissolved oxygen was lower in water samples in gneiss than in samples from schist. Radon concentrations in samples from gneiss ranged from 180 to 13,000 pCi/L (median: 2,600 pCi/L). The three highest radon concentrations in the study were from a well in the Baltimore Gneiss (13,000 pCi/L) and two wells in the Slaughterhouse Gneiss (both 11,000 pCi/L).

Water samples from the 11 sites in marble aquifers (10 in the Cockeysville Marble; one in the Hydes Marble Member of the Loch Raven Schist) had a calcium-bicarbonate water chemistry. Alkalinity, pH, calcium, and hardness were all significantly higher than samples from either schist or gneiss; sodium and radon concentrations were lower. There was no significant difference in nitrate concentrations or pesticide detection frequency between water samples from marble, schist, or gneiss aquifers.

Water samples from four of the five wells in mafic-rock aquifers were calcium-magnesium-bicarbonate waters; the fifth was a calcium-magnesium-chloride water that had been affected by road salt. The samples tended to have smaller percentages of sodium and potassium than samples from schist and gneiss aquifers. Alkalinity and pH tended to be higher in samples from mafic-rock aquifers than in samples from schists and gneisses, and silica concentrations tended to be higher than in samples from all other rock types.

Wells were grouped into categories of agricultural, residential, forested, and commercial land use, based on the predominant land use within a 1,000-ft radius of each site. Water samples from wells in agricultural areas had significantly higher calcium concentrations than samples from wells in forested areas, but were not significantly different from residential-area water samples. Nitrate concentrations were significantly higher in samples from agricultural areas (median: 5.3 mg/L) than in samples from either forest or residential areas (median values: 1.15 mg/L and 2.9 mg/L, respectively). Nitrate concentrations were also significantly higher in wells having at least one pesticide detection than in wells without pesticide detections, suggesting that agricultural activities have a greater impact on ground-water nitrate than residential activities. Eighty-three percent of samples from agricultural-area wells had at least one pesticide detection, compared to 67 percent of wells in forested areas and 52 percent of wells in residential areas.

Samples from 23 sites were analyzed for $^{15}N_{NO3}$ to help identify sources of ground-water nitrate. Most $\delta^{15}N_{NO3}$ values in samples from wells downgradient of agricultural areas (median: +2.9 per mil) fell within the upper end of the range of values associated with commercial fertilizers, whereas the values of most samples from wells downgradient from non-agricultural areas (median: +4.7 per mil) fell within the lower end of the range of values associated with soil nitrogen. The low $\delta^{15}N_{NO3}$ from non-agricultural area wells indicated that there is little impact of septic-system effluent on nitrate concentrations.

There was a significant negative correlation between chloride concentrations and distance to paved roads, which strongly suggests that road salt is the source for elevated chloride concentrations in many of these wells (although chloride exceeded the SMCL of 250 mg/L in only one well). The low sodium concentrations relative to chloride and high calcium concentrations in water samples having more than about 30 mg/L chloride are attributed to ion exchange, in which sodium in ground water has replaced calcium and other cations on clays and other adsorbing surfaces. No relationship was seen between chloride or any other constituent and distance to septic reserve areas, which suggests that septic effluent does not significantly affect overall well-water quality. There was also no evidence that disposal of brine water used to back-flush water-treatment systems is having a significant impact on well-water quality in the study area.

There was little relationship between water quality and casing depth, depth to water, relative position of water table, well yield, or the age of wells. There was also very little relationship between concentrations of water-quality constituents and well depth, which suggests that there is little impact on water quality from water entering wells from deeper fracture systems. A notable exception to this was observed in water samples collected from a deep well (1,050 ft deep; open interval mostly in marble) and an adjacent shallower well (400 ft deep; open interval in schist). The deep well had a sodium-calcium-chloride water type and TDS of 300 mg/L, while the shallow well had a mixed-cation-bicarbonate water chemistry typical of other samples

from schist aquifers (TDS: 70 mg/L). The different water chemistries in samples from the two wells suggest that there is a component of "deep" ground-water flow in the area. This type of deep-flow system is probably not common in the county, and may be limited to areas where the Cockeysville Marble and the Hydes Marble Member of the Loch Raven Schist underlie non-carbonate aquifers.

Ten wells were sampled at monthly intervals for nitrate, chloride, atrazine, pH, specific conductance, and water temperature. Chloride concentrations varied less than 20 mg/L in eight of the 10 wells, and there was little relationship between chloride concentrations and time of year, even in wells that had apparently been affected by road salt. The range of nitrate concentrations from most sites was less than 3 mg/L throughout the year. There was no consistent trend in nitrate concentrations among all wells, although several wells had peak nitrate concentrations in mid- to late summer followed by gradually decreasing concentrations through the fall and winter. Atrazine concentrations (determined by immunoassay) were all less than 2 µg/L, and the range of values at most sites was less than 0.5 µg/L. Atrazine concentrations increased through the summer and reached their peaks in late summer and early fall, followed by a general decrease through January.

Six wells within a new residential development (Coachmans Field) were sampled for major ions, nutrients, trace elements, radon, pesticides, and VOCs in order to observe local variation in ground-water quality and to document ground-water quality in a relatively new residential development built on former cropland. The relative percentages of major ions in the Coachmans Field samples were similar to other samples from the Pleasant Grove Schist, although the ranges of concentrations were narrower. Radon concentrations were lower than other samples from the Pleasant Grove Schist. Five pesticides (atrazine, DEA, metolachlor, carbofuran, and simazine) were detected; four of the five pesticides were detected in all six wells. No MCLs were exceeded. $\delta^{15}N_{NO3}$ values were within the range of values associated with nitrate derived from commercial fertilizer.

Tritium samples collected from 27 sites indicate that all samples contain at least some water that was recharged since about 1953. The range of detected values was similar to the range of decay-corrected atmospheric tritium values from the last 20 years, suggesting that most of the ground water was recharged during this time. No differences were observed in tritium concentrations between groups of wells with different topographic positions and depths, or between wells with and without pesticide detections.

The data gathered during this study indicate that ground water in the rural portions of the Piedmont in Baltimore County is generally of good quality, with few water samples exceeding drinking-water health standards. Current well construction and location requirements are adequate for ground-water protection with respect to drinking-water standards for chemical constituents.

Several of the study's findings relate to ground-water management. Agricultural activities in the study area have affected ground-water quality, as indicated by the nitrate, pesticide, and $^{15}N_{NO3}$ data. There are no widespread confining units in the study area to protect ground water from point and nonpoint sources of contamination. Future residential developments built on former agricultural land will likely have low-level detections of agricultural chemicals in well water, and the data suggest that these constituents may persist for many years after agricultural activity has stopped. However, the overall health risk due to agricultural chemicals appears to be small because few of the samples in this study exceeded health-related criteria.

There were large differences in ground-water radon concentrations between the different geologic formations. Most of the risk associated with radon in well water appears to be due to radon escaping into the air and being inhaled, rather than to direct consumption of water. If a home is located in an area underlain by a geologic unit that has high ground-water radon concentrations (such as the Piney Run Formation, the Pleasant Grove Schist, or the Slaughterhouse Gneiss), it may be advisable for homeowners to test the air radon level.

Carbonate aquifers (including marble aquifers) have traditionally been considered to be more vulnerable to contamination than non-carbonate aquifers. The data, however, indicate that the marble and non-marble aquifers have similar levels of contaminants, suggesting that they are equally susceptible to ground-water contamination. More data are needed to confirm this; however, for the purpose of managing development, it would be prudent to consider all geologic formations in the study area as being equally susceptible to contamination.

RECOMMENDATIONS FOR FUTURE STUDY

The information presented in this report provides a framework that can be used to evaluate the effectiveness of ground-water management initiatives in the Piedmont portion of Baltimore County. Data on several specific aspects of ground-water quality were not collected during this study, but would be helpful in order to effectively manage the ground-water resource. These include:

- Conduct one or two site-specific studies of chloride

movement near roads that have been treated with deicing salts. In this study, chloride concentrations were found to decrease with increasing distance from paved roads *in general*, but this relationship was not evaluated for any specific site. Site-specific studies would provide information on the horizontal and vertical movement of chloride in relation to salt application rates, recharge events, soil characteristics, and other factors. The information could be used in conjunction with data from this study to help determine setback distances for wells adjacent to paved roads.

- Resample some of the wells from this study every few years, especially the wells located in new residential developments. Data from ongoing monitoring would provide insight into the causes of long-term changes in ground-water quality, especially with respect to constituents associated with agricultural and residential land use.
- Conduct site-specific studies of ground-water quality near septic systems. In the current study, there was little relationship between concentrations of ground-water quality constituents and distance to the nearest septic-reserve area. This may be because water-quality constituents have been attenuated within 100 ft of the septic reserve area, or because concentrations have been diluted by pristine water entering the well from a different zone. Understanding the local distribution of septic-effluent constituents (including pathogenic organisms) would help guide well-siting requirements.
- Analyze several well-water samples for radionuclides other than radon. Because radionuclide concentrations are related to aquifer lithology, wells in the major aquifers should be sampled in numbers proportional to the number of county residents relying on them for water. Analysis for gross alpha and beta particle activity would be helpful for screening samples; those with values exceeding MCLs could be analyzed for additional radionuclides (including radium and uranium). Wells that had relatively high radon concentrations in the current study should also be tested.
- Test air radon levels in homes located in different geologic formations in order to establish what relationship, if any, exists between radon levels in well water and indoor air.
- Conduct a study of fracture-trace orientation and distribution in the study area (or a portion of the study area). Fractures control availability of water and may relate to specific water quality issues.
- Collect additional samples from wells in the Cockeysville Marble and Hydes Marble Member of the Loch Raven Schist. The data from this study suggest that there is little difference between marble and non-marble formations with respect to nitrate and chloride concentrations and pesticide detections. Only 11 sites sampled in this study were in marble formations, however, and more data would be necessary to confirm this observation.
- Analyze water quality from individual fracture zones in the same well in order to identify the relative contribution to water quality of the different zones (including saprolite). This would require running geophysical logs in the open hole (to identify the individual fractures contributing water to the well), isolating or packing off the individual fracture zone, and sampling each zone separately. This could be done on a recently-drilled private water well, or on a well drilled specifically for the study.

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APPENDIXES

TABLE 8
Summary of inorganic constituents and comparison to water-quality standards and health advisories

TABLE 24
Summary of statistical relationships between selected well characteristics and water-quality constituents

APPENDIX A
Water-quality tables

APPENDIX B
Well and spring characteristics

APPENDIX C
Locations of wells and springs

Table 8.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

[Lithologic groups are defined in table 9. Source of MCL, SMCL, and HAL data: U.S. Environmental Protection Agency (1995). MCL, Maximum Contaminant Level; SMCL, Secondary Maximum Contaminant Level; HAL, Health Advisory Level; mg/L, milligrams per liter; μg/L, micrograms per liter; pcu, platinum-cobalt units; pCi/L, picocuries per liter; <, less than]

ALKALINITY (mg/L as $CaCO_3$)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	17	3	152		--		--
Gneiss	21	36	7	96		--		--
Marble	11	145	76	275	(none)	--	(none)	--
Mafic rocks	5	68	43	82		--		--
All samples	112	23	3	275		--		--

AMMONIUM (mg/L as N)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL (mg/L)	Number of samples exceeding standard
Schist	74	<0.015	<0.015	0.03		--		--
Gneiss	21	<0.015	<0.015	0.03		--		--
Marble	11	<0.015	<0.015	0.02	(none)	--	30[1]	--
Mafic rocks	5	<0.015	<0.015	<0.015		--		--
All samples	111	<0.015	<0.015	0.03		--		--

[1]Ammonia

ANTIMONY								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	<1	<1	<1		0		0
Gneiss	21	<1	<1	<1		0		0
Marble	11	<1	<1	<1	6	0	3	0
Mafic rocks	4	<1	<1	<1		0		0
All samples	111	<1	<1	<1		0		0

ARSENIC								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	<1	<1	3		0		--
Gneiss	21	<1	<1	<1		0		--
Marble	11	<1	<1	<1	50[1]	0	none	--
Mafic rocks	5	<1	<1	1		0		--
All samples	112	<1	<1	3		0		--

[1]Under review

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

BARIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	13	<2	280		0		0
Gneiss	21	51	17	210		0		0
Marble	11	--[2]	--[2]	--[2]	2,000	0	2,000	0
Mafic rocks	5	5	<2	150		0		0
All samples	112	14	<2	280		0		0

[2]Nine of the samples in marble aquifers were reported as <100 μg/L; the other two were reported as 12 μg/L and 73 μg/L.

BERYLLIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	<10	<10	<10		0		--
Gneiss	21	<10	<10	<10		0		--
Marble	11	<10	<10	<10	4	0	(none)	--
Mafic rocks	5	<10	<10	<10		0		--
All samples	112	<10	<10	<10		0		--

CADMIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	<1	<1	<1		0		0
Gneiss	21	<1	<1	<1		0		0
Marble	11	<1	<1	<1	5	0	5	0
Mafic rocks	5	<1	<1	<1		0		0
All samples	112	<1	<1	<1		0		0

CALCIUM								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	9.5	1.8	58		--		--
Gneiss	21	17	6.1	35		--		--
Marble	11	45	22	68	(none)	--	(none)	--
Mafic rocks	5	14	8	98		--		--
All samples	112	13	1.8	98		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

CHLORIDE								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	SMCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	9.6	1.6	230		0		--
Gneiss	21	9.4	2.9	63		0		--
Marble	11	5.2	1.2	23	250	0	(none)	--
Mafic rocks	5	4.9	2.5	280		1		--
All samples	112	8.6	1.2	280		1		--

CHROMIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL or SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	<1	<1	10		0		0
Gneiss	21	<1	<1	6		0		0
Marble	11	<1	<1	<1	100	0	100	0
Mafic rocks	5	4	<1	20		0		0
All samples	112	<1	<1	20		0		0

COLOR (platinum-cobalt units)								
Lithologic group	Sample size	Median (pcu)	Minimum (pcu)	Maximum (pcu)	SMCL (pcu)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	73	3	<1	37		4		--
Gneiss	21	3	<1	7		0		--
Marble	11	2	<1	7	15	0	(none)	--
Mafic rocks	5	1	<1	50		1		--
All samples	109	2	<1	50		5		--

COPPER								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	11	<1	410		0		--
Gneiss	21	12	<1	100		0		--
Marble	11	2	<1	12	1,300[1]	0	(none)	--
Mafic rocks	5	5	<1	35		0		--
All samples	112	10	<1	410		0		--

[1]Action level

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

CYANIDE								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	73	<0.01	<0.01	<0.01		0		0
Gneiss	21	<0.01	<0.01	<0.01		0		0
Marble	10	<0.01	<0.01	<0.01	200	0	200	0
Mafic rocks	5	<0.01	<0.01	<0.01		0		0
All samples	109	<0.01	<0.01	<0.01		0		0

DISSOLVED OXYGEN								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	8	<2	9.8		--		--
Gneiss	21	6.9	<1	8.7		--		--
Marble	11	6.2	4.4	9.4	(none)	--	(none)	--
Mafic rocks	5	5.2	<1	7.6		--		--
All samples	112	7.4	<1	9.8		--		--

FLUORIDE								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	<0.1	<0.1	0.3		0		--
Gneiss	21	<0.1	<0.1	0.3		0		--
Marble	11	<0.1	<0.1	0.2	4[1]	0	(none)	--
Mafic rocks	5	<0.1	<0.1	0.2		0		--
All samples	112	<0.1	<0.1	0.3		0		--

[1]Under review

HARDNESS (mg/L as $CaCO_3$)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	41	9	230		--		--
Gneiss	21	63	26	140		--		--
Marble	11	190	85	280	(none)	--	(none)	--
Mafic rocks	5	60	46	480		--		--
All samples	112	57	9	480		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

IRON (0.1μ-filtered)								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	5	<3	1,200		2		--
Gneiss	21	3	<3	4,900		1		--
Marble	11	<3	<3	4	300	0	(none)	--
Mafic rocks	5	5	<3	4,500		1		--
All samples	112	4	<3	4,900		4		--

IRON (unfiltered)								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	100	<10	380,000		23		--
Gneiss	21	100	<10	10,000		8		--
Marble	11	60	<10	200	300	0	(none)	--
Mafic rocks	5	310	20	3,300		3		--
All samples	112	100	<10	380,000		34		--

LEAD								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	1	<1	70		2		--
Gneiss	21	1	<1	10		0		--
Marble	11	<1	<1	2	15[1]	0	(none)	--
Mafic rocks	5	<1	<1	3		0		--
All samples	112	1	<1	70		0		--

[1]Action level

MAGNESIUM								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	3.9	0.75	32		--		--
Gneiss	21	5.4	2.5	16		--		--
Marble	11	15	3.6	30	(none)	--	(none)	--
Mafic rocks	5	6.3	4.0	56		--		--
All samples	112	4.8	0.75	56		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

MANGANESE (0.1μ-filtered)								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	5	<1	210		10		--
Gneiss	21	3	<1	84		2		--
Marble	11	<1	<1	<1	50	0	(none)	--
Mafic rocks	5	<1	<1	310		1		--
All samples	112	4	<1	310		13		--

MANGANESE (unfiltered)								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	10	<10	290		11		--
Gneiss	21	<10	<10	90		4		--
Marble	11	<10	<10	20	50	0	(none)	--
Mafic rocks	5	<10	<10	200		1		--
All samples	112	<10	<10	290		16		--

MERCURY								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	73	<0.1	<0.1	0.2		0		0
Gneiss	21	<0.1	<0.1	<0.1		0		0
Marble	10	<0.1	<0.1	<0.1	2[1]	0	2[1]	0
Mafic rocks	5	<0.1	<0.1	<0.1		0		0
All samples	109	<0.1	<0.1	0.2		0		0

[1] Inorganic mercury

METHYLENE-BLUE ACTIVE SUBSTANCES								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	<0.02	<0.02	0.08		--		--
Gneiss	21	<0.02	<0.02	0.21		--		--
Marble	11	<0.02	<0.02	<0.02	(none)	--	(none)	--
Mafic rocks	5	<0.02	<0.02	0.02		--		--
All samples	111	<0.02	<0.02	0.21		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

NICKEL								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	<1	<1	86		0		0
Gneiss	21	<1	<1	7		0		0
Marble	11	<1	<1	<1	100[1]	0	100	0
Mafic rocks	5	<1	<1	2		0		0
All samples	112	<1	<1	86		0		0

[1] Being remanded

NITRATE PLUS NITRITE (mg/L as N)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	3.4	<0.05	35		5		--
Gneiss	21	3.0	0.06	7.8		0		--
Marble	11	2.9	0.32	9.1	10	0	(none)	--
Mafic rocks	5	0.81	<0.05	2.2		0		--
All samples	111	2.9	<0.05	35		5		--

NITRITE (mg/L as N)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	<0.010	<0.010	<0.010		0		--
Gneiss	21	<0.010	<0.010	0.030		0		--
Marble	11	<0.010	<0.010	<0.010	1	0	(none)	--
Mafic rocks	5	<0.010	<0.010	<0.010		0		--
All samples	111	<0.010	<0.010	0.030		0		--

TOTAL ORGANIC CARBON								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	0.5	<0.1	7.7		--		--
Gneiss	21	0.5	0.1	3.4		--		--
Marble	10	0.9	0.2	2.5	(none)	--	(none)	--
Mafic rocks	5	1.2	0.5	3.4		--		--
All samples	111	0.5	<0.1	7.7		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

ORTHOPHOSPHORUS (mg/L as P)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	0.010	<0.010	0.060		--		--
Gneiss	21	0.020	<0.010	0.040		--		--
Marble	11	<0.010	<0.010	0.020	(none)	--	(none)	--
Mafic rocks	5	0.020	0.010	0.15		--		--
All samples	111	0.010	<0.010	0.15		--		--

pH								
Lithologic group	Sample size	Median	Minimum	Maximum	SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	5.8	5.1	7.9		63 <6.5		--
Gneiss	21	6.0	5.3	7.1		14 <6.5		--
Marble	11	7.6	7.3	8.0	6.5—8.5	0	(none)	--
Mafic rocks	5	6.6	6.1	7.3		2 <6.5		--
All samples	112	6.0	5.1	8.0		79 <6.5		--

PHOSPHORUS (mg/L as P)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	<0.01	<0.01	0.56		--		--
Gneiss	21	0.02	<0.01	0.05		--		--
Marble	11	<0.01	<0.01	0.03	(none)	--	(none)	--
Mafic rocks	5	0.02	<0.01	0.15		--		--
All samples	111	0.01	<0.01	0.56		--		--

POTASSIUM								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	1.4	0.2	5.7		--		--
Gneiss	21	2.6	1.1	6.1		--		--
Marble	11	1.7	1.1	9.2	(none)	--	(none)	--
Mafic rocks	5	0.9	0.2	5		--		--
All samples	112	1.7	0.2	9.2		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

RADON								
Lithologic group	Sample size	Median (pCi/L)	Minimum (pCi/L)	Maximum (pCi/L)	MCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	73	2,900	<80	8,400		--		--
Gneiss	21	2,600	180	13,000		--		--
Marble	11	550	<80	1,200	(none)	--	(none)	--
Mafic rocks	5	540	110	790		--		--
All samples	110	2,450	<80	13,000		--		--

SELENIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	<1	<1	2		0		--
Gneiss	21	<1	<1	2		0		--
Marble	11	<1	<1	<1	50	0	(none)	--
Mafic rocks	5	<1	<1	<1		0		--
All samples	112	<1	<1	2		0		--

SILICA (mg/L as SiO_2)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	13	5.7	63		--		--
Gneiss	21	26	15	45		--		--
Marble	11	12	8.7	21	(none)	--	(none)	--
Mafic rocks	5	37	21	63		--		--
All samples	112	15	5.7	63		--		--

SODIUM								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL or SMCL	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	5.2	1.5	69		--		--
Gneiss	21	7.4	5.1	15		--		--
Marble	11	2.4	1.4	7.6	(none)	--	(none)	--
Mafic rocks	5	2.8	2.2	12		--		--
All samples	112	5.5	1.4	69		--		--

Table 8, continued.
Summary of inorganic constituents and comparison to water-quality standards and health advisories.

SULFATE								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	MCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	75	2.5	<0.1	28		0		--
Gneiss	21	15	1.5	41		0		--
Marble	11	4.6	0.5	20	500[1]	0	(none)	--
Mafic rocks	5	1.3	0.2	31		0		--
All samples	112	3.6	<0.1	41		0		--

[1] Proposed

THALLIUM								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	MCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	74	<1	<1	<1		0		--
Gneiss	21	<1	<1	<1		0		--
Marble	11	<1	<1	<1	2	0	0.4	--[1]
Mafic rocks	5	<1	<1	<1		0		--
All samples	111	<1	<1	<1		0		--

[1]HAL < reporting limit

TOTAL DISSOLVED SOLIDS (residue at 180° C.)								
Lithologic group	Sample size	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)	SMCL (mg/L)	Number of samples exceeding standard	Lifetime HAL	Number of samples exceeding standard
Schist	74	84	18	596		1		--
Gneiss	21	132	66	258		0		--
Marble	11	220	92	298	500	0	(none)	--
Mafic rocks	5	138	78	718		1		--
All samples	111	104	18	718		2		--

ZINC								
Lithologic group	Sample size	Median (μg/L)	Minimum (μg/L)	Maximum (μg/L)	SMCL (μg/L)	Number of samples exceeding standard	Lifetime HAL (μg/L)	Number of samples exceeding standard
Schist	75	<10	<10	440		0		0
Gneiss	21	<10	<10	50		0		0
Marble	11	<10	<10	80	5,000	0	2,000	0
Mafic rocks	5	<10	<10	<10		0		0
All samples	112	<10	<10	440		0		0

Table 24.
Summary of statistical relationships between selected well characteristics and water-quality constituents.

[Shaded areas indicate significant differences between groups ($P<0.05$; Mann-Whitney rank sum test) or significant relationships between variables ($P<0.05$ and $r>\pm0.250$; Spearman rank order test). <, less than; ≤, less than or equal to; >, greater than; ≥, greater than or equal to; mg/L, milligrams per liter; pCi/L, picocuries per liter; μg/L, micrograms per liter; ft, feet below land surface; gpm, gallons per minute]

		Well depth		Casing depth		Water level		Well yield	
		≤200 ft (n=57)	>200 ft (n=49)	≤40 ft (n=51)	>40 ft (n=55)	<39 ft (n=29)	≥39 ft (n=28)	<7 gpm (n=50)	≥7 gpm (n=56)
Residue on evaporation at 180° C.	Median (mg/L)	101	110	112	194	118	83	101.5	116
	Mann-Whitney *P*-value	0.278		0.390		0.072		0.962	
	Spearman *r*-value	-0.053		-0.076		-0.218		-0.029	
	Spearman *P*-value	0.592		0.439		0.103		0.769	
pH	Median	6.0	6.1	6.0	6.2	6.1	5.9	6.0	6.1
	Mann-Whitney *P*-value	0.207		0.037		0.080		0.111	
	Spearman *r*-value	0.095		0.205		-0.273		0.150	
	Spearman *P*-value	0.331		0.035		0.040		0.125	
Alkalinity	Median (mg/L)	22	28	22	24	26	14	22.5	24.5
	Mann-Whitney *P*-value	0.068		0.515		0.022		0.508	
	Spearman *r*-value	0.128		0.049		-0.375		0.071	
	Spearman *P*-value	0.190		0.621		0.004		0.469	
Dissoived oxygen	Median (mg/L)	8.1	6.3	7.4	7.4	6.8	8.05	7.35	7.5
	Mann-Whitney *P*-value	<0.001		0.970		0.037		0.947	
	Spearman *r*-value	-0.268		-0.026		0.393		0.067	
	Spearman *P*-value	0.005		0.788		0.003		0.496	

Table 24, continued.
Summary of statistical relationships between selected well characteristics and water-quality constituents.

[Shaded areas indicate significant differences between groups ($P<0.05$; Mann-Whitney rank sum test) or significant relationships between variables ($P<0.05$ and $r>\pm0.250$; Spearman rank order test). <, less than; ≤, less than or equal to; >, greater than; ≥, greater than or equal to; mg/L, milligrams per liter; pCi/L, picocuries per liter; μg/L, micrograms per liter; ft, feet below land surface; gpm, gallons per minute]

		Well depth		Casing depth		Water level		Well yield	
		≤200 ft (n=57)	>200 ft (n=49)	≤40 ft (n=51)	>40 ft (n=55)	<39 ft (n=29)	≥39 ft (n=28)	<7 gpm (n=50)	≥7 gpm (n=56)
Calcium	Median (mg/L)	11	15	13	14	15	7.9	11	15
	Mann-Whitney *P*-value	0.101		0.899		0.039		0.423	
	Spearman *r*-value	0.074		0.010		-0.251		0.086	
	Spearman *P*-value	0.449		0.918		0.060		0.381	
Magnesium	Median (mg/L)	4.3	5.5	4.4	4.8	4.8	4.0	4.6	4.75
	Mann-Whitney *P*-value	0.478		0.519		0.222		0.827	
	Spearman *r*-value	0.013		-0.121		-0.150		-0.007	
	Spearman *P*-value	0.895		0.216		0.266		0.943	
Sodium	Median (mg/L)	5.1	5.9	6.4	4.8	5.4	4.85	6.35	4.9
	Mann-Whitney *P*-value	0.568		0.039		0.867		0.070	
	Spearman *r*-value	0.081		-0.184		-0.059		-0.218	
	Spearman *P*-value	0.409		0.060		0.663		0.025	
Potassium	Median (mg/L)	1.4	2.2	1.7	1.6	1.7	1.3	1.6	1.7
	Mann-Whitney *P*-value	0.035		0.502		0.221		0.633	
	Spearman *r*-value	0.182		-0.106		-0.275		-0.062	
	Spearman *P*-value	0.062		0.281		0.039		0.530	

Table 24, continued.

Summary of statistical relationships between selected well characteristics and water-quality constituents.

[Shaded areas indicate significant differences between groups ($P<0.05$; Mann-Whitney rank sum test) or significant relationships between variables ($P<0.05$ and $r>\pm0.250$; Spearman rank order test). <, less than; ≤, less than or equal to; >, greater than; ≥, greater than or equal to; mg/L, milligrams per liter; pCi/L, picocuries per liter; μg/L, micrograms per liter; ft, feet below land surface; gpm, gallons per minute]

		Well depth		Casing depth		Water level		Well yield	
		≤200 ft (n=57)	>200 ft (n=49)	≤40 ft (n=51)	>40 ft (n=55)	<39 ft (n=29)	≥39 ft (n=28)	<7 gpm (n=50)	≥7 gpm (n=56)
Chloride	Median (mg/L)	9.4	8.1	10	7.9	8.8	6.35	10	8.55
	Mann-Whitney *P*-value	0.805		0.184		0.867		0.660	
	Spearman *r*-value	-0.041		-0.154		-0.010		-0.030	
	Spearman *P*-value	0.679		0.114		-0.959		0.764	
Sulfate	Median (mg/L)	3.4	4.6	7.6	2.8	3.7	3.1	4.2	3.45
	Mann-Whitney *P*-value	0.207		0.006		0.267		0.922	
	Spearman *r*-value	0.090		-0.270		-0.249		-0.065	
	Spearman *P*-value	0.359		0.005		0.062		0.510	
Silica	Median (mg/L as SiO_2)	14	17	15	17	20	12.5	15	16
	Mann-Whitney *P*-value	0.226		0.909		0.002		0.847	
	Spearman *r*-value	0.067		-0.013		-0.462		-0.072	
	Spearman *P*-value	0.493		0.896		<0.005		0.466	
Total organic carbon	Median (mg/L)	0.5	0.5 (n=48)	0.5 (n=50)	0.5	0.5	0.8	0.5	0.5 (n=55)
	Mann-Whitney *P*-value	0.779		0.608		0.246		0.039	
	Spearman *r*-value	0.025		-0.078		0.160		-0.166	
	Spearman *P*-value	0.800		0.431		0.233		0.090	

Table 24, continued.

Summary of statistical relationships between selected well characteristics and water-quality constituents.

[Shaded areas indicate significant differences between groups ($P<0.05$; Mann-Whitney rank sum test) or significant relationships between variables ($P<0.05$ and $r>\pm0.250$; Spearman rank order test). <, less than; ≤, less than or equal to; >, greater than; ≥, greater than or equal to; mg/L, milligrams per liter; pCi/L, picocuries per liter; μg/L, micrograms per liter; ft, feet below land surface; gpm, gallons per minute]

		Well depth		Casing depth		Water level		Well yield	
		≤200 ft (n=57)	>200 ft (n=49)	≤40 ft (n=51)	>40 ft (n=55)	<39 ft (n=29)	≥39 ft (n=28)	<7 gpm (n=50)	≥7 gpm (n=56)
Nitrate+nitrite	Median (mg/L as N)	3.5	2.9 (n=48)	3.15 (n=50)	2.7	3.2	2.85	2.9 (n=49)	3.45
	Mann-Whitney *P*-value	0.305		0.466		0.199		0.153	
	Spearman *r*-value	-0.101		-0.004		-0.028		0.143	
	Spearman *P*-value	0.306		0.966		0.837		0.146	
Radon	Median (pCi/L)	2,300	2,650 (n=48)	2,100	2,750 (n=54)	2,650 (n=28)	2,650	2,650	1,800 (n=55)
	Mann-Whitney *P*-value	0.789		0.557		0.812		0.109	
	Spearman *r*-value	0022		0.031		-0.090		-0.178	
	Spearman *P*-value	0.820		0.755		0.506		0.068	
Iron (unfiltered)	Median (μg/L)	110	100	70	140	630	95	105	105
	Mann-Whitney *P*-value	0.671		0.022		0.006		0.997	
	Spearman *r*-value	-0.087		0.241		-0.316		-0.037	
	Spearman *P*-value	0.375		0.013		0.017		0.706	
Manganese (unfiltered)	Median (μg/L)	<1	10	<1	<1	10	<1	<1	<1
	Mann-Whitney *P*-value	0.132		0.382		0.343		0.966	
	Spearman *r*-value	0.218		0.049		-0.224		-0.156	
	Spearman *P*-value	0.025		0.616		0.094		0.109	

Table 24, continued.

Summary of statistical relationships between selected well characteristics and water-quality constituents.

[<, less than; ≤, less than or equal to; >, greater than; ≥, greater than or equal to; mg/L, milligrams per liter; pCi/L, picocuries per liter; μg/L, micrograms per liter; ft, feet below land surface; gpm, gallons per minute]

	Well depth		Casing depth		Water level		Well yield	
	≤200 ft (n=57)	>200 ft (n=49)	≤40 ft (n=51)	>40 ft (n=55)	<39 ft (n=29)	≥39 ft (n=28)	<7 gpm (n=50)	≥7 gpm (n=56)
Number of wells with ≥1 detection/ number of wells with no detections	39/18	37/12	40/11	36/19	24/5	18/10	37/13	39/17
χ^2 value	0.350		1.603		1.645		0.079	
P-value	0.554		0.205		0.200		0.779	

APPENDIX A

WATER-QUALITY TABLES

TABLE A1
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Site number	Date	Discharge (gal/min)	Water level (feet below land surface)	Water temperature (deg. C)	Specific conductance (µS/cm)	pH	Alkalinity (mg/L as $CaCO_3$)
BA Ab 51	394206076470201	04-18-95	2.5	79.88	12.0	132	5.1	3
		02-07-96	1.8	--	11.5	125	5.1	--
BA Ab 52	394011076465601	07-06-95	1.4	--	14.0	86	5.3	7
BA Ac 151	394057076423301	11-30-94	5.0	64.07	11.5	32	5.9	9
BA Ac 152	394023076401001	08-26-96	10	--	13.0	48	5.4	8
BA Ad 145	394130076360101	12-01-94	2.1	32.59	12.0	159	6.0	21
		08-26-96	2.0	--	13.0	156	5.9	--
BA Ad 146	394019076374501	03-27-95	2.2	61.39	11.5	26	5.8	8
		02-09-96	3.2	--	11.0	27	--	--
		08-22-96	2.4	--	11.5	25	5.6	7
BA Ad 147	394243076383201	05-11-95	2.1	48.94	13.5	106	5.1	3
		02-08-96	3.3	--	12.0	104	--	--
BA Ad 148	394303076355401	05-16-95	1.5	--	13.5	229	6.4	31
BA Ad 149	394250076370801	05-23-95	1.5	--	14.0	47	6.4	11
BA Ae 19	394013076343001	11-21-94	6.0	--	11.5	38	5.7	15
BA Bb 136	393937076482101	09-21-94	--	--	14.0	228	5.7	17
BA Bb 138	393543076451301	10-31-94	2.0	32.51	13.5	304	6.1	34
BA Bb 139	393843076462401	12-29-94	2.0	45.97	10.5	69	6.2	17
		02-08-96	2.9	--	11.0	64	6.1	--
BA Bb 140	393746076470001	02-22-95	2.7	58.60	12.5	266	6.2	17
BA Bb 141	393723076471401	03-01-95	3.8	--	11.5	70	6.5	26
		02-09-96	3.2	--	11.5	69	6.2	--
BA Bb 143	393607076485001	03-14-95	2.3	13.19	11.0	139	6.6	20
BA Bb 144	393544076463401	03-20-95	1.4	13.93	12.5	94	6.2	24
BA Bb 145	393540076455801	03-21-95	2.3	32.70	13.0	92	6.4	24
BA Bb 147	393641076493501	05-18-95	1.6	--	12.0	37	5.7	11
		02-09-96	2.1	--	11.0	--	--	--
BA Bb 148	393707076450801	06-20-95	2.1	--	13.0	172	5.3	4
BA Bb 150	393639076480601	07-24-95	--	--	18.5	465	7.1	68
BA Bb 151	393643076480201	07-24-95	15	38.90	13.5	407	6.7	25
BA Bc 264	393841076430901	08-22-96	6.0	--	11.0	40	5.9	6
BA Bc 267	393633076443801	12-21-94	2.6	31.90	12.0	413	5.7	15
		12-12-95	1.5	--	11.5	452	5.6	--
BA Bc 268	393929076441301	12-13-94	4.6	--	12.0	99	6.2	22
BA Bc 270	393918076412801	04-11-95	2.0	68.52	12.0	52	5.6	6
BA Bc 271	393818076411501	04-19-95	1.9	65.90	12.0	82	6.5	38
BA Bc 272	393803076420101	05-16-95	1.5	49.83	13.5	170	5.4	17
BA Bc 273	393755076402801	05-18-95	1.3	46.44	12.5	721	5.7	11
BA Bc 274	393639076435501	06-07-95	1.8	30.11	13.5	172	6.7	32
		08-08-96	2.0	--	13.5	183	6.8	--
BA Bc 275	393534076401601	07-05-95	1.0	36.86	15.0	861	5.3	25
BA Bd 224	393520076372201	09-28-94	1.0	49.21	15.0	59	5.7	11
		08-06-96	2.0	--	17.0	--	--	--
BA Bd 225	393902076371301	11-21-94	3.0	--	12.5	84	5.9	8
BA Bd 226	393936076352101	12-12-94	4.0	29.23	12.5	169	6.6	40
BA Bd 227	393928076381301	12-07-94	4.0	--	12.0	224	5.6	7
BA Bd 229	393741076380601	01-11-95	3.0	45.35	11.5	129	6.0	8
		01-19-95	2.6	--	12.0	139	--	--
BA Bd 231	393732076354101	05-23-95	1.5	20.92	12.5	340	7.1	152
BA Bd 232	393554076384401	07-19-95	2.1	57.46	13.5	43	5.9	7
BA Bd 233	393732076392401	10-15-96	1.8	--	13.0	141	5.9	13
BA Bd 234	393739076391801	10-16-96	1.8	--	13.5	140	5.5	21
		10-29-96	2.0	--	13.0	141	--	--
BA Bd 235	393733076391301	10-15-96	2.0	--	12.5	129	6.0	13
BA Bd 236	393742076390701	10-16-96	2.6	--	13.0	176	6.3	20
		10-29-96	2.8	--	13.5	--	--	--
BA Bd 237	393738076391401	10-23-96	2.3	--	13.0	170	5.8	9
BA Bd 238	393736076390401	10-23-96	2.1	--	13.5	68	6.0	7
BA Be 36	393546076341201	08-31-94	1.4	--	14.0	324	5.6	8

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Solids, residue at 180 deg. C (mg/L)	Solids, sum of constituents (mg/L)	Oxygen, dissolved (mg/L)	Color (platinum cobalt units)	Calcium (mg/L)	Magnesium (mg/L)	Hardness (mg/L as $CaCO_3$)	Sodium (mg/L)
BA Ab 51	04-18-95	84	--	8.9	1	5.3	6.0	38	5.5
	02-07-96	--	--	--	--	--	--	--	--
BA Ab 52	07-06-95	64	58	8.4	3	4.8	3.3	26	3.2
BA Ac 151	11-30-94	20	27	9.3	5	2.6	0.75	10	2.1
BA Ac 152	08-26-96	22	35	8.4	--	2.6	1.6	13	2.3
BA Ad 145	12-01-94	118	103	8.1	5	14	3.5	49	6.3
	08-26-96	--	--	--	--	--	--	--	--
BA Ad 146	03-27-95	18	22	9.0	3	1.8	1.1	9	1.5
	02-09-96	--	--	--	--	--	--	--	--
	08-22-96	16	--	9.2	5	1.4	0.89	7	1.4
BA Ad 147	05-11-95	66	--	8.9	1	5.0	4.7	32	2.9
	02-08-96	--	--	--	--	--	--	--	--
BA Ad 148	05-16-95	140	140	6.0	1	26	3.9	81	5.9
BA Ad 149	05-23-95	38	37	7.9	<1	3.5	1.2	14	2.8
BA Ae 19	11-21-94	24	27	8.8	3	2.7	1.1	11	2.1
BA Bb 136	09-21-94	140	120	5.2	<1	11	7.1	57	17
BA Bb 138	10-31-94	--	212	6.6	1	28	7.5	100	13
BA Bb 139	12-29-94	54	52	8.8	1	7.8	1.6	26	3.7
	02-08-96	--	--	--	--	--	--	--	--
BA Bb 140	02-22-95	176	142	8.0	3	25	6.3	88	9.6
BA Bb 141	03-01-95	46	49	8.3	<1	5.9	2.0	23	3.9
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 143	03-14-95	94	98	5.5	9	15	2.4	47	5.4
BA Bb 144	03-20-95	70	73	6.4	9	7.2	2.7	29	5.1
BA Bb 145	03-21-95	70	68	7.9	3	9.1	2.5	33	4.3
BA Bb 147	05-18-95	20	31	9.5	<1	2.3	0.85	9	3.3
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 148	06-20-95	96	99	8.7	5	10	6.4	51	6.1
BA Bb 150	07-24-95	334	244	--	--	46	10	160	21
BA Bb 151	07-24-95	332	221	9.4	8	37	15	150	8.0
BA Bc 264	08-22-96	20	28	9.4	--	1.8	1.4	10	2.2
BA Bc 267	12-21-94	252	214	8.0	3	34	11	130	16
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	74	67	8.1	3	9.9	2.3	34	3.9
BA Bc 270	04-11-95	32	--	9.4	9	3.3	1.5	14	2.7
BA Bc 271	04-19-95	54	58	5.4	1	11	2.1	36	3.1
BA Bc 272	05-16-95	96	94	5.4	1	8.0	4.4	38	15
BA Bc 273	05-18-95	416	331	8.3	<1	31	14	140	69
BA Bc 274	06-07-95	104	101	6.3	10	19	2.7	59	5.5
	08-08-96	--	--	--	--	--	--	--	--
BA Bc 275	07-05-95	596	407	1.1	4	43	30	230	52
BA Bd 224	09-28-94	26	44	8.0	2	3.1	2.2	17	2.5
	08-06-96	--	--	--	--	--	--	--	--
BA Bd 225	11-21-94	48	52	8.4	1	3.5	4.0	25	2.9
BA Bd 226	12-12-94	104	105	4.8	3	19	3.9	64	4.6
BA Bd 227	12-07-94	146	136	9.6	8	18	7.1	74	5.7
BA Bd 229	01-11-95	76	71	9.8	4	5.0	3.6	27	10
	01-19-95	--	--	--	--	--	--	--	--
BA Bd 231	05-23-95	180	184	8.3	<1	14	32	170	1.8
BA Bd 232	07-19-95	26	34	9.1	5	2.1	1.1	10	3.3
BA Bd 233	10-15-96	108	99	8.6	<1	9.9	4.9	45	6.2
BA Bd 234	10-16-96	104	89	4.7	<1	9.7	5.2	46	4.4
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 235	10-15-96	86	87	8.0	3	11	4.5	46	5.1
BA Bd 236	10-16-96	116	112	8.8	3	14	5.1	56	6.5
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 237	10-23-96	114	--	9.0	<1	13	5.8	56	5.4
BA Bd 238	10-23-96	52	48	9.6	3	4.4	2.1	20	3.6
BA Be 36	08-31-94	174	171	5.5	<1	13	9.0	70	26

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Sodium adsorption ratio	Sodium percent	Potassium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Silica (mg/L as SiO_2)	Iron (filtered) (µg/L)
BA Ab 51	04-18-95	0.4	23	1.2	13	<0.10	<0.10	5.7	<3
	02-07-96	--	--	--	--	--	--	--	--
BA Ab 52	07-06-95	0.3	21	1.0	7.5	1.5	<0.10	12	8
BA Ac 151	11-30-94	0.3	31	0.30	1.7	0.50	<0.10	9.6	12
BA Ac 152	08-26-96	0.3	26	0.90	3.1	2.1	<0.10	8.8	<3
BA Ad 145	12-01-94	0.4	21	2.5	10	8.0	<0.10	15	6
	08-26-96	--	--	--	--	--	--	--	--
BA Ad 146	03-27-95	0.2	26	0.30	2.2	0.20	<0.10	7.9	<3
	02-09-96	--	--	--	--	--	--	--	--
	08-22-96	0.2	29	0.30	2.1	<0.10	<0.10	6.7	9
BA Ad 147	05-11-95	0.2	16	0.80	5.9	<0.10	<0.10	6.3	<3
	02-08-96	--	--	--	--	--	--	--	--
BA Ad 148	05-16-95	0.3	13	2.2	11	13	<0.10	15	3
BA Ad 149	05-23-95	0.3	30	0.20	2.8	1.5	0.10	13	4
BA Ae 19	11-21-94	0.3	28	0.40	2.0	0.40	<0.10	8.8	7
BA Bb 136	09-21-94	1	39	1.0	41	3.4	<0.10	6.6	16
BA Bb 138	10-31-94	0.6	22	1.7	21	14	0.20	63	<3
BA Bb 139	12-29-94	0.3	23	0.70	3.9	3.3	<0.10	13	<3
	02-08-96	--	--	--	--	--	--	--	--
BA Bb 140	02-22-95	0.4	19	1.3	54	1.0	<0.10	18	11
BA Bb 141	03-01-95	0.4	26	0.70	3.1	1.7	<0.10	16	<3
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 143	03-14-95	0.3	20	0.50	4.8	1.9	<0.10	18	5
BA Bb 144	03-20-95	0.4	26	1.9	4.4	3.5	<0.10	23	18
BA Bb 145	03-21-95	0.3	22	0.60	3.1	3.8	<0.10	18	8
BA Bb 147	05-18-95	0.5	42	0.40	3.2	0.10	<0.10	12	<3
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 148	06-20-95	0.4	20	2.3	21	0.60	<0.10	8.3	4
BA Bb 150	07-24-95	0.7	22	2.9	68	11	<0.10	8.9	41
BA Bb 151	07-24-95	0.3	10	1.7	74	3.4	<0.10	20	29
BA Bc 264	08-22-96	0.3	30	0.60	4.1	1.6	<0.10	7.3	<3
BA Bc 267	12-21-94	0.6	21	2.2	82	6.8	<0.10	14	4
	12-12-95	--	--	--	91	--	--	--	--
BA Bc 268	12-13-94	0.3	19	0.90	7.4	2.3	<0.10	14	32
BA Bc 270	04-11-95	0.3	28	0.60	2.7	<0.10	<0.10	7.8	<3
BA Bc 271	04-19-95	0.2	16	0.50	2.2	2.9	<0.10	13	<3
BA Bc 272	05-16-95	1	45	0.80	29	1.3	<0.10	8.9	<3
BA Bc 273	05-18-95	3	52	1.8	190	0.70	<0.10	13	24
BA Bc 274	06-07-95	0.3	17	0.70	16	1.6	<0.10	14	<3
	08-08-96	--	--	--	--	--	--	--	--
BA Bc 275	07-05-95	1	32	5.7	230	3.4	<0.10	18	110
BA Bd 224	09-28-94	0.3	23	1.3	3.6	0.70	<0.10	11	<3
	08-06-96	--	--	--	--	--	--	--	--
BA Bd 225	11-21-94	0.3	20	0.60	6.9	0.70	<0.10	8.2	<3
BA Bd 226	12-12-94	0.3	13	0.70	8.8	2.7	<0.10	13	<3
BA Bd 227	12-07-94	0.3	14	1.4	17	0.60	<0.10	11	<3
BA Bd 229	01-11-95	0.8	44	0.60	20	7.5	<0.10	8.8	<3
	01-19-95	--	--	--	--	--	--	--	--
BA Bd 231	05-23-95	0.1	2	0.90	2.3	17	<0.10	16	8
BA Bd 232	07-19-95	0.5	40	0.90	5.0	0.60	<0.10	11	7
BA Bd 233	10-15-96	0.4	23	0.90	9.6	0.50	<0.10	15	<3
BA Bd 234	10-16-96	0.3	17	0.90	9.5	0.40	<0.10	12	4
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 235	10-15-96	0.3	19	1.0	10	11	<0.10	13	<3
BA Bd 236	10-16-96	0.4	20	0.9	9.8	17	<0.10	14	<3
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 237	10-23-96	0.3	17	1.1	16	<0.10	<0.10	12	<3
BA Bd 238	10-23-96	0.4	28	0.7	5.5	0.10	<0.10	11	<3
BA Be 36	08-31-94	1	43	3.6	64	25	<0.10	12	5

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Iron (unfiltered) (µg/L)	Manganese (filtered) (µg/L)	Manganese (unfiltered) (µg/L)	Total organic carbon (mg/L)	Chemical oxygen demand (mg/L)	Methylene blue active substances (mg/L)	Nitrate plus nitrite (mg/L as N)
BA Ab 51	04-18-95	160	29	40	1.6	--	<0.02	8.20
	02-07-96	--	--	--	--	<10	--	8.50
BA Ab 52	07-06-95	50	6	<10	0.40	--	<0.02	4.30
BA Ac 151	11-30-94	1600	2	<10	0.10	--	<0.02	0.840
BA Ac 152	08-26-96	<10	<1	<10	0.20	--	<0.02	1.60
BA Ad 145	12-01-94	2600	16	30	1.1	--	<0.02	6.80
	08-26-96	--	--	--	--	<10	--	7.50
BA Ad 146	03-27-95	140	<1	10	0.90	--	<0.02	0.310
	02-09-96	--	--	--	--	--	--	--
	08-22-96	<10	<1	<10	--	--	--	0.200
BA Ad 147	05-11-95	40	13	20	0.80	--	<0.02	9.00
	02-08-96	--	--	--	--	<10	--	8.30
BA Ad 148	05-16-95	70	1	<10	0.30	--	<0.02	9.10
BA Ad 149	05-23-95	40	<1	<10	0.10	--	<0.02	0.800
BA Ae 19	11-21-94	4000	3	10	0.10	--	0.02	0.180
BA Bb 136	09-21-94	110	58	60	0.90	--	<0.02	4.90
BA Bb 138	10-31-94	120	8	20	0.60	--	0.03	9.70
BA Bb 139	12-29-94	20	<1	<10	0.40	--	<0.02	0.620
	02-08-96	--	--	--	--	--	--	--
BA Bb 140	02-22-95	60	<1	<10	0.80	--	<0.02	2.80
BA Bb 141	03-01-95	10	<1	<10	0.20	--	<0.02	<0.050
	02-09-96	--	--	--	--	--	--	--
BA Bb 143	03-14-95	380000	5	90	2.7	--	<0.02	7.50
BA Bb 144	03-20-95	17000	3	<10	0.40	--	<0.02	2.40
BA Bb 145	03-21-95	100	14	20	0.20	--	<0.02	2.30
BA Bb 147	05-18-95	20	<1	<10	0.50	--	<0.02	0.120
	02-09-96	--	--	--	--	--	--	--
BA Bb 148	06-20-95	<10	110	110	0.10	--	<0.02	9.10
BA Bb 150	07-24-95	110	41	40	--	--	--	7.50
BA Bb 151	07-24-95	12000	7	290	0.40	--	<0.02	9.00
BA Bc 264	08-22-96	<10	<1	<10	0.20	<10	<0.02	1.00
BA Bc 267	12-21-94	840	7	10	0.50	--	<0.02	8.50
	12-12-95	--	--	--	--	<10	--	11.0
BA Bc 268	12-13-94	320	3	<10	0.80	--	0.04	2.90
BA Bc 270	04-11-95	6400	9	30	4.3	--	<0.02	3.40
BA Bc 271	04-19-95	20	4	<10	2.1	--	<0.02	0.110
BA Bc 272	05-16-95	10	59	60	1.3	--	<0.02	3.60
BA Bc 273	05-18-95	80	39	40	0.40	--	<0.02	0.590
BA Bc 274	06-07-95	1000	7	<10	0.30	--	0.03	4.70
	08-08-96	--	--	--	--	--	--	--
BA Bc 275	07-05-95	130	96	130	0.70	--	0.08	2.10
BA Bd 224	09-28-94	20	1	<10	0.30	--	<0.02	2.90
	08-06-96	--	--	--	--	--	--	--
BA Bd 225	11-21-94	40	3	<10	0.20	--	0.05	4.70
BA Bd 226	12-12-94	<10	6	<10	0.10	--	<0.02	6.10
BA Bd 227	12-07-94	<10	<1	<10	0.20	--	<0.02	16.0
BA Bd 229	01-11-95	10	<1	<10	0.30	--	<0.02	2.50
	01-19-95	--	--	--	--	--	--	--
BA Bd 231	05-23-95	130	<1	10	1.7	--	<0.02	1.00
BA Bd 232	07-19-95	<10	2	<10	0.20	--	<0.02	1.10
BA Bd 233	10-15-96	<10	3	<10	0.20	--	<0.02	9.90
BA Bd 234	10-16-96	<10	8	10	0.30	--	<0.02	7.40
	10-29-96	--	--	--	--	--	--	--
BA Bd 235	10-15-96	<10	2	<10	0.20	--	<0.02	5.10
BA Bd 236	10-16-96	<10	3	<10	0.40	--	<0.02	7.50
	10-29-96	--	--	--	--	--	--	--
BA Bd 237	10-23-96	<10	2	<10	0.30	--	<0.02	5.30
BA Bd 238	10-23-96	<10	3	<10	0.30	--	<0.02	3.60
BA Be 36	08-31-94	60	11	10	0.50	--	<0.02	2.70

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Nitrite (mg/L as N)	Phos-phorus (mg/L as P)	Ortho-phos-phorus (mg/L as P)	Ammonium (mg/L as N)	Radon-222 (pCi/L)	Tritium (pCi/L)	N15/N14 (nitrate) (per mil)	Arsenic (µg/L)
BA Ab 51	04-18-95	<0.010	<0.010	0.020	<0.015	2300	--	--	<1
	02-07-96	--	--	--	--	--	43	2.9	--
BA Ab 52	07-06-95	<0.010	<0.010	0.010	0.020	2100	--	--	<1
BA Ac 151	11-30-94	<0.010	0.020	0.030	<0.015	3700	--	--	<1
BA Ac 152	08-26-96	<0.010	0.020	0.030	<0.015	4700	--	--	<1
BA Ad 145	12-01-94	<0.010	0.560	<0.010	<0.015	5900	--	--	<1
	08-26-96	--	--	--	--	--	--	3.6	--
BA Ad 146	03-27-95	<0.010	0.020	0.020	<0.015	8400	--	--	<1
	02-09-96	--	--	--	--	--	40	--	--
	08-22-96	<0.010	<0.010	0.030	<0.015	--	--	--	--
BA Ad 147	05-11-95	<0.010	0.020	0.010	<0.015	4300	--	--	<1
	02-08-96	--	--	--	--	--	--	2.5	--
BA Ad 148	05-16-95	<0.010	<0.010	<0.010	0.020	520	--	--	<1
BA Ad 149	05-23-95	<0.010	<0.010	0.020	0.020	4100	--	--	<1
BA Ae 19	11-21-94	<0.010	0.010	0.010	<0.015	4200	--	--	<1
BA Bb 136	09-21-94	<0.010	<0.010	<0.010	0.020	1200	--	--	<1
BA Bb 138	10-31-94	<0.010	0.040	0.020	<0.015	3300	--	--	<1
BA Bb 139	12-29-94	<0.010	0.060	0.030	<0.015	1900	--	--	<1
	02-08-96	--	--	--	--	--	33	--	--
BA Bb 140	02-22-95	<0.010	0.030	0.030	0.020	4600	--	--	<1
BA Bb 141	03-01-95	<0.010	0.020	<0.010	<0.015	1200	--	--	<1
	02-09-96	--	--	--	--	--	45	--	--
BA Bb 143	03-14-95	<0.010	<0.010	<0.010	0.020	670	--	--	<1
BA Bb 144	03-20-95	<0.010	0.020	0.020	<0.015	1800	--	--	<1
BA Bb 145	03-21-95	<0.010	<0.010	0.020	<0.015	2700	--	--	<1
BA Bb 147	05-18-95	<0.010	0.050	0.050	<0.015	3000	--	--	<1
	02-09-96	--	--	--	--	--	50	--	--
BA Bb 148	06-20-95	<0.010	0.010	<0.010	0.030	4500	--	--	<1
BA Bb 150	07-24-95	<0.010	<0.010	<0.010	<0.015	--	--	--	--
BA Bb 151	07-24-95	<0.010	<0.010	0.020	<0.015	110	--	--	<1
BA Bc 264	08-22-96	<0.010	0.020	0.030	0.020	--	35	2.9	<1
BA Bc 267	12-21-94	<0.010	0.010	0.030	<0.015	2900	--	--	<1
	12-12-95	--	--	--	--	--	--	5.1	--
BA Bc 268	12-13-94	<0.010	0.010	<0.010	<0.015	3100	--	--	<1
BA Bc 270	04-11-95	<0.010	0.020	0.030	<0.015	3300	--	--	<1
BA Bc 271	04-19-95	<0.010	0.020	0.020	<0.015	3900	--	--	<1
BA Bc 272	05-16-95	<0.010	0.030	0.030	0.020	2100	--	--	<1
BA Bc 273	05-18-95	<0.010	<0.010	<0.010	<0.015	2900	--	--	<1
BA Bc 274	06-07-95	<0.010	<0.010	0.020	0.020	8300	--	--	<1
	08-08-96	--	--	--	--	--	52	--	--
BA Bc 275	07-05-95	<0.010	<0.010	<0.010	<0.015	--	--	--	<1
BA Bd 224	09-28-94	<0.010	<0.010	<0.010	0.020	1800	--	--	<1
	08-06-96	--	--	--	--	--	38	--	--
BA Bd 225	11-21-94	<0.010	0.020	0.010	<0.015	2400	--	--	<1
BA Bd 226	12-12-94	<0.010	0.010	<0.010	<0.015	4000	--	--	<1
BA Bd 227	12-07-94	<0.010	<0.010	<0.010	<0.015	4300	--	--	<1
BA Bd 229	01-11-95	<0.010	0.020	0.020	<0.015	--	--	--	<1
	01-19-95	--	--	--	--	4800	--	--	--
BA Bd 231	05-23-95	<0.010	<0.010	0.010	<0.015	81	--	--	<1
BA Bd 232	07-19-95	<0.010	<0.010	<0.010	<0.015	4600	--	--	<1
BA Bd 233	10-15-96	0.010	0.040	0.040	0.030	2600	42	2.6	<1
BA Bd 234	10-16-96	<0.010	<0.010	0.020	0.030	--	44	2.5	<1
	10-29-96	--	--	--	--	1400	--	--	--
BA Bd 235	10-15-96	0.010	0.040	0.040	0.030	1600	44	1.7	<1
BA Bd 236	10-16-96	<0.010	0.050	0.030	0.030	2200	46	--	<1
	10-29-96	--	--	--	--	--	--	0.4	--
BA Bd 237	10-23-96	<0.010	0.010	0.030	<0.015	2200	43	1.1	<1
BA Bd 238	10-23-96	<0.010	0.020	0.030	<0.015	2100	37	2.2	<1
BA Be 36	08-31-94	<0.010	<0.010	0.020	0.010	4500	--	--	<1

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Antimony (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Chromium (µg/L)	Cyanide (µg/L)	Lead (µg/L)
BA Ab 51	04-18-95	<1	24	<10	<1.0	64	<1	<0.01	16
	02-07-96	--	--	--	--	--	--	--	--
BA Ab 52	07-06-95	<1	29	<10	<1.0	11	<1	<0.01	<1
BA Ac 151	11-30-94	<1	<2	<0.5	<1.0	6	<1	<0.01	<1
BA Ac 152	08-26-96	<1	8	<0.5	<1.0	<1	<1	--	<1
BA Ad 145	12-01-94	<1	<2	<0.5	<1.0	4	<1	<0.01	<1
	08-26-96	--	--	--	--	--	--	--	--
BA Ad 146	03-27-95	<1	<2	<10	<1.0	15	<1	<0.01	4
	02-09-96	--	--	--	--	--	--	--	--
	08-22-96	--	--	--	--	--	--	--	--
BA Ad 147	05-11-95	<1	16	<10	<1.0	15	<1	<0.01	2
	02-08-96	--	--	--	--	--	--	--	--
BA Ad 148	05-16-95	<1	6	<10	<1.0	22	<1	<0.01	<1
BA Ad 149	05-23-95	<1	<2	<10	<1.0	6	<1	<0.01	<1
BA Ae 19	11-21-94	<1	4	<0.5	<1.0	10	<1	<0.01	2
BA Bb 136	09-21-94	<1	33	<0.5	<1.0	410	<1	<0.01	9
BA Bb 138	10-31-94	<1	11	<0.5	<1.0	74	<1	<0.01	8
BA Bb 139	12-29-94	<1	3	<10	<1.0	9	<1	<0.01	2
	02-08-96	--	--	--	--	--	--	--	--
BA Bb 140	02-22-95	<1	6	<10	<1.0	2	<1	<0.01	<1
BA Bb 141	03-01-95	<1	6	<10	<1.0	10	<1	<0.01	<1
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 143	03-14-95	<1	<2	<10	<1.0	8	<1	<0.01	<1
BA Bb 144	03-20-95	<1	<2	<10	<1.0	2	<1	<0.01	<1
BA Bb 145	03-21-95	<1	<2	<10	<1.0	8	<1	<0.01	<1
BA Bb 147	05-18-95	<1	<2	<10	<1.0	12	<1	<0.01	<1
	02-09-96	--	--	--	--	--	--	--	--
BA Bb 148	06-20-95	<1	75	<10	<1.0	22	<1	<0.01	12
BA Bb 150	07-24-95	--	--	--	--	--	--	--	--
BA Bb 151	07-24-95	<1	60	<10	<1.0	1	<1	<0.01	<1
BA Bc 264	08-22-96	<1	5	0.8	<1.0	<1	<1	--	<1
BA Bc 267	12-21-94	<1	44	<0.5	<1.0	34	<1	<0.01	2
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<1	3	<0.5	<1.0	10	<1	<0.01	<1
BA Bc 270	04-11-95	<1	<2	<10	<1.0	23	<1	<0.01	4
BA Bc 271	04-19-95	<1	10	<10	<1.0	9	<1	<0.01	<1
BA Bc 272	05-16-95	<1	21	<10	<1.0	53	<1	<0.01	4
BA Bc 273	05-18-95	<1	190	<10	<1.0	23	<1	<0.01	6
BA Bc 274	06-07-95	<1	18	<10	<1.0	9	<1	<0.01	<1
	08-08-96	--	--	--	--	--	--	--	--
BA Bc 275	07-05-95	<1	140	<10	<1.0	1	<1	<0.01	<1
BA Bd 224	09-28-94	<1	13	<0.5	<1.0	210	<1	<0.01	2
	08-06-96	--	--	--	--	--	--	--	--
BA Bd 225	11-21-94	<1	14	<0.5	<1.0	11	<1	<0.01	2
BA Bd 226	12-12-94	<1	7	<0.5	<1.0	2	<1	<0.01	3
BA Bd 227	12-07-94	<1	33	<0.5	<1.0	5	<1	<0.01	3
BA Bd 229	01-11-95	<1	12	<10	<1.0	10	<1	<0.01	<1
	01-19-95	--	--	--	--	--	--	--	--
BA Bd 231	05-23-95	<1	7	<10	<1.0	5	10	<0.01	1
BA Bd 232	07-19-95	<1	8	<10	<1.0	16	<1	<0.01	2
BA Bd 233	10-15-96	<1	11	<0.5	<1.0	10	<1	--	<1
BA Bd 234	10-16-96	<1	11	<0.5	<1.0	18	1	--	1
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 235	10-15-96	<1	2	<0.5	<1.0	2	<1	--	<1
BA Bd 236	10-16-96	<1	3	<0.5	<1.0	5	<1	--	<1
	10-29-96	--	--	--	--	--	--	--	--
BA Bd 237	10-23-96	<1	6	<0.5	<1.0	9	<1	--	<1
BA Bd 238	10-23-96	<1	3	<0.5	<1.0	6	<1	--	<1
BA Be 36	08-31-94	<1	46	<0.5	<1.0	100	<1	<0.01	5

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Lithium (µg/L)	Mercury (µg/L)	Nickel (µg/L)	Selenium (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Zinc (µg/L)
BA Ab 51	04-18-95	--	<0.1	2	<1	--	<1	20
	02-07-96	<4	--	--	--	36	--	--
BA Ab 52	07-06-95	--	<0.1	<1	<1	--	<1	<10
BA Ac 151	11-30-94	--	<0.1	<1	<1	--	<1	<3
BA Ac 152	08-26-96	--	--	<1	<1	--	<1	<3
BA Ad 145	12-01-94	--	<0.1	<1	<1	--	<1	<3
	08-26-96	5	--	--	--	95	--	--
BA Ad 146	03-27-95	--	<0.1	<1	<1	--	<1	<10
	02-09-96	--	--	--	--	--	--	--
	08-22-96	--	--	--	--	--	--	--
BA Ad 147	05-11-95	--	<0.1	<1	<1	--	<1	<10
	02-08-96	<4	--	--	--	42	--	--
BA Ad 148	05-16-95	--	<0.1	<1	<1	--	<1	<10
BA Ad 149	05-23-95	--	<0.1	<1	<1	--	<1	<10
BA Ae 19	11-21-94	--	<0.1	<1	<1	--	<1	<3
BA Bb 136	09-21-94	--	<0.1	3	<1	--	<1	58
BA Bb 138	10-31-94	--	<0.1	1	<1	--	--	11
BA Bb 139	12-29-94	--	<0.1	<1	<1	--	<1	<10
	02-08-96	--	--	--	--	--	--	--
BA Bb 140	02-22-95	--	<0.1	<1	<1	--	<1	<10
BA Bb 141	03-01-95	--	<0.1	<1	<1	--	<1	<10
	02-09-96	--	--	--	--	--	--	--
BA Bb 143	03-14-95	--	<0.1	<1	<1	--	<1	<10
BA Bb 144	03-20-95	--	<0.1	<1	<1	--	<1	<10
BA Bb 145	03-21-95	--	<0.1	<1	<1	--	<1	<10
BA Bb 147	05-18-95	--	<0.1	<1	<1	--	<1	<10
	02-09-96	--	--	--	--	--	--	--
BA Bb 148	06-20-95	--	<0.1	2	<1	--	<1	<10
BA Bb 150	07-24-95	--	--	--	--	--	--	--
BA Bb 151	07-24-95	--	<0.1	<1	<1	--	<1	20
BA Bc 264	08-22-96	4	--	<1	<1	12	<1	10
BA Bc 267	12-21-94	--	<0.1	1	<1	--	<1	<3
	12-12-95	<4	--	--	--	300	--	--
BA Bc 268	12-13-94	--	0.1	<1	<1	--	<1	3
BA Bc 270	04-11-95	--	<0.1	<1	<1	--	<1	<10
BA Bc 271	04-19-95	--	<0.1	<1	<1	--	<1	<10
BA Bc 272	05-16-95	--	<0.1	<1	<1	--	<1	20
BA Bc 273	05-18-95	--	0.1	9	<1	--	<1	40
BA Bc 274	06-07-95	--	<0.1	<1	<1	--	<1	<10
	08-08-96	--	--	--	--	--	--	--
BA Bc 275	07-05-95	--	0.2	7	<1	--	<1	<10
BA Bd 224	09-28-94	--	<0.1	<1	<1	--	<1	4
	08-06-96	--	--	--	--	--	--	--
BA Bd 225	11-21-94	--	<0.1	1	<1	--	<1	14
BA Bd 226	12-12-94	--	<0.1	<1	<1	--	<1	5
BA Bd 227	12-07-94	--	<0.1	<1	<1	--	<1	<3
BA Bd 229	01-11-95	--	0.1	<1	<1	--	<1	<10
	01-19-95	--	--	--	--	--	--	--
BA Bd 231	05-23-95	--	<0.1	4	<1	--	<1	<10
BA Bd 232	07-19-95	--	<0.1	<1	<1	--	<1	<10
BA Bd 233	10-15-96	--	--	2	<1	--	<1	4
BA Bd 234	10-16-96	--	--	3	<1	--	<1	19
	10-29-96	--	--	--	--	--	--	--
BA Bd 235	10-15-96	--	--	1	<1	--	<1	7
BA Bd 236	10-16-96	--	--	2	<1	--	<1	<3
	10-29-96	--	--	--	--	--	--	--
BA Bd 237	10-23-96	--	--	2	<1	--	<1	9
BA Bd 238	10-23-96	--	--	<1	<1	--	<1	8
BA Be 36	08-31-94	--	<0.1	1	2	--	<1	10

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Site number	Date	Discharge (gal/min)	Water level (feet below land surface)	Water temperature (deg. C)	Specific conductance (µS/cm)	pH	Alkalinity (mg/L as $CaCO_3$)
BA Be 37	393708076345501	09-15-94	10	--	12.0	198	5.7	6
BA Be 38	393519076344701	01-19-95	3.0	39.71	12.5	87	6.8	28
BA Ca 66	393355076501901	07-19-95	2.0	39.72	14.0	97	5.6	23
BA Ca 69	393222076510501	04-10-95	2.5	23.97	12.0	130	5.8	17
BA Cb 126	393241076472401	09-28-94	3.4	31.38	14.0	106	6.1	26
BA Cb 133	393028076465301	08-29-94	4.0	--	17.5	245	6.7	46
		08-07-96	1.7	--	21.0	243	6.3	--
BA Cb 134	393243076450901	09-13-94	2.6	--	13.5	178	5.3	9
		08-05-96	2.0	--	14.0	208	--	--
BA Cb 136	393119076454501	11-09-94	2.4	32.19	15.0	296	6.0	14
		12-11-95	2.8	--	12.5	307	5.7	--
BA Cb 137	393403076454201	12-22-94	3.0	--	12.5	132	5.8	12
		12-12-95	3.3	--	11.5	131	5.6	--
BA Cb 138	393237076495601	02-21-95	2.8	35.66	12.0	276	6.1	28
BA Cb 139	393228076493201	04-19-95	1.9	49.73	11.5	336	5.8	9
BA Cb 141	393456076494601	03-08-95	3.5	--	12.0	85	5.9	10
		02-07-96	1.8	63.89	11.0	88	5.6	--
BA Cb 142	393221076483401	03-22-95	1.5	--	13.0	183	6.0	31
		12-13-95	2.6	--	13.0	199	6.0	--
BA Cb 143	393114076462701	11-08-95	2.7	32.88	12.0	222	7.8	106
BA Cb 144	393036076452901	10-31-95	2.3	--	13.5	541	7.3	275
BA Cc 253	393427076412201	09-20-94	3.2	--	12.5	628	6.0	23
		12-13-95	2.5	--	12.0	645	5.9	--
BA Cc 254	393418076435301	09-22-94	1.0	--	15.0	243	5.6	17
BA Cc 255	393002076334501	11-09-94	3.0	--	13.0	253	6.0	25
BA Cc 256	393117076440101	01-04-95	4.0	15.99	13.0	150	6.0	39
BA Cc 257	393058076441701	01-18-95	2.0	--	12.5	193	6.5	53
BA Cc 258	393340076442501	03-13-95	2.0	60.18	11.5	84	5.7	15
BA Cc 259	393158076431301	10-30-95	2.0	--	13.0	207	8.0	87
BA Cd 229	393150076374201	09-14-94	3.2	--	14.0	172	5.9	40
		08-07-96	--	--	15.0	206	5.7	--
BA Cd 230	393426076361401	09-22-94	1.0	--	15.0	233	5.8	19
BA Cd 231	393402076350901	10-20-94	2.7	45.86	13.0	167	7.1	60
BA Cd 232	393442076375301	11-01-94	3.0	--	13.5	196	6.6	44
BA Cd 234	393352076365301	12-06-94	3.6	--	13.5	90	6.3	25
BA Cd 235	393313076373701	11-30-94	3.6	57.41	12.5	265	6.0	34
		08-06-96	2.0	--	13.0	179	5.9	--
BA Cd 236	393219076371901	01-11-95	4.0	--	11.5	205	6.7	52
BA Cd 237	393212076365901	04-20-95	--	--	11.5	163	5.9	39
BA Cd 238	393221076375701	05-02-95	1.5	--	12.5	280	5.8	36
BA Cd 239	393155076385301	06-19-95	2.3	--	13.0	179	5.8	23
BA Cd 241	393019076391401	06-20-95	1.3	39.30	14.5	267	7.1	96
BA Ce 309	393008076334001	09-27-94	1.0	--	17.0	119	5.6	22
BA Ce 311	393002076354001	11-14-94	3.8	--	13.0	127	5.4	10
BA Ce 312	393035076331701	04-18-95	1.5	--	11.5	76	5.4	10
BA Ce 313	393143076332601	04-24-95	1.5	17.96	12.0	105	7.1	33
BA Da 120	392731076510601	08-03-94	5.9	--	13.0	221	6.1	21
BA Da 122	392703076510301	09-21-94	2.0	--	13.0	143	5.6	22
		08-05-96	2.5	--	13.0	--	5.7	--
BA Da 123	392538076510101	05-31-95	1.5	10.87	13.5	182	6.7	65
BA Db 259	392803076455001	09-29-94	1.6	--	16.0	160	7.9	74
BA Db 261	392843076473101	11-06-95	3.6	--	12.0	177	8.0	76
BA Dc 59	392620076440001	08-27-96	45	--	13.5	226	7.8	101
BA Dc 444	392931076410301	06-23-94	4.7	35.41	13.0	275	7.8	144
		10-04-95	15	40.93	12.5	267	7.7	140
		09-20-96	6.0	36.37	12.0	281	7.8	145
BA Dc 445	392841076400201	08-04-94	3.6	--	14.5	515	7.6	186
		12-12-95	2.2	--	11.5	529	7.5	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Solids, residue at 180 deg. C (mg/L)	Solids, sum of constit-uents (mg/L)	Oxygen, dis-solved (mg/L)	Color (plat-inum cobalt units)	Calcium (mg/L)	Magnesium (mg/L)	Hardness (mg/L as $CaCO_3$)	Sodium (mg/L)
BA Be 37	09-15-94	124	119	6.1	<1	13	7.3	63	6.7
BA Be 38	01-19-95	66	65	7.2	33	5.0	3.2	26	4.6
BA Ca 66	07-19-95	74	71	7.9	7	8.7	2.2	31	5.1
BA Ca 69	04-10-95	68	81	7.9	8	12	3.2	43	4.6
BA Cb 126	09-28-94	78	80	8.2	<1	7.5	3.0	31	6.8
BA Cb 133	08-29-94	174	158	6.0	1	24	5.7	83	9.6
	08-07-96	--	--	--	--	--	--	--	--
BA Cb 134	09-13-94	102	108	3.3	1	9.4	7.4	54	6.6
	08-05-96	--	--	--	--	--	--	--	--
BA Cb 136	11-09-94	194	175	7.7	1	25	8.2	96	9.3
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	84	--	9.1	5	9.5	3.1	36	6.9
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	164	167	6.8	5	26	6.6	92	9.3
BA Cb 139	04-19-95	234	205	8.2	1	26	13	120	8.8
BA Cb 141	03-08-95	52	57	8.2	<1	6.5	2.4	26	3.8
	02-07-96	--	--	--	--	--	--	--	--
BA Cb 142	03-22-95	110	114	8.6	3	19	4.9	68	4.4
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	138	124	7.1	2	36	3.6	100	1.6
BA Cb 144	10-31-95	286	294	6.2	<1	64	30	280	1.7
BA Cc 253	09-20-94	382	306	7.5	<1	58	16	210	20
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	140	129	8.5	1	12	7.8	62	15
BA Cc 255	11-09-94	166	152	7.4	2	22	6.7	83	9.4
BA Cc 256	01-04-95	112	114	5.8	5	14	5.4	57	6.4
BA Cc 257	01-18-95	148	147	8.3	3	17	7.6	74	5.9
BA Cc 258	03-13-95	54	56	8.8	3	5.1	3.4	27	3.4
BA Cc 259	10-30-95	138	129	5.0	3	26	6.3	91	3.8
BA Cd 229	09-14-94	114	114	6.7	<1	15	3.8	53	9.3
	08-07-96	--	--	--	--	--	--	--	--
BA Cd 230	09-22-94	146	140	6.3	1	18	7.6	76	7.8
BA Cd 231	10-20-94	88	117	1.6	3	19	3.8	63	5.6
BA Cd 232	11-01-94	132	133	<1.0	4	13	6.9	61	6.7
BA Cd 234	12-06-94	66	78	6.9	5	6.1	2.5	26	5.1
BA Cd 235	11-30-94	172	170	8.4	<1	25	6.0	87	11
	08-06-96	--	--	--	--	--	--	--	--
BA Cd 236	01-11-95	130	136	6.1	1	15	8.4	72	6.6
BA Cd 237	04-20-95	88	103	7.5	1	15	4.6	56	6.6
BA Cd 238	05-02-95	170	163	7.0	4	21	7.1	82	15
BA Cd 239	06-19-95	132	118	8.4	5	17	3.4	56	7.2
BA Cd 241	06-20-95	170	155	2.4	5	35	4.2	100	9.4
BA Ce 309	09-27-94	72	78	7.0	2	8.5	4.3	39	3.9
BA Ce 311	11-14-94	84	49	9.2	1	6.7	4.2	34	6.4
BA Ce 312	04-18-95	50	52	7.6	3	3.7	2.9	21	4.8
BA Ce 313	04-24-95	82	82	1.2	22	10	2.6	36	4.8
BA Da 120	08-03-94	174	132	8.2	1	17	5.4	65	10
BA Da 122	09-21-94	101	92	8.8	1	10	4.1	42	7.9
	08-05-96	--	--	--	--	--	--	--	--
BA Da 123	05-31-95	128	114	2.9	35	11	9.8	68	5.0
BA Db 259	09-29-94	84	94	8.5	2	20	6.1	75	2.1
BA Db 261	11-06-95	92	98	9.4	1	22	7.3	85	1.4
BA Dc 59	08-27-96	106	126	5.5	--	34	5.4	110	1.8
BA Dc 444	06-23-94	154	152	2.1	1	34	14	140	1.5
	10-04-95	148	150	5.9	2	32	15	140	1.5
	09-20-96	--	--	2.2	--	--	--	--	--
BA Dc 445	08-04-94	298	291	7.3	1	52	25	230	2.4
	12-12-95	--	--	--	--	--	--	--	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Sodium adsorption ratio	Sodium percent	Potassium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Silica (mg/L as SiO_2)	Iron (filtered) (µg/L)
BA Be 37	09-15-94	0.4	18	1.9	21	6.4	<0.10	14	<3
BA Be 38	01-19-95	0.4	25	2.9	3.1	7.7	0.30	21	37
BA Ca 66	07-19-95	0.4	26	0.60	3.4	6.6	<0.10	19	4
BA Ca 69	04-10-95	0.3	18	0.90	11	0.50	<0.10	14	10
BA Cb 126	09-28-94	0.5	31	1.4	3.7	8.0	<0.10	21	21
BA Cb 133	08-29-94	0.5	19	4.3	15	20	<0.10	26	<3
	08-07-96	--	--	--	--	--	--	--	--
BA Cb 134	09-13-94	0.4	20	1.6	12	0.40	<0.10	11	<3
	08-05-96	--	--	--	--	--	--	--	--
BA Cb 136	11-09-94	0.4	17	2.6	49	8.9	<0.10	29	6
	12-11-95	--	--	--	50	--	--	--	--
BA Cb 137	12-22-94	0.5	28	1.1	10	<0.10	<0.10	14	4
	12-12-95	--	--	--	11	--	--	--	--
BA Cb 138	02-21-95	0.4	18	1.0	32	2.3	<0.10	20	25
BA Cb 139	04-19-95	0.4	14	1.4	22	15	<0.10	15	7
BA Cb 141	03-08-95	0.3	24	0.60	4.2	1.3	<0.10	8.5	38
	02-07-96	--	--	--	--	--	--	--	--
BA Cb 142	03-22-95	0.2	12	1.6	6.8	20	<0.10	12	4
	12-13-95	--	--	--	10	--	--	--	--
BA Cb 143	11-08-95	0.1	3	1.7	2.5	1.7	<0.10	8.7	<3
BA Cb 144	10-31-95	0.0	1	1.3	5.2	7.1	0.20	12	<3
BA Cc 253	09-20-94	0.6	17	3.8	170	0.50	<0.10	23	7
	12-13-95	--	--	--	170	--	--	--	--
BA Cc 254	09-22-94	0.8	33	2.6	49	0.90	<0.10	12	<3
BA Cc 255	11-09-94	0.5	19	2.1	41	7.6	<0.10	30	<3
BA Cc 256	01-04-95	0.4	19	1.3	3.4	20	<0.10	33	<3
BA Cc 257	01-18-95	0.3	15	1.1	3.9	12	<0.10	45	<3
BA Cc 258	03-13-95	0.3	21	1.5	5.2	0.50	<0.10	11	7
BA Cc 259	10-30-95	0.2	8	2.3	4.0	4.4	0.20	21	4
BA Cd 229	09-14-94	0.6	27	2.3	9.4	14	0.10	23	<3
	08-07-96	--	--	--	--	--	--	--	--
BA Cd 230	09-22-94	0.4	17	3.0	33	23	<0.10	24	<3
BA Cd 231	10-20-94	0.3	15	3.4	5.0	13	0.10	30	140
BA Cd 232	11-01-94	0.4	18	4.2	4.2	39	0.10	32	4900
BA Cd 234	12-06-94	0.4	28	2.1	3.0	10	<0.10	29	6
BA Cd 235	11-30-94	0.5	21	3.4	21	41	<0.10	28	4
	08-06-96	--	--	--	--	--	--	--	--
BA Cd 236	01-11-95	0.3	16	3.3	11	2.8	<0.10	27	4
BA Cd 237	04-20-95	0.4	19	3.6	6.9	19	<0.10	15	<3
BA Cd 238	05-02-95	0.7	28	2.3	34	9.6	<0.10	23	<3
BA Cd 239	06-19-95	0.4	21	2.6	13	10	<0.10	23	5
BA Cd 241	06-20-95	0.4	16	3.2	6.8	21	0.30	16	<3
BA Ce 309	09-27-94	0.3	17	2.3	7.2	8.4	<0.10	15	13
BA Ce 311	11-14-94	0.5	28	1.9	11	0.40	<0.10	13	6
BA Ce 312	04-18-95	0.5	31	1.5	8.3	0.30	<0.10	11	6
BA Ce 313	04-24-95	0.3	21	2.7	1.6	10	0.20	28	120
BA Da 120	08-03-94	0.5	24	2.3	37	7.8	<0.10	23	13
BA Da 122	09-21-94	0.5	28	1.5	15	0.90	<0.10	15	<3
	08-05-96	--	--	--	--	--	--	--	--
BA Da 123	05-31-95	0.3	13	3.8	11	3.7	<0.10	28	28
BA Db 259	09-29-94	0.1	6	1.5	4.8	2.5	<0.10	12	<3
BA Db 261	11-06-95	0.1	3	1.1	1.2	0.50	<0.10	9.2	<3
BA Dc 59	08-27-96	0.1	3	1.1	2.9	2.1	<0.10	11	<3
BA Dc 444	06-23-94	0.0	2	1.5	3.1	1.4	<0.10	9.3	11
	10-04-95	0.0	2	1.6	3.4	1.1	<0.10	9.2	4
	09-20-96	--	--	--	--	--	--	--	--
BA Dc 445	08-04-94	0.1	2	9.2	17	13	<0.10	16	<3
	12-12-95	--	--	--	18	--	--	--	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Iron (unfiltered) (µg/L)	Manganese (filtered) (µg/L)	Manganese (unfiltered) (µg/L)	Total organic carbon (mg/L)	Chemical oxygen demand (mg/L)	Methylene blue active substances (mg/L)	Nitrate plus nitrite (mg/L as N)
BA Be 37	09-15-94	10	4	10	0.40	--	<0.02	9.80
BA Be 38	01-19-95	17000	24	40	0.50	--	<0.02	<0.050
BA Ca 66	07-19-95	670	2	<10	0.60	--	<0.02	2.30
BA Ca 69	04-10-95	7600	4	20	0.40	--	<0.02	5.40
BA Cb 126	09-28-94	<10	<1	<10	0.50	--	<0.02	2.90
BA Cb 133	08-29-94	<10	4	<10	0.70	--	<0.02	6.30
	08-07-96	--	--	--	--	<10	--	6.70
BA Cb 134	09-13-94	10	210	220	0.30	--	<0.02	12.0
	08-05-96	--	--	--	--	<10	--	13.0
BA Cb 136	11-09-94	210	<1	<10	0.30	--	<0.02	7.40
	12-11-95	--	--	--	--	<10	--	7.60
BA Cb 137	12-22-94	140	7	<10	0.40	--	<0.02	8.10
	12-12-95	--	--	--	--	<10	--	7.80
BA Cb 138	02-21-95	9200	6	<10	0.50	--	<0.02	12.0
BA Cb 139	04-19-95	90	3	<10	0.60	--	0.02	21.0
BA Cb 141	03-08-95	500	14	20	2.2	--	<0.02	5.30
	02-07-96	--	--	--	--	<10	--	6.00
BA Cb 142	03-22-95	330	<1	<10	7.7	--	<0.02	6.10
	12-13-95	--	--	--	--	--	--	6.20
BA Cb 143	11-08-95	80	<1	<10	0.20	--	<0.02	1.30
BA Cb 144	10-31-95	20	<1	<10	0.30	--	<0.02	2.90
BA Cc 253	09-20-94	150	6	10	0.20	--	<0.02	0.200
	12-13-95	--	--	--	--	--	--	0.230
BA Cc 254	09-22-94	20	<1	<10	0.60	--	<0.02	4.20
BA Cc 255	11-09-94	10	<1	<10	0.40	--	<0.02	2.90
BA Cc 256	01-04-95	380	<1	<10	0.30	--	<0.02	1.40
BA Cc 257	01-18-95	450	<1	<10	1.5	--	<0.02	4.30
BA Cc 258	03-13-95	110	5	<10	0.90	--	<0.02	3.90
BA Cc 259	10-30-95	130	<1	10	2.5	--	<0.02	2.70
BA Cd 229	09-14-94	<10	3	<10	0.50	--	<0.02	3.00
	08-07-96	--	--	--	--	<10	--	4.80
BA Cd 230	09-22-94	20	4	<10	0.60	--	<0.02	2.60
BA Cd 231	10-20-94	2200	39	60	0.10	--	<0.02	0.260
BA Cd 232	11-01-94	10000	43	60	0.30	--	<0.02	0.060
BA Cd 234	12-06-94	800	4	10	0.10	--	<0.02	1.20
BA Cd 235	11-30-94	100	2	<10	0.90	--	<0.02	3.10
	08-06-96	--	--	--	--	<10	--	2.70
BA Cd 236	01-11-95	10	<1	<10	0.30	--	<0.02	7.70
BA Cd 237	04-20-95	20	<1	<10	2.6	--	<0.02	2.10
BA Cd 238	05-02-95	1100	3	10	3.4	--	0.21	5.70
BA Cd 239	06-19-95	40	<1	<10	0.40	--	<0.02	5.80
BA Cd 241	06-20-95	10	23	30	0.70	--	<0.02	0.130
BA Ce 309	09-27-94	20	2	<10	0.90	--	<0.02	3.30
BA Ce 311	11-14-94	130	4	<10	0.40	--	<0.02	--
BA Ce 312	04-18-95	20	4	<10	1.4	--	<0.02	2.70
BA Ce 313	04-24-95	22000	25	50	1.8	--	0.03	0.060
BA Da 120	08-03-94	170	2	<10	0.50	--	<0.02	3.70
BA Da 122	09-21-94	70	<1	<10	0.50	--	<0.02	5.40
	08-05-96	--	--	--	--	<10	--	5.90
BA Da 123	05-31-95	10000	68	100	3.4	--	0.08	0.620
BA Db 259	09-29-94	<10	<1	<10	0.10	--	<0.02	0.180
BA Db 261	11-06-95	60	<1	10	0.30	--	<0.02	0.320
BA Dc 59	08-27-96	20	<1	<10	0.90	--	<0.02	0.720
BA Dc 444	06-23-94	250	1	<10	0.40	--	--	0.210
	10-04-95	1300	<1	30	--	--	--	--
	09-20-96	--	--	--	--	--	--	0.200
BA Dc 445	08-04-94	20	<1	<10	1.7	--	<0.02	9.00
	12-12-95	--	--	--	--	--	--	8.80

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Nitrite (mg/L as N)	Phos-phorus (mg/L as P)	Ortho-phos-phorus (mg/L as P)	Ammonium (mg/L as N)	Radon-222 (pCi/L)	Tritium (pCi/L)	N15/N14 (nitrate) (per mil)	Arsenic (µg/L)
BA Be 37	09-15-94	<0.010	0.030	0.020	0.010	2500	--	--	<1
BA Be 38	01-19-95	<0.010	<0.010	<0.010	<0.015	1700	--	--	3
BA Ca 66	07-19-95	<0.010	0.050	0.060	0.020	3200	--	--	<1
BA Ca 69	04-10-95	<0.010	<0.010	<0.010	<0.015	2600	--	--	<1
BA Cb 126	09-28-94	<0.010	0.050	0.030	0.020	5200	--	--	<1
BA Cb 133	08-29-94	0.010	<0.010	<0.010	0.010	2700	--	--	<1
	08-07-96	--	--	--	--	--	--	3.6	--
BA Cb 134	09-13-94	<0.010	<0.010	<0.010	0.010	5000	--	--	<1
	08-05-96	--	--	--	--	--	36	7.0	--
BA Cb 136	11-09-94	<0.010	0.010	0.010	<0.015	2800	--	--	<1
	12-11-95	--	--	--	--	--	49	2.8	--
BA Cb 137	12-22-94	<0.010	0.040	0.020	<0.015	4300	--	--	<1
	12-12-95	--	--	--	--	--	--	2.7	--
BA Cb 138	02-21-95	<0.010	<0.010	0.010	<0.015	4100	--	--	<1
BA Cb 139	04-19-95	<0.010	0.010	0.050	<0.015	2800	--	--	<1
BA Cb 141	03-08-95	<0.010	<0.010	<0.010	<0.015	5400	--	--	<1
	02-07-96	--	--	--	--	--	--	2.0	--
BA Cb 142	03-22-95	<0.010	<0.010	<0.010	<0.015	5200	--	--	<1
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.010	<0.010	<0.010	<0.015	110	--	--	<1
BA Cb 144	10-31-95	<0.010	<0.010	<0.010	<0.015	1100	--	--	<1
BA Cc 253	09-20-94	<0.010	<0.010	<0.010	0.030	5300	--	--	<1
	12-13-95	--	--	--	--	--	46	--	--
BA Cc 254	09-22-94	<0.010	0.010	<0.010	<0.010	5500	--	--	<1
BA Cc 255	11-09-94	<0.010	0.020	0.020	<0.015	1200	--	--	<1
BA Cc 256	01-04-95	<0.010	0.030	0.030	<0.015	1100	--	--	<1
BA Cc 257	01-18-95	<0.010	0.020	0.020	0.020	420	--	--	<1
BA Cc 258	03-13-95	<0.010	<0.010	<0.010	<0.015	2700	--	--	<1
BA Cc 259	10-30-95	<0.010	<0.010	0.010	<0.015	480	--	--	<1
BA Cd 229	09-14-94	<0.010	0.050	0.030	<0.010	890	--	--	<1
	08-07-96	--	--	--	--	--	--	4.6	--
BA Cd 230	09-22-94	<0.010	0.040	0.040	<0.010	2600	--	--	<1
BA Cd 231	10-20-94	<0.010	<0.010	0.020	<0.015	650	--	--	<1
BA Cd 232	11-01-94	<0.010	<0.010	<0.010	<0.015	7200	--	--	<1
BA Cd 234	12-06-94	<0.010	0.030	0.010	<0.015	5300	--	--	<1
BA Cd 235	11-30-94	<0.010	0.010	0.010	<0.015	2600	--	--	<1
	08-06-96	--	--	--	--	--	--	5.0	--
BA Cd 236	01-11-95	<0.010	0.030	<0.010	0.020	3900	--	--	<1
BA Cd 237	04-20-95	<0.010	<0.010	0.020	<0.015	4500	--	--	<1
BA Cd 238	05-02-95	0.020	0.040	0.030	<0.015	290	--	--	<1
BA Cd 239	06-19-95	<0.010	0.020	0.020	<0.015	1500	--	--	<1
BA Cd 241	06-20-95	0.030	0.030	<0.010	0.030	180	--	--	<1
BA Ce 309	09-27-94	<0.010	0.010	0.020	<0.010	270	--	--	<1
BA Ce 311	11-14-94	--	--	--	--	3800	--	--	<1
BA Ce 312	04-18-95	<0.010	0.020	0.010	<0.015	390	--	--	<1
BA Ce 313	04-24-95	<0.010	0.010	0.010	<0.015	1000	--	--	<1
BA Da 120	08-03-94	<0.010	0.030	0.040	0.020	6200	--	--	<1
BA Da 122	09-21-94	<0.010	0.020	0.010	0.020	6200	--	--	<1
	08-05-96	--	--	--	--	--	--	4.8	--
BA Da 123	05-31-95	<0.010	0.050	0.050	0.030	5000	--	--	<1
BA Db 259	09-29-94	<0.010	<0.010	<0.010	<0.010	1200	--	--	<1
BA Db 261	11-06-95	<0.010	<0.010	<0.010	<0.015	360	--	--	<1
BA Dc 59	08-27-96	<0.010	<0.010	0.020	<0.015	<46	--	--	<1
BA Dc 444	06-23-94	<0.010	0.010	<0.010	0.020	410	--	--	<1
	10-04-95	--	--	--	--	--	--	--	--
	09-20-96	<0.010	<0.010	<0.010	<0.020	--	--	--	--
BA Dc 445	08-04-94	<0.010	<0.010	<0.010	0.020	890	--	--	<1
	12-12-95	--	--	--	--	--	53	--	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Antimony (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Chromium (µg/L)	Cyanide (µg/L)	Lead (µg/L)
BA Be 37	09-15-94	<1	51	<0.5	<1.0	<1	<1	<0.01	<1
BA Be 38	01-19-95	<1	14	<0.5	<1.0	<1	<1	<0.01	<1
BA Ca 66	07-19-95	<1	<2	<10	<1.0	17	<1	<0.01	<1
BA Ca 69	04-10-95	<1	7	<10	<1.0	9	<1	<0.01	<1
BA Cb 126	09-28-94	<1	4	<0.5	<1.0	15	<1	<0.01	1
BA Cb 133	08-29-94	<1	59	<0.5	<1.0	2	<1	<0.01	<1
	08-07-96	--	--	--	--	--	--	--	--
BA Cb 134	09-13-94	<1	42	<0.5	<1.0	64	<1	<0.01	6
	08-05-96	--	--	--	--	--	--	--	--
BA Cb 136	11-09-94	<1	100	<0.5	<1.0	18	<1	<0.01	2
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<1	<2	<0.5	<1.0	9	<1	<0.01	<1
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<1	<2	<10	<1.0	5	<1	<0.01	<1
BA Cb 139	04-19-95	<1	15	<10	<1.0	16	1	<0.01	3
BA Cb 141	03-08-95	<1	8	<10	<1.0	9	<1	<0.01	1
	02-07-96	--	--	--	--	--	--	--	--
BA Cb 142	03-22-95	<1	9	<10	<1.0	9	<1	<0.01	1
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<1	<100	<10	<1.0	12	<1	<0.01	<1
BA Cb 144	10-31-95	<1	<100	<10	<1.0	2	<1	<0.01	1
BA Cc 253	09-20-94	<1	160	<0.5	<1.0	16	<1	<0.01	3
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	<1	10	<0.5	<1.0	390	<1	<0.01	6
BA Cc 255	11-09-94	<1	69	<0.5	<1.0	40	<1	<0.01	4
BA Cc 256	01-04-95	<1	92	<10	<1.0	12	2	<0.01	<1
BA Cc 257	01-18-95	<1	24	<10	<1.0	6	6	<0.01	2
BA Cc 258	03-13-95	<1	14	<10	<1.0	22	<1	<0.01	5
BA Cc 259	10-30-95	<1	<100	<10	<1.0	<1	<1	<0.01	<1
BA Cd 229	09-14-94	<1	85	<0.5	<1.0	4	<1	<0.01	6
	08-07-96	--	--	--	--	--	--	--	--
BA Cd 230	09-22-94	<1	170	<0.5	<1.0	42	2	<0.01	7
BA Cd 231	10-20-94	<1	31	<0.5	<1.0	2	<1	<0.01	<1
BA Cd 232	11-01-94	<1	41	<0.5	<1.0	<1	<1	<0.01	<1
BA Cd 234	12-06-94	<1	43	<0.5	<1.0	45	<1	<0.01	1
BA Cd 235	11-30-94	<1	40	<0.5	<1.0	12	<1	<0.01	<1
	08-06-96	--	--	--	--	--	--	--	--
BA Cd 236	01-11-95	<1	17	<10	<1.0	6	<1	<0.01	<1
BA Cd 237	04-20-95	<1	27	<10	<1.0	<1	<1	<0.01	<1
BA Cd 238	05-02-95	<1	150	<10	<1.0	35	1	<0.01	4
BA Cd 239	06-19-95	<1	22	<10	<1.0	15	1	<0.01	3
BA Cd 241	06-20-95	<1	19	<10	<1.0	8	<1	<0.01	<1
BA Ce 309	09-27-94	<1	9	<0.5	<1.0	200	<1	<0.01	7
BA Ce 311	11-14-94	<1	34	<0.5	<1.0	25	<1	<0.01	4
BA Ce 312	04-18-95	<1	23	<10	<1.0	18	<1	<0.01	4
BA Ce 313	04-24-95	<1	14	<10	<1.0	<1	<1	<0.01	<1
BA Da 120	08-03-94	<1	21	<0.5	<1.0	20	<1	<0.01	<1
BA Da 122	09-21-94	<1	12	<0.5	<1.0	53	<1	<0.01	7
	08-05-96	--	--	--	--	--	--	--	--
BA Da 123	05-31-95	<1	29	<10	<1.0	<1	<1	<0.01	<1
BA Db 259	09-29-94	<1	13	<0.5	<1.0	1	<1	<0.01	<1
BA Db 261	11-06-95	<1	<100	<10	<1.0	<1	<1	<0.01	<1
BA Dc 59	08-27-96	<1	12	<0.5	<1.0	<1	<1	--	<1
BA Dc 444	06-23-94	<1	29	<0.5	<1.0	<1	<1	<0.01	<1
	10-04-95	--	--	--	--	--	--	--	--
	09-20-96	--	--	--	--	--	--	--	--
BA Dc 445	08-04-94	<1	73	<0.5	<1.0	2	<1	<0.01	<1
	12-12-95	--	--	--	--	--	--	--	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Lithium (µg/L)	Mercury (µg/L)	Nickel (µg/L)	Selenium (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Zinc (µg/L)
BA Be 37	09-15-94	--	<0.1	<1	<1	--	<1	5
BA Be 38	01-19-95	--	<0.1	<1	<1	--	<1	8
BA Ca 66	07-19-95	--	<0.1	<1	<1	--	<1	<10
BA Ca 69	04-10-95	--	<0.1	<1	<1	--	<1	<10
BA Cb 126	09-28-94	--	<0.1	<1	<1	--	<1	98
BA Cb 133	08-29-94	--	<0.1	<1	<1	--	<1	<3
	08-07-96	5	--	--	--	73	--	--
BA Cb 134	09-13-94	--	<0.1	10	<1	--	<1	440
	08-05-96	4	--	--	--	93	--	--
BA Cb 136	11-09-94	--	<0.1	3	<1	--	<1	6
	12-11-95	<4	--	--	--	140	--	--
BA Cb 137	12-22-94	--	<0.1	<1	<1	--	<1	<3
	12-12-95	<4	--	--	--	97	--	--
BA Cb 138	02-21-95	--	<0.1	<1	<1	--	<1	<10
BA Cb 139	04-19-95	--	<0.1	2	1	--	<1	100
BA Cb 141	03-08-95	--	<0.1	1	<1	--	<1	<10
	02-07-96	<4	--	--	--	42	--	--
BA Cb 142	03-22-95	--	<0.1	<1	1	--	<1	<10
	12-13-95	--	--	--	--	--	--	--
BA Cb 143	11-08-95	--	<0.1	<1	<1	--	<1	20
BA Cb 144	10-31-95	--	<0.1	<1	<1	--	<1	80
BA Cc 253	09-20-94	--	<0.1	<1	<1	--	<1	5
	12-13-95	--	--	--	--	--	--	--
BA Cc 254	09-22-94	--	<0.1	<1	<1	--	<1	10
BA Cc 255	11-09-94	--	<0.1	<1	<1	--	<1	<3
BA Cc 256	01-04-95	--	<0.1	<1	<1	--	<1	<10
BA Cc 257	01-18-95	--	<0.1	<1	<1	--	<1	<10
BA Cc 258	03-13-95	--	<0.1	<1	<1	--	<1	<10
BA Cc 259	10-30-95	--	<0.1	<1	<1	--	<1	<10
BA Cd 229	09-14-94	--	<0.1	<1	<1	--	<1	4
	08-07-96	<4	--	--	--	180	--	--
BA Cd 230	09-22-94	--	<0.1	<1	<1	--	<1	<3
BA Cd 231	10-20-94	--	<0.1	1	<1	--	<1	<3
BA Cd 232	11-01-94	--	<0.1	<1	<1	--	<1	5
BA Cd 234	12-06-94	--	<0.1	7	<1	--	<1	5
BA Cd 235	11-30-94	--	<0.1	<1	<1	--	<1	13
	08-06-96	6	--	--	--	130	--	--
BA Cd 236	01-11-95	--	<0.1	<1	<1	--	<1	<10
BA Cd 237	04-20-95	--	<0.1	<1	1	--	<1	<10
BA Cd 238	05-02-95	--	<0.1	1	<1	--	<1	<10
BA Cd 239	06-19-95	--	<0.1	<1	2	--	<1	<10
BA Cd 241	06-20-95	--	<0.1	<1	<1	--	<1	20
BA Ce 309	09-27-94	--	<0.1	2	1	--	<1	16
BA Ce 311	11-14-94	--	<0.1	<1	<1	--	<1	10
BA Ce 312	04-18-95	--	<0.1	1	<1	--	<1	<10
BA Ce 313	04-24-95	--	<0.1	<1	<1	--	<1	<10
BA Da 120	08-03-94	--	<0.1	<1	<1	--	<1	5
BA Da 122	09-21-94	--	<0.1	3	<1	--	<1	6
	08-05-96	<4	--	--	--	130	--	--
BA Da 123	05-31-95	--	<0.1	<1	<1	--	<1	<10
BA Db 259	09-29-94	--	<0.1	<1	<1	--	<1	11
BA Db 261	11-06-95	--	<0.1	<1	<1	--	<1	<10
BA Dc 59	08-27-96	--	--	<1	<1	--	<1	<3
BA Dc 444	06-23-94	--	<0.1	1	<1	--	<1	<3
	10-04-95	--	--	--	--	--	--	--
	09-20-96	--	--	--	--	--	--	--
BA Dc 445	08-04-94	--	<0.1	<1	<1	--	<1	4
	12-12-95	--	--	--	--	--	--	--

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Site number	Date	Discharge (gal/min)	Water level (feet below land surface)	Water temperature (deg. C)	Specific conductance (µS/cm)	pH	Alkalinity (mg/L as $CaCO_3$)
BA Dc 446	392807076440401	08-15-94	--	--	15.0	60	5.5	4
BA Dc 447	392537076423301	09-13-94	1.0	--	14.0	150	7.6	31
BA Dc 448	392730076420301	01-31-95	3.1	--	12.5	--	6.3	53
		08-05-96	2.0	--	--	--	--	--
BA Dc 449	392808076412401	06-06-95	1.5	5.54	14.5	75	5.4	12
BA Dc 450	392650076433901	06-19-95	1.5	--	13.0	91	5.1	4
BA Dc 451	392620076440101	12-06-95	2.0	3.99	12.0	227	7.7	111
BA Dd 300	392928076380601	02-27-95	1.8	40.44	11.5	139	5.6	13
		02-08-96	1.5	--	11.0	168	5.4	--
BA De 632	392923076324901	10-20-94	3.4	--	14.5	167	5.2	8
BA De 633	392859076323601	11-17-94	3.0	--	13.0	148	5.7	--
		12-12-95	2.7	--	11.5	127	5.5	--
BA De 635	392656076312001	01-26-95	4.8	33.03	12.5	75	5.7	9
BA De 636	392959076310401	03-07-95	1.8	51.31	12.0	167	5.4	12
		02-08-96	1.3	--	12.0	153	5.4	--
BA De 637	392837076333401	04-12-95	1.8	43.29	12.5	543	5.1	9
BA De 638	392546076334501	07-05-95	1.6	12.64	13.5	357	6.2	78
BA De 639	392713076300101	10-31-95	2.2	52.90	14.5	386	7.5	185
BA De 640	392635076312501	12-07-95	2.8	--	13.5	551	6.4	68
		12-07-95	2.8	--	13.5	551	6.4	68
BA De 641	392636076312501	12-07-95	2.0	37.06	13.0	111	5.8	29
		12-07-95	2.0	37.06	13.0	111	5.8	29
BA Df 351	392605076254601	04-26-95	1.5	18.72	12.5	104	6.1	27
		08-09-95	4.6	--	14.5	115	6.2	--
BA Df 352	392814076271101	07-20-95	2.3	--	13.0	149	7.0	37
BA Df 353	392538076291401	05-30-95	1.5	29.89	13.5	437	5.3	9
BA Df 354	392806076275401	11-02-95	2.8	50.34	13.5	453	7.6	169
		11-02-95	--	--	--	--	--	--
BA Df 355	392904076291201	11-08-95	2.4	--	13.0	413	7.6	145
BA Dg 117	392610076241701	03-28-95	1.3	7.11	11.5	157	6.6	68
BA Ea 90	392206076503201	08-03-94	1.1	--	17.5	117	5.8	17
BA Ea 91	392410076514001	08-24-94	1.0	--	15.5	380	6.1	40
		08-25-94	2.0	--	14.5	374	--	--
BA Ea 92	392341076521801	02-02-95	2.0	--	13.0	107	6.6	43
		08-14-95	3.3	--	14.0	122	--	--
		08-21-96	1.7	--	15.5	145	6.9	48
BA Ea 93	392358076500901	02-14-95	1.6	--	12.0	498	6.3	65
BA Ea 95	392159076520101	06-06-95	1.7	2.60	15.5	198	5.9	22
		02-07-96	1.5	--	9.5	210	6.3	--
BA Eb 291	392025076465301	10-05-94	2.2	38.90	13.5	212	7.3	82
BA Ec 203	392430076410301	01-25-95	1.5	33.20	12.0	129	5.3	7
BA Ec 204	392434076404301	07-06-95	2.0	39.91	17.5	129	6.1	28
BA Ec 205	392446076434101	11-07-95	2.7	--	13.0	519	7.3	210
		11-07-95	2.7	--	13.0	519	7.3	210
BA Fb 81	391857076474301	01-10-95	4.0	57.66	12.0	1220	6.3	79

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Solids, residue at 180 deg. C (mg/L)	Solids, sum of constit-uents (mg/L)	Oxygen, dis-solved (mg/L)	Color (plat-inum cobalt units)	Calcium (mg/L)	Magnesium (mg/L)	Hardness (mg/L as $CaCO_3$)	Sodium (mg/L)
BA Dc 446	08-15-94	44	44	8.7	2	2.7	2.0	15	3.0
BA Dc 447	09-13-94	80	96	1.0	3	18	3.2	58	5.2
BA Dc 448	01-31-95	116	105	7.2	8	14	6.5	62	7.9
	08-05-96	--	--	--	--	--	--	--	--
BA Dc 449	06-06-95	42	46	7.1	1	3.3	3.3	22	3.5
BA Dc 450	06-19-95	62	64	8.0	7	3.1	3.5	22	5.2
BA Dc 451	12-06-95	118	110	6.2	7	35	5.9	110	2.1
BA Dd 300	02-27-95	82	80	8.1	3	7.4	6.4	45	4.1
	02-08-96	--	--	--	--	--	--	--	--
BA De 632	10-20-94	100	92	5.2	1	7.5	5.6	42	9.1
BA De 633	11-17-94	88	96	6.8	2	9.2	4.3	41	7.0
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	62	53	7.1	3	3.9	2.6	20	3.4
BA De 636	03-07-95	110	111	1.5	<1	6.3	4.8	36	13
	02-08-96	--	--	--	--	--	--	--	--
BA De 637	04-12-95	308	263	3.9	4	17	9.3	81	58
BA De 638	07-05-95	214	206	2.5	7	30	14	130	8.8
BA De 639	10-31-95	220	220	4.4	2	50	16	190	3.7
BA De 640	12-07-95	300	299	6.7	3	37	11	140	44
	12-07-95	--	--	6.7	--	--	--	--	--
BA De 641	12-07-95	70	80	8.8	3	8.8	3.0	34	7.1
	12-07-95	--	--	8.8	--	--	--	--	--
BA Df 351	04-26-95	88	--	5.0	1	--	--	--	--
	08-09-95	86	90	--	5	12	4.0	46	5.0
BA Df 352	07-20-95	112	104	<2.0	37	11	3.8	43	8.1
BA Df 353	05-30-95	330	293	8.6	<1	43	14	170	8.7
BA Df 354	11-02-95	246	247	6.8	3	46	24	210	3.2
	11-02-95	--	--	--	--	--	--	--	--
BA Df 355	11-08-95	240	231	4.9	2	45	18	190	3.2
BA Dg 117	03-28-95	138	140	0.5	50	15	5.5	60	2.2
BA Ea 90	08-03-94	94	89	5.3	<1	7.7	2.8	31	7.4
BA Ea 91	08-24-94	258	209	7.3	<1	29	16	140	8.2
	08-25-94	--	--	--	--	--	--	--	--
BA Ea 92	02-02-95	78	75	7.4	<1	8.0	6.3	46	2.2
	08-14-95	--	--	--	--	--	--	--	--
	08-21-96	--	--	6.2	--	--	--	--	--
BA Ea 93	02-14-95	270	265	3.8	3	34	31	210	4.8
BA Ea 95	06-06-95	130	131	8.7	7	16	4.8	60	10
	02-07-96	--	--	--	--	--	--	--	--
BA Eb 291	10-05-94	154	162	5.2	1	14	16	100	2.8
BA Ec 203	01-25-95	86	82	7.6	3	7.8	3.0	32	6.5
BA Ec 204	07-06-95	96	93	5.3	3	11	3.1	40	6.1
BA Ec 205	11-07-95	274	274	5.1	1	68	15	230	7.6
	11-07-95	--	--	5.1	--	--	--	--	--
BA Fb 81	01-10-95	718	563	7.6	1	98	56	480	12

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Sodium adsorption ratio	Sodium percent	Potassium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Silica (mg/L as SiO_2)	Iron (filtered) (µg/L)
BA Dc 446	08-15-94	0.3	28	1.2	5.2	0.10	0.10	11	15
BA Dc 447	09-13-94	0.3	16	2.4	3.2	12	0.10	19	64
BA Dc 448	01-31-95	0.4	21	3.5	19	10	0.10	23	4
	08-05-96	--	--	--	--	--	--	--	--
BA Dc 449	06-06-95	0.3	24	1.3	8.1	3.8	<0.10	11	<3
BA Dc 450	06-19-95	0.5	32	1.3	3.9	0.60	<0.10	9.3	5
BA Dc 451	12-06-95	0.1	4	1.1	2.8	2.1	<0.10	12	<3
BA Dd 300	02-27-95	0.3	16	1.6	21	3.4	<0.10	12	4
	02-08-96	--	--	--	--	--	--	--	--
BA De 632	10-20-94	0.6	30	2.9	29	3.8	<0.10	11	9
BA De 633	11-17-94	0.5	26	2.5	12	4.3	<0.10	17	<3
	12-12-95	--	--	--	10	--	--	--	--
BA De 635	01-26-95	0.3	24	2.0	5.5	2.9	<0.10	13	34
BA De 636	03-07-95	0.9	42	2.6	11	22	<0.10	23	23
	02-08-96	--	--	--	--	--	--	--	--
BA De 637	04-12-95	3	59	4.5	130	0.50	<0.10	11	70
BA De 638	07-05-95	0.3	12	4.8	32	14	<0.10	28	12
BA De 639	10-31-95	0.1	4	3.1	7.9	4.6	0.20	17	<3
BA De 640	12-07-95	2	40	3.8	110	21	0.20	29	3500
	12-07-95	--	--	--	--	--	--	--	--
BA De 641	12-07-95	0.5	30	1.7	8.0	6.1	<0.10	23	93
	12-07-95	--	--	--	--	--	--	--	--
BA Df 351	04-26-95	--	--	--	4.9	0.90	<0.10	25	--
	08-09-95	0.3	19	0.60	4.7	1.6	<0.10	27	5
BA Df 352	07-20-95	0.5	27	3.0	9.6	14	0.20	30	1200
BA Df 353	05-30-95	0.3	10	4.2	31	10	<0.10	20	3
BA Df 354	11-02-95	0.1	3	1.7	14	14	<0.10	11	<3
	11-02-95	--	--	--	--	--	--	--	--
BA Df 355	11-08-95	0.1	4	2.1	16	7.8	<0.10	16	<3
BA Dg 117	03-28-95	0.1	7	5.0	5.1	0.20	0.20	63	4500
BA Ea 90	08-03-94	0.6	32	2.4	4.9	21	<0.10	26	<3
BA Ea 91	08-24-94	0.3	11	6.1	63	21	0.20	26	3
	08-25-94	--	--	--	--	--	--	--	--
BA Ea 92	02-02-95	0.1	9	1.4	4.0	1.3	<0.10	21	3
	08-14-95	--	--	--	--	--	--	--	--
	08-21-96	--	--	--	--	--	--	--	--
BA Ea 93	02-14-95	0.1	5	0.40	81	28	<0.10	29	460
BA Ea 95	06-06-95	0.6	26	2.6	8.9	17	<0.10	22	42
	02-07-96	--	--	--	--	--	--	--	--
BA Eb 291	10-05-94	0.1	6	0.20	2.5	18	<0.10	53	<3
BA Ec 203	01-25-95	0.5	28	3.3	19	1.5	0.10	16	6
BA Ec 204	07-06-95	0.4	24	2.0	2.9	15	0.20	26	6
BA Ec 205	11-07-95	0.2	7	2.5	23	20	<0.10	14	<3
	11-07-95	--	--	--	--	--	--	--	--
BA Fb 81	01-10-95	0.2	5	0.90	280	31	<0.10	37	14

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Iron (unfiltered) (µg/L)	Manganese (filtered) (µg/L)	Manganese (unfiltered) (µg/L)	Total organic carbon (mg/L)	Chemical oxygen demand (mg/L)	Methylene blue active substances (mg/L)	Nitrate plus nitrite (mg/L as N)
BA Dc 446	08-15-94	30	8	10	0.10	--	<0.02	3.50
BA Dc 447	09-13-94	130	33	40	0.10	--	<0.02	<0.050
BA Dc 448	01-31-95	14000	110	110	0.40	--	<0.02	0.530
	08-05-96	--	--	--	--	--	--	--
BA Dc 449	06-06-95	<10	24	20	0.30	--	<0.02	0.640
BA Dc 450	06-19-95	50	10	20	<0.10	--	<0.02	7.70
BA Dc 451	12-06-95	70	<1	20	1.0	--	<0.02	0.690
BA Dd 300	02-27-95	40	6	<10	0.30	--	<0.02	3.70
	02-08-96	--	--	--	--	<10	--	3.00
BA De 632	10-20-94	<10	4	<10	0.40	--	<0.02	4.00
BA De 633	11-17-94	280	4	10	0.50	--	<0.02	5.90
	12-12-95	--	--	--	--	<10	--	4.90
BA De 635	01-26-95	1500	10	10	0.50	--	<0.02	3.20
BA De 636	03-07-95	30	98	90	1.1	--	--	4.50
	02-08-96	--	--	--	--	11	--	3.80
BA De 637	04-12-95	170	53	50	5.5	--	<0.02	5.90
BA De 638	07-05-95	4100	15	50	0.40	--	<0.02	5.30
BA De 639	10-31-95	200	<1	<10	2.3	--	<0.02	2.90
BA De 640	12-07-95	8000	690	660	0.60	--	<0.02	0.060
	12-07-95	--	--	--	--	--	--	--
BA De 641	12-07-95	44000	68	130	1.4	--	<0.02	0.870
	12-07-95	--	--	--	--	--	--	--
BA Df 351	04-26-95	340	--	<10	3.2	--	0.02	2.20
	08-09-95	630	2	<10	--	--	--	2.10
BA Df 352	07-20-95	1300	100	110	0.60	--	<0.02	0.060
BA Df 353	05-30-95	80	3	<10	0.40	--	<0.02	35.0
BA Df 354	11-02-95	<10	<1	<10	1.1	--	<0.02	6.70
	11-02-95	--	--	--	--	--	--	--
BA Df 355	11-08-95	100	<1	<10	0.40	--	<0.02	9.10
BA Dg 117	03-28-95	3300	310	200	1.2	--	<0.02	<0.050
BA Ea 90	08-03-94	30	7	<10	0.50	--	<0.02	1.20
BA Ea 91	08-24-94	270	2	<10	0.60	--	<0.02	3.00
	08-25-94	--	--	--	--	--	--	--
BA Ea 92	02-02-95	20	<1	<10	1.2	--	<0.02	1.20
	08-14-95	--	--	--	--	--	--	--
	08-21-96	--	--	--	--	--	--	--
BA Ea 93	02-14-95	3900	20	30	0.60	--	<0.02	0.640
BA Ea 95	06-06-95	4400	84	90	0.80	--	<0.02	7.80
	02-07-96	--	--	--	--	<10	--	8.90
BA Eb 291	10-05-94	110	<1	<10	0.50	--	<0.02	0.810
BA Ec 203	01-25-95	510	6	10	0.50	--	<0.02	4.50
BA Ec 204	07-06-95	100	73	80	0.40	--	<0.02	1.80
BA Ec 205	11-07-95	<10	<1	<10	--	--	<0.02	4.80
	11-07-95	--	--	--	--	--	--	--
BA Fb 81	01-10-95	310	<1	<10	3.4	--	<0.02	0.320

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Nitrite (mg/L as N)	Phos-phorus (mg/L as P)	Ortho-phos-phorus (mg/L as P)	Ammonium (mg/L as N)	Radon-222 (pCi/L)	Tritium (pCi/L)	N15/N14 (nitrate) (per mil)	Arsenic (µg/L)
BA Dc 446	08-15-94	<0.010	<0.010	<0.010	0.020	2500	--	--	<1
BA Dc 447	09-13-94	<0.010	<0.010	<0.010	0.010	1100	--	--	<1
BA Dc 448	01-31-95	<0.010	<0.010	<0.010	<0.015	1200	--	--	<1
	08-05-96	--	--	--	--	--	24	--	--
BA Dc 449	06-06-95	<0.010	<0.010	<0.010	<0.015	3700	--	--	<1
BA Dc 450	06-19-95	<0.010	<0.010	<0.010	<0.015	1500	--	--	<1
BA Dc 451	12-06-95	<0.010	0.010	<0.010	<0.015	550	--	--	<1
BA Dd 300	02-27-95	<0.010	<0.010	0.010	<0.015	670	--	--	<1
	02-08-96	--	--	--	--	--	35	3.5	--
BA De 632	10-20-94	<0.010	<0.010	0.020	<0.015	1200	--	--	<1
BA De 633	11-17-94	<0.010	0.020	0.020	<0.015	400	--	--	<1
	12-12-95	--	--	--	--	--	36	3.9	--
BA De 635	01-26-95	<0.010	<0.010	<0.010	<0.015	870	--	--	<1
BA De 636	03-07-95	<0.010	<0.010	<0.010	<0.015	270	--	--	<1
	02-08-96	--	--	--	--	--	40	10.9	--
BA De 637	04-12-95	<0.010	<0.010	<0.010	0.020	1600	--	--	<1
BA De 638	07-05-95	<0.010	0.020	0.020	0.020	720	--	--	<1
BA De 639	10-31-95	<0.010	<0.010	<0.010	<0.015	700	--	--	<1
BA De 640	12-07-95	<0.010	<0.010	0.010	<0.015	1800	--	--	<1
	12-07-95	--	--	--	--	--	35	--	--
BA De 641	12-07-95	<0.010	<0.010	<0.010	<0.015	5700	--	--	<1
	12-07-95	--	--	--	--	--	42	--	--
BA Df 351	04-26-95	<0.010	0.010	0.010	<0.015	790	--	--	<1
	08-09-95	<0.010	<0.010	<0.010	<0.015	--	--	--	--
BA Df 352	07-20-95	<0.010	<0.010	0.010	0.020	1000	--	--	<1
BA Df 353	05-30-95	<0.010	0.020	0.020	<0.015	6900	--	--	<1
BA Df 354	11-02-95	<0.010	0.030	<0.010	<0.015	780	--	--	<1
	11-02-95	--	--	--	--	--	44	--	--
BA Df 355	11-08-95	<0.010	<0.010	<0.010	<0.015	260	--	--	<1
BA Dg 117	03-28-95	<0.010	0.150	0.150	<0.015	560	--	--	<1
BA Ea 90	08-03-94	<0.010	0.030	0.030	0.010	5700	--	--	<1
BA Ea 91	08-24-94	<0.010	0.010	0.020	<0.010	--	--	--	<1
	08-25-94	--	--	--	--	2100	--	--	--
BA Ea 92	02-02-95	<0.010	0.020	0.020	<0.015	--	--	--	1
	08-14-95	--	--	--	--	540	--	--	--
	08-21-96	--	--	--	--	--	60	--	--
BA Ea 93	02-14-95	<0.010	<0.010	<0.010	<0.015	<80	--	--	<1
BA Ea 95	06-06-95	<0.010	0.040	<0.010	0.020	13000	--	--	<1
	02-07-96	--	--	--	--	--	--	4.2	--
BA Eb 291	10-05-94	<0.010	0.030	0.030	<0.015	110	--	--	<1
BA Ec 203	01-25-95	<0.010	0.020	0.010	<0.015	11000	--	--	<1
BA Ec 204	07-06-95	<0.010	<0.010	<0.010	0.030	11000	--	--	<1
BA Ec 205	11-07-95	<0.010	<0.010	<0.010	<0.015	1200	--	--	<1
	11-07-95	--	--	--	--	--	44	--	--
BA Fb 81	01-10-95	<0.010	<0.010	0.010	<0.015	210	--	--	<1

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Antimony (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Cadmium (µg/L)	Copper (µg/L)	Chromium (µg/L)	Cyanide (µg/L)	Lead (µg/L)
BA Dc 446	08-15-94	<1	22	<0.5	<1.0	17	<1	<0.01	5
BA Dc 447	09-13-94	<1	2	<0.5	<1.0	<1	<1	<0.01	<1
BA Dc 448	01-31-95	<1	3	<10	<1.0	2	<1	<0.01	<1
	08-05-96	--	--	--	--	--	--	--	--
BA Dc 449	06-06-95	<1	9	<10	<1.0	22	<1	<0.01	12
BA Dc 450	06-19-95	<1	45	<10	<1.0	12	<1	<0.01	13
BA Dc 451	12-06-95	<1	<100	<10	<1.0	4	<1	<0.01	2
BA Dd 300	02-27-95	<1	33	<10	<1.0	26	<1	<0.01	10
	02-08-96	--	--	--	--	--	--	--	--
BA De 632	10-20-94	<1	48	<0.5	<1.0	20	<1	<0.01	3
BA De 633	11-17-94	<1	22	<0.5	<1.0	7	<1	<0.01	2
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<1	28	<10	<1.0	18	<1	<0.01	8
BA De 636	03-07-95	<1	23	<10	<1.0	16	<1	<0.01	70
	02-08-96	--	--	--	--	--	--	--	--
BA De 637	04-12-95	<1	280	<10	<1.0	55	<1	<0.01	8
BA De 638	07-05-95	<1	220	<10	<1.0	11	<1	<0.01	<1
BA De 639	10-31-95	<1	<100	<10	<1.0	5	<1	<0.01	<1
BA De 640	12-07-95	<1	<100	<10	<1.0	<1	<1	<0.01	<1
	12-07-95	--	--	--	--	--	--	--	--
BA De 641	12-07-95	<1	<100	<10	<1.0	6	<1	<0.01	<1
	12-07-95	--	--	--	--	--	--	--	--
BA Df 351	04-26-95	--	--	<10	<1.0	35	<1	<0.01	3
	08-09-95	--	5	--	--	--	--	--	--
BA Df 352	07-20-95	<1	4	<10	<1.0	<1	<1	<0.01	<1
BA Df 353	05-30-95	<1	120	<10	<1.0	14	<1	<0.01	3
BA Df 354	11-02-95	<1	<100	<10	<1.0	<1	<1	<0.01	<1
	11-02-95	--	--	--	--	--	--	--	--
BA Df 355	11-08-95	<1	<100	<10	<1.0	4	<1	<0.01	<1
BA Dg 117	03-28-95	<1	150	<10	<1.0	<1	<1	<0.01	<1
BA Ea 90	08-03-94	<1	51	<0.5	<1.0	100	1	<0.01	4
BA Ea 91	08-24-94	<1	130	<0.5	<1.0	60	2	<0.01	1
	08-25-94	--	--	--	--	--	--	--	--
BA Ea 92	02-02-95	<1	15	<10	<1.0	5	20	<0.01	<1
	08-14-95	--	--	--	--	--	--	--	--
	08-21-96	--	--	--	--	--	--	--	--
BA Ea 93	02-14-95	<1	13	<10	<1.0	8	<1	<0.01	<1
BA Ea 95	06-06-95	<1	43	<10	<1.0	47	<1	<0.01	<1
	02-07-96	--	--	--	--	--	--	--	--
BA Eb 291	10-05-94	<1	<2	<0.5	<1.0	5	10	<0.01	<1
BA Ec 203	01-25-95	<1	210	<10	<1.0	51	<1	<0.01	10
BA Ec 204	07-06-95	<1	69	<10	<1.0	6	<1	<0.01	<1
BA Ec 205	11-07-95	<1	<100	<10	<1.0	2	<1	<0.01	<1
	11-07-95	--	--	--	--	--	--	--	--
BA Fb 81	01-10-95	<1	<2	<10	<1.0	7	4	<0.01	2

TABLE A1, CONTINUED
MAJOR IONS, NUTRIENTS, FIELD PARAMETERS, AND OTHER CHEMICAL-QUALITY DATA

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; <, less than)

Local name	Date	Lithium (µg/L)	Mercury (µg/L)	Nickel (µg/L)	Selenium (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Zinc (µg/L)
BA Dc 446	08-15-94	--	<0.1	<1	<1	--	<1	6
BA Dc 447	09-13-94	--	<0.1	<1	<1	--	<1	<3
BA Dc 448	01-31-95	--	<0.1	<1	<1	--	<1	<10
	08-05-96	--	--	--	--	--	--	--
BA Dc 449	06-06-95	--	<0.1	<1	<1	--	<1	<10
BA Dc 450	06-19-95	--	<0.1	4	<1	--	<1	<10
BA Dc 451	12-06-95	--	<0.1	<1	<1	--	<1	<10
BA Dd 300	02-27-95	--	<0.1	1	<1	--	<1	<10
	02-08-96	<4	--	--	--	77	--	--
BA De 632	10-20-94	--	<0.1	1	<1	--	<1	<3
BA De 633	11-17-94	--	<0.1	2	<1	--	<1	6
	12-12-95	<4	--	--	--	83	--	--
BA De 635	01-26-95	--	<0.1	2	<1	--	<1	<10
BA De 636	03-07-95	--	--	86	<1	--	<1	260
	02-08-96	7	--	--	--	73	--	--
BA De 637	04-12-95	--	<0.1	8	<1	--	<1	30
BA De 638	07-05-95	--	<0.1	<1	<1	--	<1	<10
BA De 639	10-31-95	--	<0.1	<1	<1	--	<1	30
BA De 640	12-07-95	--	<0.1	11	<1	--	<1	10
	12-07-95	--	--	--	--	--	--	--
BA De 641	12-07-95	--	<0.1	2	<1	--	<1	10
	12-07-95	--	--	--	--	--	--	--
BA Df 351	04-26-95	--	<0.1	<1	<1	--	<1	<10
	08-09-95	--	--	--	--	--	--	--
BA Df 352	07-20-95	--	<0.1	<1	<1	--	<1	<10
BA Df 353	05-30-95	--	<0.1	<1	<1	--	<1	<10
BA Df 354	11-02-95	--	<0.1	<1	<1	--	<1	<10
	11-02-95	--	--	--	--	--	--	--
BA Df 355	11-08-95	--	<0.1	<1	<1	--	<1	<10
BA Dg 117	03-28-95	--	<0.1	2	<1	--	<1	<10
BA Ea 90	08-03-94	--	<0.1	1	<1	--	<1	14
BA Ea 91	08-24-94	--	<0.1	2	<1	--	<1	8
	08-25-94	--	--	--	--	--	--	--
BA Ea 92	02-02-95	--	<0.1	2	<1	--	<1	<10
	08-14-95	--	--	--	--	--	--	--
	08-21-96	--	--	--	--	--	--	--
BA Ea 93	02-14-95	--	<0.1	2	<1	--	<1	<10
BA Ea 95	06-06-95	--	<0.1	3	1	--	<1	50
	02-07-96	6	--	--	--	180	--	--
BA Eb 291	10-05-94	--	<0.1	<1	<1	--	<1	<3
BA Ec 203	01-25-95	--	<0.1	1	<1	--	<1	30
BA Ec 204	07-06-95	--	<0.1	<1	<1	--	<1	<10
BA Ec 205	11-07-95	--	<0.1	<1	<1	--	<1	<10
	11-07-95	--	--	--	--	--	--	--
BA Fb 81	01-10-95	--	0.1	<1	<1	--	<1	<10

Table A2
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Site number	Date	Aceto-chlor, (μg/L)	Ala-chlor, (μg/L)	Deethyl atra-zine, (μg/L)	Atra-zine, (μg/L)	Methyl azin-phos (μg/L)	Ben-flur-alin (μg/L)	Butyl-ate, (μg/L)
BA Ab 51	394206076470201	04-18-95	<0.002	<0.002	E0.031	<0.001	<0.001	<0.002	<0.002
BA Ab 52	394011076465601	07-06-95	<0.002	<0.002	E0.110	0.100	<0.001	<0.002	<0.002
BA Ac 151	394057076423301	11-30-94	<0.002	<0.002	E0.011	<0.001	<0.001	<0.002	<0.002
BA Ac 152	394023076401001	08-26-96	<0.002	<0.002	E0.070	<0.001	<0.001	<0.002	<0.002
BA Ad 145	394130076360101	12-01-94	<0.002	0.010	E0.280	0.046	<0.001	<0.002	<0.002
BA Ad 146	394019076374501	03-27-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		08-22-96	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Ad 147	394243076383201	05-11-95	<0.002	<0.002	E0.230	0.016	<0.001	<0.002	<0.002
BA Ad 148	394303076355401	05-16-95	<0.002	0.012	E1.00	0.540	<0.001	<0.002	<0.002
BA Ad 149	394250076370801	05-23-95	<0.002	<0.002	E0.002	<0.001	<0.001	<0.002	<0.002
BA Ae 19	394013076343001	11-21-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bb 136	393937076482101	09-21-94	<0.002	<0.002	E0.340	0.430	<0.001	<0.002	<0.002
BA Bb 138	393543076451301	10-31-94	<0.002	<0.002	E0.004	0.003	<0.001	<0.002	<0.002
BA Bb 139	393843076462401	12-29-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bb 140	393746076470001	02-22-95	<0.002	<0.002	E0.083	0.003	<0.001	<0.002	<0.002
BA Bb 141	393723076471401	03-01-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bb 143	393607076485001	03-14-95	<0.002	<0.002	E0.074	<0.001	<0.001	<0.002	<0.002
BA Bb 144	393544076463401	03-20-95	<0.002	<0.002	E0.056	0.011	<0.001	<0.002	<0.002
BA Bb 145	393540076455801	03-21-95	<0.002	<0.002	E0.003	<0.001	<0.001	<0.002	<0.002
BA Bb 147	393641076493501	05-18-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bb 148	393707076450801	06-20-95	<0.002	<0.002	E0.430	0.063	<0.001	<0.002	<0.002
BA Bb 151	393643076480201	07-24-95	<0.002	<0.002	E0.630	0.024	<0.001	<0.002	<0.002
BA Bc 264	393841076430901	08-22-96	<0.002	<0.002	E0.008	0.005	<0.001	<0.002	<0.002
BA Bc 267	393633076443801	12-21-94	<0.002	<0.002	E0.230	0.290	<0.001	<0.002	<0.002
		12-12-95	--	--	--	--	--	--	--
BA Bc 268	393929076441301	12-13-94	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Bc 270	393918076412801	04-11-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bc 271	393818076411501	04-19-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bc 272	393803076420101	05-16-95	<0.002	<0.002	E0.001	<0.001	<0.001	<0.002	<0.002
BA Bc 273	393755076402801	05-18-95	<0.002	<0.002	E0.005	<0.001	<0.001	<0.002	<0.002
BA Bc 274	393639076435501	06-07-95	<0.002	<0.002	E0.430	0.066	<0.001	<0.002	<0.002
BA Bc 275	393534076401601	07-05-95	<0.002	<0.002	E0.170	0.089	<0.001	<0.002	<0.002
BA Bd 224	393520076372201	09-28-94	<0.002	<0.002	E0.003	0.006	<0.001	<0.002	<0.002
BA Bd 225	393902076371301	11-21-94	<0.002	<0.002	E0.087	0.100	<0.001	<0.002	<0.002
BA Bd 226	393936076352101	12-12-94	<0.002	<0.002	E0.270	0.033	<0.001	<0.002	<0.002
BA Bd 227	393928076381301	12-07-94	<0.002	<0.002	E0.450	0.140	<0.001	<0.002	<0.002
BA Bd 229	393741076380601	01-11-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bd 231	393732076354101	05-23-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Bd 232	393554076384401	07-19-95	<0.002	<0.002	E0.650	0.012	<0.001	<0.002	<0.002
BA Bd 233	393732076392401	10-15-96	<0.002	<0.002	E0.594	0.029	<0.001	<0.002	<0.002
BA Bd 234	393739076391801	10-16-96	<0.002	<0.002	E0.534	0.217	<0.001	<0.002	<0.002
BA Bd 235	393733076391301	10-15-96	<0.002	<0.002	E0.455	0.395	<0.001	<0.002	<0.002
BA Bd 236	393742076390701	10-16-96	<0.002	<0.002	E0.776	0.231	<0.001	<0.002	<0.002
BA Bd 237	393738076391401	10-23-96	<0.002	<0.002	E1.910	0.114	<0.001	<0.002	<0.002
BA Bd 238	393736076390401	10-23-96	<0.002	<0.002	E0.102	0.100	<0.001	<0.002	<0.002
BA Be 36	393546076341201	08-31-94	--	<0.002	E0.039	0.036	<0.001	<0.002	<0.002
BA Be 37	393708076345501	09-15-94	<0.002	<0.002	E0.380	0.110	<0.001	<0.002	<0.002
BA Be 38	393519076344701	01-19-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ca 66	393355076501901	07-19-95	<0.002	<0.002	E0.016	0.006	<0.001	<0.002	<0.002
BA Ca 69	393222076510501	04-10-95	<0.002	<0.002	E0.450	0.002	<0.001	<0.002	<0.002
BA Cb 126	393241076472401	09-28-94	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Cb 133	393028076465301	08-29-94	--	<0.002	E0.220	<0.001	<0.001	<0.002	<0.002
BA Cb 134	393243076450901	09-13-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cb 136	393119076454501	11-09-94	<0.002	<0.002	E1.10	0.530	<0.001	<0.002	<0.002
		12-11-95	--	--	--	--	--	--	--
BA Cb 137	393403076454201	12-22-94	<0.002	<0.002	E1.30	0.800	<0.001	<0.002	<0.002
		12-12-95	--	--	--	--	--	--	--
BA Cb 138	393237076495601	02-21-95	<0.002	<0.002	E0.051	0.004	<0.001	<0.002	<0.002
		12-13-95	--	--	--	--	--	--	--
BA Cb 139	393228076493201	04-19-95	<0.002	<0.002	E0.580	0.012	<0.001	<0.002	<0.002

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Carbaryl (µg/L)	Carbofuran (µg/L)	Chlorpyrifos (µg/L)	Cyanazine (µg/L)	DCPA (µg/L)	p,p' DDE (µg/L)	Diazinon (µg/L)	Dieldrin (µg/L)	2,6-Diethyl aniline (µg/L)
BA Ab 51	04-18-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ab 52	07-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ac 151	11-30-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ac 152	08-26-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ad 145	12-01-94	<0.003	E0.006	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ad 146	03-27-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	08-22-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ad 147	05-11-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ad 148	05-16-95	<0.003	E0.063	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ad 149	05-23-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ae 19	11-21-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 136	09-21-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 138	10-31-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 139	12-29-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 140	02-22-95	<0.003	E0.016	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 141	03-01-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 143	03-14-95	<0.003	E0.023	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 144	03-20-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 145	03-21-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 147	05-18-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 148	06-20-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bb 151	07-24-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 264	08-22-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 267	12-21-94	<0.003	E0.017	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-12-95	--	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<0.003	<0.003	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Bc 270	04-11-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 271	04-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 272	05-16-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 273	05-18-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 274	06-07-95	<0.003	E0.062	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bc 275	07-05-95	<0.003	E0.052	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 224	09-28-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 225	11-21-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 226	12-12-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 227	12-07-94	<0.003	E0.030	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 229	01-11-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Bd 231	05-23-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 232	07-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 233	10-15-96	<0.003	E0.133	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 234	10-16-96	<0.003	E0.082	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 235	10-15-96	<0.003	E0.053	<0.004	E0.003	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 236	10-16-96	<0.003	E0.032	<0.004	E0.003	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 237	10-23-96	<0.003	E0.066	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Bd 238	10-23-96	<0.003	E0.011	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Be 36	08-31-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Be 37	09-15-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Be 38	01-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Ca 66	07-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ca 69	04-10-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cb 126	09-28-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cb 133	08-29-94	E0.100	E0.130	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cb 134	09-13-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cb 136	11-09-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-11-95	--	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-12-95	--	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<0.003	E0.008	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-13-95	--	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Dimethoate (μg/L)	Disulfoton (μg/L)	EPTC (μg/L)	Ethalfluralin (μg/L)	Ethoprop (μg/L)	Fonofos (μg/L)	Alpha BHC (μg/L)	Lindane (μg/L)
BA Ab 51	04-18-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ab 52	07-06-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ac 151	11-30-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ac 152	08-26-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ad 145	12-01-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ad 146	03-27-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	08-22-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ad 147	05-11-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ad 148	05-16-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ad 149	05-23-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ae 19	11-21-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 136	09-21-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 138	10-31-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 139	12-29-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 140	02-22-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 141	03-01-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 143	03-14-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 144	03-20-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 145	03-21-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 147	05-18-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 148	06-20-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bb 151	07-24-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 264	08-22-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 267	12-21-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 270	04-11-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 271	04-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 272	05-16-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 273	05-18-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 274	06-07-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bc 275	07-05-95	--	<0.017	<0.002	<0.004	0.004	<0.003	<0.002	<0.004
BA Bd 224	09-28-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 225	11-21-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 226	12-12-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 227	12-07-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 229	01-11-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 231	05-23-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 232	07-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 233	10-15-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 234	10-16-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 235	10-15-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 236	10-16-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 237	10-23-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Bd 238	10-23-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Be 36	08-31-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Be 37	09-15-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Be 38	01-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ca 66	07-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ca 69	04-10-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 126	09-28-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 133	08-29-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 134	09-13-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 136	11-09-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Linuron (μg/L)	Malathion (μg/L)	Methyl parathion (μg/L)	Metolachlor (μg/L)	Metribuzin (μg/L)	Molinate (μg/L)	Napropamide (μg/L)	Parathion (μg/L)
BA Ab 51	04-18-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
BA Ab 52	07-06-95	<0.002	<0.005	<0.006	0.009	<0.004	<0.004	<0.003	<0.004
BA Ac 151	11-30-94	<0.002	<0.005	<0.006	0.064	<0.004	<0.004	<0.003	<0.004
BA Ac 152	08-26-96	<0.002	<0.005	<0.006	0.022	<0.004	<0.004	<0.003	<0.004
BA Ad 145	12-01-94	<0.002	<0.005	<0.006	0.058	<0.004	<0.004	<0.003	<0.004
BA Ad 146	03-27-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	08-22-96	<0.002	<0.005	<0.006	E0.003	<0.004	<0.004	<0.003	<0.004
BA Ad 147	05-11-95	<0.002	<0.005	<0.006	0.020	<0.004	<0.004	<0.003	<0.004
BA Ad 148	05-16-95	<0.002	<0.005	<0.006	0.590	<0.004	<0.004	<0.003	<0.004
BA Ad 149	05-23-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ae 19	11-21-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 136	09-21-94	<0.002	<0.005	<0.006	0.018	<0.004	<0.004	<0.003	<0.004
BA Bb 138	10-31-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 139	12-29-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 140	02-22-95	<0.002	<0.005	<0.006	0.011	<0.004	<0.004	<0.003	<0.004
BA Bb 141	03-01-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 143	03-14-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA Bb 144	03-20-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 145	03-21-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 147	05-18-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bb 148	06-20-95	<0.002	<0.005	<0.006	0.007	<0.004	<0.004	<0.003	<0.004
BA Bb 151	07-24-95	<0.002	<0.005	<0.006	0.042	<0.004	<0.004	<0.003	<0.004
BA Bc 264	08-22-96	<0.002	<0.005	<0.006	0.005	<0.004	<0.004	<0.003	<0.004
BA Bc 267	12-21-94	<0.002	<0.005	<0.006	0.200	<0.004	<0.004	<0.003	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bc 270	04-11-95	<0.002	<0.005	<0.006	E0.001	<0.004	<0.004	<0.003	<0.004
BA Bc 271	04-19-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bc 272	05-16-95	<0.002	<0.005	<0.006	E0.001	<0.004	<0.004	<0.003	<0.004
BA Bc 273	05-18-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
BA Bc 274	06-07-95	<0.002	<0.005	<0.006	0.140	<0.004	<0.004	<0.003	<0.004
BA Bc 275	07-05-95	<0.002	<0.005	<0.006	0.046	<0.004	<0.004	<0.003	<0.004
BA Bd 224	09-28-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bd 225	11-21-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Bd 226	12-12-94	<0.002	<0.005	<0.006	0.010	<0.004	<0.004	<0.003	<0.004
BA Bd 227	12-07-94	<0.002	<0.005	<0.006	0.130	<0.004	<0.004	<0.003	<0.004
BA Bd 229	01-11-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA Bd 231	05-23-95	<0.002	<0.005	<0.006	E0.001	<0.004	<0.004	<0.003	<0.004
BA Bd 232	07-19-95	<0.002	<0.005	<0.006	0.063	<0.004	<0.004	<0.003	<0.004
BA Bd 233	10-15-96	<0.002	<0.005	<0.006	0.332	<0.004	<0.004	<0.003	<0.004
BA Bd 234	10-16-96	<0.002	<0.005	<0.006	0.390	<0.004	<0.004	<0.003	<0.004
BA Bd 235	10-15-96	<0.002	<0.005	<0.006	0.278	<0.004	<0.004	<0.003	<0.004
BA Bd 236	10-16-96	<0.002	<0.005	<0.006	0.415	<0.004	<0.004	<0.003	<0.004
BA Bd 237	10-23-96	<0.002	<0.005	<0.006	0.378	<0.004	<0.004	<0.003	<0.004
BA Bd 238	10-23-96	<0.002	<0.005	<0.006	0.035	<0.004	<0.004	<0.003	<0.004
BA Be 36	08-31-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Be 37	09-15-94	<0.002	<0.005	<0.006	0.220	<0.004	<0.004	<0.003	<0.004
BA Be 38	01-19-95	<0.002	<0.005	<0.006	E0.002	<0.004	<0.004	<0.003	<0.004
BA Ca 66	07-19-95	<0.002	<0.005	<0.006	0.006	<0.004	<0.004	<0.003	<0.004
BA Ca 69	04-10-95	<0.002	<0.005	<0.006	0.190	<0.004	<0.004	<0.003	<0.004
BA Cb 126	09-28-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cb 133	08-29-94	<0.002	<0.005	<0.006	0.220	<0.004	<0.004	<0.003	<0.004
BA Cb 134	09-13-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cb 136	11-09-94	<0.002	<0.005	<0.006	0.089	<0.004	<0.004	<0.003	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<0.002	<0.005	<0.006	0.028	<0.004	<0.004	<0.003	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	<0.002	<0.005	<0.006	0.091	<0.004	<0.004	<0.003	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Pebulate (µg/L)	Pendimethalin (µg/L)	Permethrin cis (µg/L)	Phorate (µg/L)	Pronamide (µg/L)	Prometon (µg/L)	Propachlor (µg/L)	Propanil (µg/L)
BA Ab 51	04-18-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ab 52	07-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ac 151	11-30-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ac 152	08-26-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ad 145	12-01-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ad 146	03-27-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	08-22-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ad 147	05-11-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ad 148	05-16-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ad 149	05-23-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ae 19	11-21-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 136	09-21-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 138	10-31-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 139	12-29-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 140	02-22-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 141	03-01-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 143	03-14-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 144	03-20-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 145	03-21-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 147	05-18-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 148	06-20-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bb 151	07-24-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 264	08-22-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 267	12-21-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 270	04-11-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 271	04-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 272	05-16-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 273	05-18-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 274	06-07-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bc 275	07-05-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 224	09-28-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 225	11-21-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 226	12-12-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 227	12-07-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 229	01-11-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 231	05-23-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 232	07-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 233	10-15-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 234	10-16-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 235	10-15-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 236	10-16-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 237	10-23-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Bd 238	10-23-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Be 36	08-31-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Be 37	09-15-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Be 38	01-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ca 66	07-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ca 69	04-10-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 126	09-28-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 133	08-29-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 134	09-13-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 136	11-09-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Propargite (μg/L)	Simazine (μg/L)	Thiobencarb (μg/L)	Tebuthiuron (μg/L)	Terbacil (μg/L)	Terbufos (μg/L)	Trialate (μg/L)	Trifluralin (μg/L)
BA Ab 51	04-18-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ab 52	07-06-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ac 151	11-30-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ac 152	08-26-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ad 145	12-01-94	<0.013	0.008	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ad 146	03-27-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	08-22-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ad 147	05-11-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ad 148	05-16-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ad 149	05-23-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ae 19	11-21-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 136	09-21-94	<0.013	0.042	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 138	10-31-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 139	12-29-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 140	02-22-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 141	03-01-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 143	03-14-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 144	03-20-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 145	03-21-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 147	05-18-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 148	06-20-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bb 151	07-24-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 264	08-22-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 267	12-21-94	<0.013	<0.005	<0.002	<0.010	E0.027	<0.013	<0.001	<0.002
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 270	04-11-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 271	04-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 272	05-16-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 273	05-18-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 274	06-07-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bc 275	07-05-95	<0.013	0.014	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 224	09-28-94	<0.013	0.019	<0.002	0.076	<0.007	<0.013	<0.001	<0.002
BA Bd 225	11-21-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 226	12-12-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 227	12-07-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 229	01-11-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 231	05-23-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 232	07-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 233	10-15-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 234	10-16-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 235	10-15-96	<0.013	0.009	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 236	10-16-96	<0.013	E0.004	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 237	10-23-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Bd 238	10-23-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Be 36	08-31-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Be 37	09-15-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Be 38	01-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ca 66	07-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ca 69	04-10-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 126	09-28-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 133	08-29-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 134	09-13-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 136	11-09-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Carb-aryl (μg/L)	Metho-myl (μg/L)	Aldi-carb (μg/L)	Propo-xur (μg/L)	Propham (μg/L)	Carbo-Furan (μg/L)	1-Naph-thol (μg/L)	Methio-carb (μg/L)
BA Ab 51	04-18-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ab 52	07-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ac 151	11-30-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ac 152	08-26-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Ad 145	12-01-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ad 146	03-27-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	08-22-96	--	--	--	--	--	--	--	--
BA Ad 147	05-11-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ad 148	05-16-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ad 149	05-23-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ae 19	11-21-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 136	09-21-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 138	10-31-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 139	12-29-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 140	02-22-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 141	03-01-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 143	03-14-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 144	03-20-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 145	03-21-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 147	05-18-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 148	06-20-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bb 151	07-24-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 264	08-22-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Bc 267	12-21-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-12-95	--	--	--	--	--	--	--	--
BA Bc 268	12-13-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 270	04-11-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 271	04-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 272	05-16-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 273	05-18-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 274	06-07-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bc 275	07-05-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 224	09-28-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 225	11-21-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 226	12-12-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 227	12-07-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 229	01-11-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 231	05-23-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 232	07-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Bd 233	10-15-96	<0.013	<0.017	<0.023	<0.015	<0.015	E0.100	<0.028	<0.023
BA Bd 234	10-16-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Bd 235	10-15-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Bd 236	10-16-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Bd 237	10-23-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Bd 238	10-23-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Be 36	08-31-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Be 37	09-15-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Be 38	01-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ca 66	07-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ca 69	04-10-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 126	09-28-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 133	08-29-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 134	09-13-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 136	11-09-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-11-95	--	--	--	--	--	--	--	--
BA Cb 137	12-22-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-12-95	--	--	--	--	--	--	--	--
BA Cb 138	02-21-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 139	04-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	2,4-D (lab) (μg/L)	2,4-D (immuno-assay) (μg/L)	Silvex (μg/L)	Pic-loram (μg/L)	2,4,5-T (μg/L)	2,4-DP (μg/L)	Dicamba (μg/L)	Glypho-sate (μg/L)
BA Ab 51	04-18-95	--	<1	--	--	--	--	--	--
BA Ab 52	07-06-95	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Ac 151	11-30-94	--	<1	--	--	--	--	--	--
BA Ac 152	08-26-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Ad 145	12-01-94	--	<1	--	--	--	--	--	--
BA Ad 146	03-27-95	--	<1	--	--	--	--	--	--
	08-22-96	--	--	--	--	--	--	--	--
BA Ad 147	05-11-95	--	<1	--	--	--	--	--	--
BA Ad 148	05-16-95	--	<1	--	--	--	--	--	--
BA Ad 149	05-23-95	--	<1	--	--	--	--	--	--
BA Ae 19	11-21-94	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bb 136	09-21-94	--	<1	--	--	--	--	--	--
BA Bb 138	10-31-94	--	<1	--	--	--	--	--	--
BA Bb 139	12-29-94	--	<1	--	--	--	--	--	--
BA Bb 140	02-22-95	--	<1	--	--	--	--	--	--
BA Bb 141	03-01-95	--	<1	--	--	--	--	--	--
BA Bb 143	03-14-95	--	<1	--	--	--	--	--	--
BA Bb 144	03-20-95	--	<1	--	--	--	--	--	--
BA Bb 145	03-21-95	--	<1	--	--	--	--	--	--
BA Bb 147	05-18-95	--	<1	--	--	--	--	--	--
BA Bb 148	06-20-95	--	<1	--	--	--	--	--	--
BA Bb 151	07-24-95	--	--	--	--	--	--	--	--
BA Bc 264	08-22-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bc 267	12-21-94	--	<1	--	--	--	--	--	--
	12-12-95	--	--	--	--	--	--	--	<5.00
BA Bc 268	12-13-94	--	<1	--	--	--	--	--	--
BA Bc 270	04-11-95	--	<1	--	--	--	--	--	--
BA Bc 271	04-19-95	--	<1	--	--	--	--	--	--
BA Bc 272	05-16-95	<0.010	<1	<0.010	<0.010	0.010	<0.010	<0.010	--
BA Bc 273	05-18-95	--	<1	--	--	--	--	--	--
BA Bc 274	06-07-95	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bc 275	07-05-95	--	<1	--	--	--	--	--	--
BA Bd 224	09-28-94	--	<1	--	--	--	--	--	--
BA Bd 225	11-21-94	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 226	12-12-94	--	<1	--	--	--	--	--	--
BA Bd 227	12-07-94	--	<1	--	--	--	--	--	--
BA Bd 229	01-11-95	--	<1	--	--	--	--	--	--
BA Bd 231	05-23-95	--	<1	--	--	--	--	--	--
BA Bd 232	07-19-95	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 233	10-15-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 234	10-16-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 235	10-15-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 236	10-16-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 237	10-23-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Bd 238	10-23-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Be 36	08-31-94	--	<1	--	--	--	--	--	--
BA Be 37	09-15-94	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Be 38	01-19-95	--	<1	--	--	--	--	--	--
BA Ca 66	07-19-95	--	<1	--	--	--	--	--	--
BA Ca 69	04-10-95	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Cb 126	09-28-94	--	<1	--	--	--	--	--	--
BA Cb 133	08-29-94	--	<1	--	--	--	--	--	--
BA Cb 134	09-13-94	--	<1	--	--	--	--	--	--
BA Cb 136	11-09-94	--	<1	--	--	--	--	--	--
	12-11-95	--	--	--	--	--	--	--	<5.00
BA Cb 137	12-22-94	--	<1	--	--	--	--	--	--
	12-12-95	--	--	--	--	--	--	--	<5.00
BA Cb 138	02-21-95	--	<1	--	--	--	--	--	--
	12-13-95	--	--	--	--	--	--	--	<5.00
BA Cb 139	04-19-95	--	<1	--	--	--	--	--	--

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Site number	Date	Aceto-chlor, (μg/L)	Ala-chlor, (μg/L)	Deethyl atra-zine, (μg/L)	Atra-zine, (μg/L)	Methyl azin-phos (μg/L)	Ben-flur-alin (μg/L)	Butyl-ate, (μg/L)
BA Cb 141	393456076494601	03-08-95	<0.002	E0.006	E0.260	E0.002	<0.001	<0.002	<0.002
BA Cb 142	393221076483401	03-22-95	<0.002	<0.002	E0.015	0.026	<0.001	<0.002	<0.002
		12-13-95	--	--	--	--	--	--	--
BA Cb 143	393114076462701	11-08-95	<0.002	<0.002	E0.013	0.020	<0.001	<0.002	<0.002
BA Cb 144	393036076452901	10-31-95	<0.002	<0.002	E0.052	0.031	<0.001	<0.002	<0.002
BA Cc 253	393427076412201	09-20-94	--	<0.002	0.022	<0.001	<0.001	<0.002	<0.002
		12-13-95	--	--	--	--	--	--	--
BA Cc 254	393418076435301	09-22-94	<0.002	<0.002	E0.038	0.003	<0.001	<0.002	<0.002
BA Cc 255	393002076334501	11-09-94	<0.002	<0.002	E0.140	0.031	<0.001	<0.002	<0.002
BA Cc 256	393117076440101	01-04-95	<0.002	<0.002	E0.023	0.005	<0.001	<0.002	<0.002
BA Cc 257	393058076441701	01-18-95	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Cc 258	393340076442501	03-13-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cc 259	393158076431301	10-30-95	<0.002	<0.002	E0.007	<0.001	<0.001	<0.002	<0.002
BA Cd 229	393150076374201	09-14-94	--	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 230	393426076361401	09-22-94	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Cd 231	393402076350901	10-20-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 232	393442076375301	11-01-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 234	393352076365301	12-06-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 235	393313076373701	11-30-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 236	393219076371901	01-11-95	<0.002	<0.002	E0.750	0.003	<0.001	<0.002	<0.002
BA Cd 237	393212076365901	04-20-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Cd 238	393221076375701	05-02-95	<0.002	<0.002	E0.110	0.065	<0.001	<0.002	<0.002
BA Cd 239	393155076385301	06-19-95	<0.002	<0.002	E0.270	0.700	<0.001	<0.002	<0.002
BA Cd 241	393019076391401	06-20-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ce 309	393008076334001	09-27-94	--	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ce 311	393002076354001	11-14-94	<0.002	<0.002	E0.008	<0.001	<0.001	<0.002	<0.002
BA Ce 312	393035076331701	04-18-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ce 313	393143076332601	08-11-95	<0.002	<0.002	E0.007	<0.001	<0.001	<0.002	<0.002
BA Da 120	392731076510601	08-03-94	--	<0.002	E0.028	<0.001	<0.001	<0.002	<0.002
BA Da 122	392703076510301	09-21-94	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Da 123	392538076510101	05-31-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Db 259	392803076455001	09-29-94	--	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Db 261	392843076473101	11-06-95	<0.002	<0.002	E0.021	0.008	<0.001	<0.002	<0.002
BA Dc 59	392620076440001	08-27-96	<0.002	<0.002	E0.039	0.065	<0.001	<0.002	<0.002
BA Dc 444	392931076410301	06-23-94	--	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		10-04-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		09-20-96	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Dc 445	392841076400201	08-04-94	--	<0.002	E0.750	0.240	<0.001	<0.002	<0.002
		12-12-95	--	--	--	--	--	--	--
BA Dc 446	392807076440401	08-15-94	--	<0.002	E0.056	<0.001	<0.001	<0.002	<0.002
BA Dc 447	392537076423301	09-13-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Dc 448	392730076420301	01-31-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Dc 449	392808076412401	06-06-95	<0.002	<0.002	E0.003	<0.001	<0.001	<0.002	<0.002
BA Dc 450	392650076433901	06-19-95	<0.002	<0.002	E0.004	<0.001	<0.001	<0.002	<0.002
BA Dc 451	392620076440101	12-06-95	<0.002	<0.002	E0.033	0.095	<0.001	<0.002	<0.002
BA Dd 300	392928076380601	02-27-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 632	392923076324901	10-20-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 633	392859076323601	11-17-94	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		12-12-95	--	--	--	--	--	--	--
BA De 635	392656076312001	01-26-95	<0.002	<0.002	E0.076	<0.001	<0.001	<0.002	<0.002
BA De 636	392959076310401	03-07-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 637	392837076333401	04-12-95	<0.002	<0.002	E0.001	<0.001	<0.001	<0.002	<0.002
BA De 638	392546076334501	07-05-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 639	392713076300101	10-31-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 640	392635076312501	12-07-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA De 641	392636076312501	12-07-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Df 351	392605076254601	08-09-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Df 352	392814076271101	07-20-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Df 353	392538076291401	05-30-95	<0.002	<0.002	E0.045	E0.011	<0.001	<0.002	<0.002
BA Df 354	392806076275401	11-02-95	<0.002	<0.002	E0.032	0.130	<0.001	<0.002	<0.002

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Carbaryl (μg/L)	Carbofuran (μg/L)	Chlorpyrifos (μg/L)	Cyanazine (μg/L)	DCPA (μg/L)	p,p' DDE (μg/L)	Diazinon (μg/L)	Dieldrin (μg/L)	2,6-Diethyl aniline (μg/L)
BA Cb 141	03-08-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cb 142	03-22-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-13-95	--	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.000	<0.002	<0.001	<0.003
BA Cb 144	10-31-95	<0.020	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cc 253	09-20-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-13-95	--	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	E0.009	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cc 255	11-09-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cc 256	01-04-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cc 257	01-18-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Cc 258	03-13-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cc 259	10-30-95	<0.025	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 229	09-14-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 230	09-22-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 231	10-20-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 232	11-01-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 234	12-06-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 235	11-30-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 236	01-11-95	<0.003	E0.130	<0.004	<0.004	<0.002	E0.001	<0.002	<0.001	<0.003
BA Cd 237	04-20-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 238	05-02-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 239	06-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Cd 241	06-20-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ce 309	09-27-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ce 311	11-14-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ce 312	04-18-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ce 313	08-11-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	E0.003	<0.001	<0.003
BA Da 120	08-03-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Da 122	09-21-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Da 123	05-31-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Db 259	09-29-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Db 261	11-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 59	08-27-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 444	06-23-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	10-04-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	09-20-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 445	08-04-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-12-95	--	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 447	09-13-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 448	01-31-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 449	06-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 450	06-19-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Dc 451	12-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.002	<0.002	<0.001	<0.003
BA Dd 300	02-27-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 632	10-20-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 633	11-17-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-12-95	--	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 636	03-07-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 637	04-12-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 638	07-05-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 639	10-31-95	<0.020	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 640	12-07-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA De 641	12-07-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.002	<0.002	<0.001	<0.003
BA Df 351	08-09-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Df 352	07-20-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Df 353	05-30-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Df 354	11-02-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Dimethoate (µg/L)	Disulfoton (µg/L)	EPTC (µg/L)	Ethalfluralin (µg/L)	Ethoprop (µg/L)	Fonofos (µg/L)	Alpha BHC (µg/L)	Lindane (µg/L)
BA Cb 141	03-08-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 142	03-22-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	--	<0.017	0.004	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cb 144	10-31-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 253	09-20-94	<0.02	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 255	11-09-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 256	01-04-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 257	01-18-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 258	03-13-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cc 259	10-30-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 229	09-14-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 230	09-22-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 231	10-20-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 232	11-01-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 234	12-06-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 235	11-30-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 236	01-11-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 237	04-20-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 238	05-02-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 239	06-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Cd 241	06-20-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ce 309	09-27-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ce 311	11-14-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ce 312	04-18-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ce 313	08-11-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Da 120	08-03-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Da 122	09-21-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Da 123	05-31-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Db 259	09-29-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Db 261	11-06-95	--	<0.017	<0.005	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 59	08-27-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 444	06-23-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	10-04-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	09-20-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 445	08-04-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 447	09-13-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 448	01-31-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 449	06-06-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 450	06-19-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dc 451	12-06-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dd 300	02-27-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 632	10-20-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 633	11-17-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 636	03-07-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 637	04-12-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 638	07-05-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 639	10-31-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 640	12-07-95	--	E0.007	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA De 641	12-07-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Df 351	08-09-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Df 352	07-20-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Df 353	05-30-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Df 354	11-02-95	--	<0.017	0.005	<0.004	<0.003	<0.003	<0.002	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Linuron (μg/L)	Malathion (μg/L)	Methyl parathion (μg/L)	Metolachlor (μg/L)	Metribuzin (μg/L)	Molinate (μg/L)	Napropamide (μg/L)	Parathion (μg/L)
BA Cb 141	03-08-95	<0.002	<0.005	<0.006	0.060	<0.004	<0.004	<0.003	<0.004
BA Cb 142	03-22-95	<0.002	<0.005	<0.006	0.002	<0.004	<0.004	<0.003	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.002	<0.005	<0.006	0.010	<0.004	<0.004	<0.003	<0.004
BA Cb 144	10-31-95	<0.002	<0.005	<0.006	0.013	<0.004	<0.004	<0.003	<0.004
BA Cc 253	09-20-94	<0.002	<0.005	<0.006	0.100	<0.004	<0.004	<0.003	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cc 255	11-09-94	<0.002	<0.005	<0.006	0.005	<0.004	<0.004	<0.003	<0.004
BA Cc 256	01-04-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cc 257	01-18-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cc 258	03-13-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cc 259	10-30-95	<0.002	<0.005	<0.006	0.005	<0.004	<0.004	<0.003	<0.004
BA Cd 229	09-14-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 230	09-22-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 231	10-20-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 232	11-01-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 234	12-06-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 235	11-30-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 236	01-11-95	<0.002	<0.005	<0.006	0.470	<0.004	<0.004	<0.003	<0.004
BA Cd 237	04-20-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Cd 238	05-02-95	<0.002	<0.005	<0.006	0.010	<0.004	<0.004	<0.003	<0.004
BA Cd 239	06-19-95	<0.002	<0.005	<0.006	5.40	<0.004	<0.004	<0.003	<0.004
BA Cd 241	06-20-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA Ce 309	09-27-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ce 311	11-14-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ce 312	04-18-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ce 313	08-11-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Da 120	08-03-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Da 122	09-21-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Da 123	05-31-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Db 259	09-29-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Db 261	11-06-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA Dc 59	08-27-96	<0.002	<0.005	<0.006	E0.003	<0.004	<0.004	<0.003	<0.004
BA Dc 444	06-23-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	10-04-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
	09-20-96	<0.002	<0.005	<0.006	<0.004	<0.004	<0.004	<0.003	<0.004
BA Dc 445	08-04-94	<0.002	<0.005	<0.006	0.014	<0.004	<0.004	<0.003	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	<0.002	<0.005	<0.006	0.018	<0.004	<0.004	<0.003	<0.004
BA Dc 447	09-13-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Dc 448	01-31-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Dc 449	06-06-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Dc 450	06-19-95	<0.002	<0.005	<0.006	0.040	<0.004	<0.004	<0.003	<0.004
BA Dc 451	12-06-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
BA Dd 300	02-27-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA De 632	10-20-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA De 633	11-17-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA De 636	03-07-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA De 637	04-12-95	<0.002	<0.005	<0.006	E0.001	<0.004	<0.004	<0.003	<0.004
BA De 638	07-05-95	<0.002	<0.005	<0.006	0.002	<0.004	<0.004	<0.003	0.022
BA De 639	10-31-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA De 640	12-07-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
BA De 641	12-07-95	<0.002	<0.005	<0.006	0.004	<0.004	<0.004	<0.003	<0.004
BA Df 351	08-09-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Df 352	07-20-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Df 353	05-30-95	<0.002	<0.005	<0.006	0.190	<0.004	<0.004	<0.003	<0.004
BA Df 354	11-02-95	<0.002	<0.005	<0.006	0.018	<0.004	<0.004	<0.003	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Pebulate (µg/L)	Pendimethalin (µg/L)	Permethrin cis (µg/L)	Phorate (µg/L)	Pronamide (µg/L)	Prometon (µg/L)	Propachlor (µg/L)	Propanil (µg/L)
BA Cb 141	03-08-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 142	03-22-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cb 144	10-31-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cc 253	09-20-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cc 255	11-09-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cc 256	01-04-95	<0.004	<0.004	<0.005	<0.002	<0.003	0.047	<0.007	<0.004
BA Cc 257	01-18-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cc 258	03-13-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cc 259	10-30-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 229	09-14-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 230	09-22-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 231	10-20-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 232	11-01-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 234	12-06-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 235	11-30-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 236	01-11-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 237	04-20-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 238	05-02-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 239	06-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Cd 241	06-20-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ce 309	09-27-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ce 311	11-14-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ce 312	04-18-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ce 313	08-11-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Da 120	08-03-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Da 122	09-21-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Da 123	05-31-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Db 259	09-29-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Db 261	11-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 59	08-27-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 444	06-23-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	10-04-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	09-20-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 445	08-04-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 447	09-13-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 448	01-31-95	<0.004	<0.004	<0.005	0.010	<0.003	<0.018	<0.007	<0.004
BA Dc 449	06-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 450	06-19-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dc 451	12-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dd 300	02-27-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 632	10-20-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 633	11-17-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 636	03-07-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 637	04-12-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 638	07-05-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 639	10-31-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 640	12-07-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA De 641	12-07-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Df 351	08-09-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Df 352	07-20-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Df 353	05-30-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Df 354	11-02-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Propargite (µg/L)	Simazine (µg/L)	Thiobencarb (µg/L)	Tebuthiuron (µg/L)	Terbacil (µg/L)	Terbufos (µg/L)	Trialate (µg/L)	Trifluralin (µg/L)
BA Cb 141	03-08-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 142	03-22-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cb 144	10-31-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 253	09-20-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 255	11-09-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 256	01-04-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 257	01-18-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 258	03-13-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cc 259	10-30-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 229	09-14-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 230	09-22-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 231	10-20-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 232	11-01-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 234	12-06-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 235	11-30-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 236	01-11-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 237	04-20-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 238	05-02-95	<0.013	0.013	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 239	06-19-95	<0.013	0.012	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Cd 241	06-20-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ce 309	09-27-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ce 311	11-14-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ce 312	04-18-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ce 313	08-11-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Da 120	08-03-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Da 122	09-21-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Da 123	05-31-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Db 259	09-29-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Db 261	11-06-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 59	08-27-96	<0.013	E0.004	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 444	06-23-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	10-04-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	09-20-96	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 445	08-04-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-12-95	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 447	09-13-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 448	01-31-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 449	06-06-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 450	06-19-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dc 451	12-06-95	<0.013	0.008	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dd 300	02-27-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 632	10-20-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 633	11-17-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 636	03-07-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 637	04-12-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 638	07-05-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 639	10-31-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 640	12-07-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA De 641	12-07-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Df 351	08-09-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Df 352	07-20-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Df 353	05-30-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Df 354	11-02-95	<0.013	0.061	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Carb-aryl (µg/L)	Metho-myl (µg/L)	Aldi-carb (µg/L)	Propo-xur (µg/L)	Propham (µg/L)	Carbo-Furan (µg/L)	1-Naph-thol (µg/L)	Methio-carb (µg/L)
BA Cb 141	03-08-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 142	03-22-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-13-95	--	--	--	--	--	--	--	--
BA Cb 143	11-08-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cb 144	10-31-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 253	09-20-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-13-95	--	--	--	--	--	--	--	--
BA Cc 254	09-22-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 255	11-09-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 256	01-04-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 257	01-18-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 258	03-13-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cc 259	10-30-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 229	09-14-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 230	09-22-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 231	10-20-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 232	11-01-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 234	12-06-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 235	11-30-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 236	01-11-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 237	04-20-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 238	05-02-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 239	06-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Cd 241	06-20-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ce 309	09-27-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ce 311	11-14-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ce 312	04-18-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ce 313	08-11-95	--	--	--	--	--	--	--	--
BA Da 120	08-03-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Da 122	09-21-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Da 123	05-31-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Db 259	09-29-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Db 261	11-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 59	08-27-96	<0.013	<0.017	<0.023	<0.015	<0.015	<0.013	<0.028	<0.023
BA Dc 444	06-23-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	10-04-95	--	--	--	--	--	--	--	--
	09-20-96	--	--	--	--	--	--	--	--
BA Dc 445	08-04-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-12-95	--	--	--	--	--	--	--	--
BA Dc 446	08-15-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 447	09-13-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 448	01-31-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 449	06-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 450	06-19-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dc 451	12-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dd 300	02-27-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 632	10-20-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 633	11-17-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-12-95	--	--	--	--	--	--	--	--
BA De 635	01-26-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 636	03-07-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 637	04-12-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 638	07-05-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 639	10-31-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 640	12-07-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA De 641	12-07-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Df 351	08-09-95	--	--	--	--	--	--	--	--
BA Df 352	07-20-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Df 353	05-30-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Df 354	11-02-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	2,4-D (lab) (µg/L)	2,4-D (immuno-assay) (µg/L)	Silvex (µg/L)	Pic-loram (µg/L)	2,4,5-T (µg/L)	2,4-DP (µg/L)	Dicamba (µg/L)	Glypho-sate (µg/L)
BA Cb 141	03-08-95	--	<1	--	--	--	--	--	--
BA Cb 142	03-22-95	--	<1	--	--	--	--	--	--
	12-13-95	--	--	--	--	--	--	--	<5.00
BA Cb 143	11-08-95	--	<1	--	--	--	--	--	<5.00
BA Cb 144	10-31-95	--	<1	--	--	--	--	--	<5.00
BA Cc 253	09-20-94	--	<1	--	--	--	--	--	--
	12-13-95	--	--	--	--	--	--	--	<5.00
BA Cc 254	09-22-94	--	<1	--	--	--	--	--	--
BA Cc 255	11-09-94	--	<1	--	--	--	--	--	--
BA Cc 256	01-04-95	--	<1	--	--	--	--	--	--
BA Cc 257	01-18-95	--	<1	--	--	--	--	--	--
BA Cc 258	03-13-95	--	<1	--	--	--	--	--	--
BA Cc 259	10-30-95	--	<1	--	--	--	--	--	<5.00
BA Cd 229	09-14-94	--	<1	--	--	--	--	--	--
BA Cd 230	09-22-94	--	<1	--	--	--	--	--	--
BA Cd 231	10-20-94	--	<1	--	--	--	--	--	--
BA Cd 232	11-01-94	--	<1	--	--	--	--	--	--
BA Cd 234	12-06-94	--	<1	--	--	--	--	--	--
BA Cd 235	11-30-94	--	<1	--	--	--	--	--	--
BA Cd 236	01-11-95	--	<1	--	--	--	--	--	--
BA Cd 237	04-20-95	--	<1	--	--	--	--	--	--
BA Cd 238	05-02-95	--	<1	--	--	--	--	--	--
BA Cd 239	06-19-95	--	<1	--	--	--	--	--	--
BA Cd 241	06-20-95	--	<1	--	--	--	--	--	--
BA Ce 309	09-27-94	--	<1	--	--	--	--	--	--
BA Ce 311	11-14-94	--	<1	--	--	--	--	--	--
BA Ce 312	04-18-95	--	<1	--	--	--	--	--	--
BA Ce 313	08-11-95	--	<1	--	--	--	--	--	--
BA Da 120	08-03-94	--	<1	--	--	--	--	--	--
BA Da 122	09-21-94	--	<1	--	--	--	--	--	--
BA Da 123	05-31-95	--	<1	--	--	--	--	--	--
BA Db 259	09-29-94	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Db 261	11-06-95	--	<1	--	--	--	--	--	<5.00
BA Dc 59	08-27-96	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA Dc 444	06-23-94	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010	--
	10-04-95	--	--	--	--	--	--	--	--
	09-20-96	--	--	--	--	--	--	--	--
BA Dc 445	08-04-94	--	<1	--	--	--	--	--	--
	12-12-95	--	--	--	--	--	--	--	<5.00
BA Dc 446	08-15-94	--	<1	--	--	--	--	--	--
BA Dc 447	09-13-94	--	<1	--	--	--	--	--	--
BA Dc 448	01-31-95	--	<1	--	--	--	--	--	--
BA Dc 449	06-06-95	--	<1	--	--	--	--	--	--
BA Dc 450	06-19-95	--	<1	--	--	--	--	--	--
BA Dc 451	12-06-95	--	<1	--	--	--	--	--	<5.00
BA Dd 300	02-27-95	--	<1	--	--	--	--	--	--
BA De 632	10-20-94	--	<1	--	--	--	--	--	--
BA De 633	11-17-94	--	<1	--	--	--	--	--	--
	12-12-95	--	--	--	--	--	--	--	<5.00
BA De 635	01-26-95	--	<1	--	--	--	--	--	--
BA De 636	03-07-95	--	<1	--	--	--	--	--	--
BA De 637	04-12-95	<0.010	<1	<0.010	<0.010	<0.010	<0.010	<0.010	--
BA De 638	07-05-95	--	<1	--	--	--	--	--	--
BA De 639	10-31-95	--	<1	--	--	--	--	--	<5.00
BA De 640	12-07-95	--	<1	--	--	--	--	--	--
BA De 641	12-07-95	--	<1	--	--	--	--	--	--
BA Df 351	08-09-95	--	<1	--	--	--	--	--	--
BA Df 352	07-20-95	--	<1	--	--	--	--	--	--
BA Df 353	05-30-95	--	<1	--	--	--	--	--	--
BA Df 354	11-02-95	--	<1	--	--	--	--	--	<5.00

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Site number	Date	Aceto-chlor, (µg/L)	Ala-chlor, (µg/L)	Deethyl atra-zine, (µg/L)	Atra-zine, (µg/L)	Methyl azin-phos (µg/L)	Ben-flur-alin (µg/L)	Butyl-ate, (µg/L)
BA Df 355	392904076291201	11-08-95	<0.002	<0.002	E0.077	0.068	<0.001	<0.002	<0.002
BA Dg 117	392610076241701	03-28-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ea 90	392206076503201	08-08-95	<0.002	<0.002	E0.004	0.004	<0.001	<0.002	<0.002
BA Ea 91	392410076514001	08-24-94	--	<0.002	E0.030	0.007	<0.001	<0.002	<0.002
BA Ea 92	392341076521801	02-02-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		08-21-96	<0.002	<0.002	<0.002	0.006	<0.001	<0.002	<0.002
BA Ea 93	392358076500901	02-14-95	<0.002	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
		12-11-95	--	--	--	--	--	--	--
BA Ea 95	392159076520101	06-06-95	<0.002	<0.002	E0.180	<0.001	<0.001	<0.002	<0.002
BA Eb 291	392025076465301	10-05-94	--	<0.002	<0.002	<0.001	<0.001	<0.002	<0.002
BA Ec 203	392430076410301	01-25-95	<0.002	<0.002	E0.011	<0.001	<0.001	<0.002	<0.002
BA Ec 204	392434076404301	07-06-95	<0.002	<0.002	<0.002	0.010	<0.001	<0.002	<0.002
BA Ec 205	392446076434101	11-07-95	<0.002	<0.002	E0.030	0.052	<0.001	<0.002	<0.002
BA Fb 81	391857076474301	01-10-95	<0.002	<0.002	E0.005	<0.001	<0.001	<0.002	<0.002
		12-11-95	--	--	--	--	--	--	--

Local name	Date	Car-baryl (µg/L)	Carbo-furan (µg/L)	Chlor-pyrifos (µg/L)	Cyana-zine (µg/L)	DCPA (µg/L)	p,p' DDE (µg/L)	Di-azinon (µg/L)	Di-eldrin (µg/L)	2,6-Di-ethyl aniline (µg/L)
BA Df 355	11-08-95	<0.003	<0.003	<0.004	<0.004	<0.002	E0.000	<0.002	<0.001	<0.003
BA Dg 117	03-28-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ea 90	08-08-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ea 91	08-24-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ea 92	02-02-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	08-21-96	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ea 93	02-14-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-11-95	--	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Eb 291	10-05-94	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ec 203	01-25-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ec 204	07-06-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Ec 205	11-07-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
BA Fb 81	01-10-95	<0.003	<0.003	<0.004	<0.004	<0.002	<0.006	<0.002	<0.001	<0.003
	12-11-95	--	--	--	--	--	--	--	--	--

Local name	Date	Dimeth-oate (µg/L)	Disul-foton (µg/L)	EPTC (µg/L)	Ethal-flur-alin (µg/L)	Etho-prop (µg/L)	Fonofos (µg/L)	Alpha BHC (µg/L)	Lindane (µg/L)
BA Df 355	11-08-95	--	<0.017	<0.005	<0.004	<0.003	<0.003	<0.002	<0.004
BA Dg 117	03-28-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ea 90	08-08-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ea 91	08-24-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ea 92	02-02-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	08-21-96	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ea 93	02-14-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Eb 291	10-05-94	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ec 203	01-25-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
BA Ec 204	07-06-95	--	<0.017	<0.002	<0.004	E0.002	<0.003	<0.002	<0.004
BA Ec 205	11-07-95	--	<0.017	<0.005	<0.004	<0.003	<0.003	<0.002	<0.004
BA Fb 81	01-10-95	--	<0.017	<0.002	<0.004	<0.003	<0.003	<0.002	<0.004
	12-11-95	--	--	--	--	--	--	--	--

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(μg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Linuron (μg/L)	Malathion (μg/L)	Methyl parathion (μg/L)	Metolachlor (μg/L)	Metribuzin (μg/L)	Molinate (μg/L)	Napropamide (μg/L)	Parathion (μg/L)
BA Df 355	11-08-95	<0.002	<0.005	<0.006	0.003	<0.004	<0.004	<0.003	<0.004
BA Dg 117	03-28-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ea 90	08-08-95	<0.002	<0.005	<0.006	0.002	<0.004	<0.004	<0.003	<0.004
BA Ea 91	08-24-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ea 92	02-02-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	08-21-96	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ea 93	02-14-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Eb 291	10-05-94	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
BA Ec 203	01-25-95	<0.002	<0.005	<0.006	0.007	<0.004	<0.004	<0.003	<0.004
BA Ec 204	07-06-95	<0.002	<0.005	<0.006	0.002	<0.004	<0.004	<0.003	<0.004
BA Ec 205	11-07-95	<0.002	<0.005	<0.006	0.006	<0.004	<0.004	<0.003	<0.004
BA Fb 81	01-10-95	<0.002	<0.005	<0.006	<0.002	<0.004	<0.004	<0.003	<0.004
	12-11-95	--	--	--	--	--	--	--	--

Local name	Date	Pebulate (μg/L)	Pendimethalin (μg/L)	Permethrin cis (μg/L)	Phorate (μg/L)	Pronamide (μg/L)	Prometon (μg/L)	Propachlor (μg/L)	Propanil (μg/L)
BA Df 355	11-08-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Dg 117	03-28-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ea 90	08-08-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ea 91	08-24-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ea 92	02-02-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	08-21-96	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ea 93	02-14-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-11-95	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Eb 291	10-05-94	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ec 203	01-25-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ec 204	07-06-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
BA Ec 205	11-07-95	<0.004	<0.004	<0.005	<0.002	<0.003	E0.008	<0.007	<0.004
BA Fb 81	01-10-95	<0.004	<0.004	<0.005	<0.002	<0.003	<0.018	<0.007	<0.004
	12-11-95	--	--	--	--	--	--	--	--

Local name	Date	Propargite (μg/L)	Simazine (μg/L)	Thiobencarb (μg/L)	Tebuthiuron (μg/L)	Terbacil (μg/L)	Terbufos (μg/L)	Trialate (μg/L)	Trifluralin (μg/L)
BA Df 355	11-08-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Dg 117	03-28-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ea 90	08-08-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ea 91	08-24-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ea 92	02-02-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	08-21-96	<0.013	E0.003	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ea 93	02-14-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-11-95	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Eb 291	10-05-94	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ec 203	01-25-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ec 204	07-06-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Ec 205	11-07-95	<0.013	0.029	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
BA Fb 81	01-10-95	<0.013	<0.005	<0.002	<0.010	<0.007	<0.013	<0.001	<0.002
	12-11-95	--	--	--	--	--	--	--	--

Table A2, continued.
Pesticide data from Baltimore County wells and springs.

(µg/L, micrograms per liter; <, less than; E, estimated value)

Local name	Date	Carb-aryl (µg/L)	Metho-myl (µg/L)	Aldi-carb (µg/L)	Propo-xur (µg/L)	Propham (µg/L)	Carbo-Furan (µg/L)	1-Naph-thol (µg/L)	Methio-carb (µg/L)
BA Df 355	11-08-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Dg 117	03-28-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ea 90	08-08-95	--	--	--	--	--	--	--	--
BA Ea 91	08-24-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ea 92	02-02-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	08-21-96	--	--	--	--	--	--	--	--
BA Ea 93	02-14-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-11-95	--	--	--	--	--	--	--	--
BA Ea 95	06-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Eb 291	10-05-94	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ec 203	01-25-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ec 204	07-06-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Ec 205	11-07-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
BA Fb 81	01-10-95	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	12-11-95	--	--	--	--	--	--	--	--

Local name	Date	2,4-D (lab) (µg/L)	2,4-D (immuno-assay) (µg/L)	Silvex (µg/L)	Pic-loram (µg/L)	2,4,5-T (µg/L)	2,4-DP (µg/L)	Dicamba (µg/L)	Glypho-sate (µg/L)
BA Df 355	11-08-95	--	<1	--	--	--	--	--	<5.00
BA Dg 117	03-28-95	--	<1	--	--	--	--	--	--
BA Ea 90	08-08-95	--	<1	--	--	--	--	--	--
BA Ea 91	08-24-94	--	<1	--	--	--	--	--	--
BA Ea 92	02-02-95	--	<1	--	--	--	--	--	--
	08-21-96	--	--	--	--	--	--	--	--
BA Ea 93	02-14-95	--	<1	--	--	--	--	--	--
	12-11-95	--	--	--	--	--	--	--	<5.00
BA Ea 95	06-06-95	--	<1	--	--	--	--	--	--
BA Eb 291	10-05-94	--	<1	--	--	--	--	--	--
BA Ec 203	01-25-95	--	<1	--	--	--	--	--	--
BA Ec 204	07-06-95	--	<1	--	--	--	--	--	--
BA Ec 205	11-07-95	--	<1	--	--	--	--	--	<5.00
BA Fb 81	01-10-95	--	<1	--	--	--	--	--	--
	12-11-95	--	--	--	--	--	--	--	<5.00

Table A3.
Monthly water-quality data from selected Baltimore County wells. Additional water-quality data for these wells is in tables A1 and A2.

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; GC/MS, gas chromatography/mass spectrometry; <, less than; E, estimated)

Local name	Site number	Date	Water temperature (deg. C)	Specific conductance (µS/cm)	pH	Chloride (mg/L)	Nitrate plus nitrite (mg/L as N)	Atrazine (GC/MS) (µg/L)	Atrazine (immunoassay) (µg/L)
BA Bc 267	393633076443801	12-21-94	12.0	413	5.7	82	8.50	0.290	0.5
		05-09-95	13.0	424	5.5	80	9.80	--	0.6
		06-13-95	14.0	426	5.5	82	10.0	--	0.6
		07-13-95	14.0	426	5.6	82	2.00	--	0.7
		08-07-95	14.0	431	5.7	80	10.0	--	0.8
		09-12-95	14.0	427	5.7	75	11.0	--	1.1
		10-11-95	13.5	439	5.7	84	10.0	--	0.8
		11-15-95	12.0	449	5.6	87	--	--	0.7
		12-12-95	11.5	452	5.6	91	11.0	--	0.7
		01-17-96	12.0	467	5.6	92	10.0	--	0.5
		02-14-96	11.0	458	5.6	92	11.0	--	0.6
		03-12-96	11.5	451	5.6	87	9.90	--	0.6
		04-15-96	12.0	450	5.6	86	10.0	--	0.5
BA Cb 136	393119076454501	11-09-94	15.0	296	6.0	49	7.40	0.530	--
		05-09-95	12.5	299	5.8	51	7.20	--	1.0
		06-12-95	14.0	299	5.9	50	7.90	--	1.0
		07-12-95	17.0	313	5.7	52	10.0	--	1.0
		08-08-95	20.0	300	5.9	53	8.80	--	1.2
		09-11-95	16.5	294	6.0	50	7.40	--	1.2
		10-10-95	14.0	299	5.9	51	7.60	--	1.3
		11-14-95	15.5	310	5.9	53	--	--	1.2
		12-11-95	12.5	307	5.7	50	7.60	--	1.3
		01-16-96	10.5	308	5.9	51	7.70	--	1.0
		02-13-96	10.0	308	5.9	51	8.40	--	1.2
		03-12-96	10.5	305	5.9	50	7.40	--	1.2
		04-17-96	11.5	301	5.8	50	7.60	--	1.3
BA Cb 137	393403076454201	12-22-94	12.5	132	5.8	10	8.10	0.800	--
		05-09-95	13.5	133	5.5	10	8.40	--	1.2
		06-13-95	14.5	135	5.5	11	9.00	--	1.4
		07-13-95	15.0	135	5.6	11	5.80	--	1.4
		08-07-95	14.5	134	5.6	10	8.50	--	1.9
		09-12-95	14.5	133	5.5	11	8.40	--	1.5
		10-11-95	13.5	132	5.7	10	8.20	--	1.8
		11-15-95	12.0	134	5.6	10	--	--	1.6
		12-12-95	11.5	131	5.6	11	7.80	--	1.5
		01-18-96	11.0	132	5.7	10	7.80	--	1.1
		02-15-96	11.5	132	5.9	11	7.80	0.510	1.6
		03-12-96	11.5	133	5.7	10	7.90	--	1.6
		04-15-96	12.0	135	5.6	11	8.80	--	1.6
BA Cb 138	393237076495601	02-21-95	12.0	276	6.1	32	12.0	0.004	<0.05
		05-08-95	12.5	286	6.0	33	11.0	--	<0.05
		06-13-95	13.0	290	5.9	35	12.0	--	<0.05
		07-13-95	13.5	290	6.0	33	12.0	--	<0.05
		08-09-95	13.0	290	6.0	34	11.0	--	E0.06
		09-12-95	12.5	288	6.0	34	12.0	--	0.2
		10-11-95	12.5	286	5.9	34	12.0	--	E0.07
		11-16-95	12.0	285	6.0	33	--	--	E0.09
		12-13-95	11.5	289	5.9	33	11.0	--	<0.05
		01-18-96	12.5	280	6.0	32	11.0	--	<0.05
		02-15-96	12.0	276	6.2	32	10.0	--	<0.05
		03-12-96	12.0	265	6.0	31	9.90	--	0.1
		04-15-96	12.0	259	5.9	30	10.0	--	E0.09
BA Cb 142	393221076483401	03-22-95	13.0	183	6.0	6.8	6.10	0.026	<0.05
		05-08-95	13.5	191	5.9	8.2	6.10	--	<0.05
		06-13-95	14.0	197	6.0	9.3	6.70	--	<0.05
		07-13-95	14.0	197	6.1	9.2	7.40	--	<0.05
		08-07-95	14.0	234	6.2	15	7.80	--	E0.07
		09-12-95	14.0	205	6.1	8.7	6.50	--	0.2
		10-11-95	14.0	214	6.1	12	6.40	--	E0.06
		11-16-95	13.0	202	6.0	6.9	--	--	E0.05
		12-13-95	13.0	199	6.0	10	6.20	--	<0.05
		01-18-96	13.0	203	6.0	13	5.90	--	<0.05
		02-15-96	12.5	185	6.0	10	5.70	--	<0.05
		03-13-96	13.0	189	5.9	9.6	6.20	--	E0.07
		04-17-96	13.0	181	5.7	7.6	5.40	--	<0.05

Table A3, continued.

Monthly water-quality data from selected Baltimore County wells. Additional water-quality data for these wells is in tables A1 and A2.

(µS/cm, microsiemens per centimeter at 25 deg. C; mg/L, milligrams per liter; µg/L, micrograms per liter; GC/MS, gas chromatography/mass spectrometry; <, less than; E, estimated)

Local name	Site number	Date	Water temperature (deg. C)	Specific conductance (µS/cm)	pH	Chloride (mg/L)	Nitrate plus nitrite (mg/L as N)	Atrazine (GC/MS) (µg/L)	Atrazine (immunoassay) (µg/L)
BA Cc 253	393427076412201	09-20-94	12.5	628	6.0	170	0.200	<0.001	--
		05-08-95	12.5	600	5.9	150	0.210	--	<0.05
		06-13-95	13.0	615	5.8	160	0.200	--	<0.05
		07-13-95	13.0	648	5.8	160	0.180	--	<0.05
		08-07-95	13.0	618	5.9	160	0.200	--	E0.06
		09-12-95	12.5	627	5.9	160	0.190	--	0.1
		10-11-95	12.5	626	6.0	170	0.220	--	E0.06
		11-15-95	12.0	632	6.0	160	--	--	E0.07
		12-13-95	12.0	645	5.9	170	0.230	--	<0.05
		01-17-96	12.0	611	6.0	160	0.270	--	E0.05
		02-14-96	12.5	605	5.9	160	0.260	--	<0.05
		03-13-96	11.0	583	5.8	150	0.260	--	<0.05
		04-15-96	11.5	--	5.9	140	0.190	--	E0.06
BA Dc 445	392841076400201	08-04-94	14.5	515	7.6	17	9.00	0.240	--
		05-08-95	13.5	516	7.4	16	8.20	--	0.8
		06-12-95	15.0	520	--	16	9.10	--	0.9
		07-12-95	15.5	527	7.5	17	5.80	--	1.0
		08-09-95	14.5	526	7.4	17	9.00	--	1.2
		09-11-95	15.5	525	7.5	18	9.00	--	1.3
		10-10-95	15.0	525	7.5	17	9.10	--	1.2
		11-14-95	11.0	533	7.5	17	--	--	1.1
		12-12-95	11.5	529	7.5	18	8.80	--	0.9
		01-17-96	10.5	533	7.5	18	8.90	--	0.8
		02-14-96	10.5	535	7.5	17	9.90	--	1.0
		03-12-96	10.0	536	7.4	18	8.90	--	1.0
		04-17-96	12.0	535	7.3	17	8.60	0.310	1.0
BA De 633	392859076323601	11-17-94	13.0	148	5.7	12	5.90	<0.001	--
		05-08-95	13.5	140	5.6	11	5.30	--	<0.05
		06-13-95	14.5	148	5.7	12	5.80	--	<0.05
		07-13-95	14.5	142	5.7	12	5.40	--	<0.05
		08-09-95	14.5	153	5.6	13	5.60	--	<0.05
		09-11-95	14.5	141	5.5	12	5.90	--	<0.05
		10-10-95	14.5	152	5.7	13	5.80	--	<0.05
		11-15-95	12.0	133	5.7	9.8	--	--	<0.05
		12-12-95	11.5	127	5.5	10	4.90	--	<0.05
		01-17-96	12.0	129	5.7	10	4.70	--	<0.05
		02-14-96	12.0	127	5.6	9.7	4.40	--	<0.05
		03-13-96	11.0	134	5.6	11	5.40	--	<0.05
		04-17-96	12.5	143	5.5	10	4.90	<0.001	<0.05
BA Ea 93	392358076500901	02-14-95	12.0	498	6.3	81	0.640	<0.001	--
		05-09-95	13.0	509	6.0	76	0.670	--	<0.05
		06-12-95	13.5	508	6.1	76	0.520	--	<0.05
		07-12-95	13.0	514	6.3	80	0.600	--	<0.05
		08-08-95	13.0	498	6.1	75	0.740	--	E0.05
		09-11-95	13.0	492	6.2	79	0.810	--	E0.06
		10-10-95	13.0	491	6.2	72	0.880	--	<0.05
		11-14-95	12.0	489	6.2	72	--	--	<0.05
		12-11-95	11.5	488	6.1	72	0.940	--	<0.05
		01-16-96	12.0	485	6.2	72	0.810	--	<0.05
		02-13-96	12.0	481	6.2	70	0.830	--	<0.05
		03-11-96	12.0	--	6.1	71	0.760	--	<0.05
		04-16-96	12.0	484	6.1	72	0.490	--	<0.05
BA Fb 81	391857076474301	01-10-95	12.0	1220	6.3	280	0.320	<0.001	--
		05-09-95	13.5	1470	6.2	370	0.380	--	<0.05
		06-12-95	14.0	1390	6.3	370	0.430	--	<0.05
		07-12-95	14.5	1130	6.3	390	0.430	--	<0.05
		08-08-95	14.5	1490	6.3	390	0.420	--	<0.05
		09-11-95	14.0	1090	6.4	260	0.320	--	E0.05
		10-10-95	14.0	1510	6.0	400	0.450	--	<0.05
		11-14-95	12.5	1640	6.3	430	--	--	<0.05
		12-11-95	12.5	1660	6.4	450	0.570	--	<0.05
		01-16-96	12.0	1660	6.4	430	0.530	--	<0.05
		02-13-96	12.0	1450	6.4	--	0.550	--	<0.05
		03-11-96	11.5	--	6.3	310	0.430	--	<0.05
		04-16-96	12.5	1570	6.3	400	0.440	--	<0.05

APPENDIX B

WELL AND SPRING CHARACTERISTICS

EXPLANATION

Use of water:

- H: domestic supply
- Q: aquaculture
- I: institutional
- R: irrigation
- U: unused
- Z: other

Topographic position:

- H: hilltop
- S: hillside
- V: valley
- F: flat
- G: floodplain

Casing material:

- S: steel
- P: plastic

Phase of study:

- I: Phase I sample
- II: Phase II sample
- N: $^{15}N_{NO3}$
- T: tritium
- M: monthly samples
- C: Coachmans Field
- O: ongoing monitoring

Land-use category:

- A: agricultural
- R: residential
- F: forest
- C: commercial

Land use:

- 11: low-density residential
- 12: medium-density residential
- 14: commercial
- 21: cropland
- 22: pasture/grassland
- 41: deciduous forest
- 42: evergreen forest
- 43: mixed deciduous and evergreen forest
- 191: very low-density residential (dominant land cover: fields and pasture)
- 192: very low-density residential (dominant land cover: forest)

Table B1.
Well characteristics and site information for wells sampled during this study.

Well name	Latitude	Longitude	Well permit number	7.5′ USGS quadrangle	Elevation (ft)	Geologic unit	Date of construction
BA Ab 51	39-42-06	76-47-02	BA-73-2437	Lineboro	860	Prettyboy Schist	10-02-1975
BA Ab 52	39-40-11	76-46-56	BA-81-3705	Lineboro	730	Prettyboy Schist	05-03-1985
BA Ac 151	39-40-54	76-42-33	BA-81-5780	New Freedom	760	Prettyboy Schist	05-04-1987
BA Ad 145	39-41-30	76-36-01	BA-92-0820	Norrisville	690	Prettyboy Schist	08-06-1992
BA Ad 146	39-40-19	76-37-45	BA-73-4177	New Freedom	720	Prettyboy Schist	04-29-1977
BA Ad 147	39-42-43	76-38-32	BA-81-7652	New Freedom	780	Prettyboy Schist	03-30-1988
BA Ad 148	39-43-03	76-35-54	BA-73-7139	Norrisville	610	Prettyboy Schist	02-20-1980
BA Ad 149	39-42-50	76-37-08	BA-73-5817	Norrisville	730	Prettyboy Schist	06-28-1978
BA Ae 19	39-40-13	76-34-30	BA-73-6379	Norrisville	660	Prettyboy Schist	01-11-1979
BA Bb 136	39-39-37	76-48-21	BA-88-3029	Lineboro	720	Prettyboy Schist	01-04-1991
BA Bb 138	39-35-43	76-45-13	BA-73-0458	Hampstead	690	Prettyboy Schist	03-02-1973
BA Bb 139	39-38-43	76-46-24	BA-81-1319	Lineboro	620	Prettyboy Schist	03-10-1983
BA Bb 140	39-37-46	76-47-00	BA-73-1369	Lineboro	670	Prettyboy Schist	06-10-1974
BA Bb 141	39-37-23	76-47-14	BA-73-3427	Hampstead	640	Prettyboy Schist	09-21-1976
BA Bb 143	39-36-07	76-48-50	BA-73-7826	Hampstead	760	Prettyboy Schist	12-17-1980
BA Bb 144	39-35-44	76-46-34	BA-88-2003	Hampstead	660	Prettyboy Schist	02-05-1990
BA Bb 145	39-35-45	76-46-02	BA-81-0279	Hampstead	690	Prettyboy Schist	10-14-1981
BA Bb 147	39-36-42	76-49-30	BA-73-3156	Hampstead	800	Prettyboy Schist	06-29-1976
BA Bb 148	39-37-07	76-45-08	BA-73-7404	Hampstead	710	Prettyboy Schist	06-13-1980
BA Bb 151	39-36-43	76-48-02	BA-88-0193	Hampstead	660	Prettyboy Schist	12-10-1988
BA Bc 267	39-36-33	76-44-38	BA-81-0773	Hereford	630	Prettyboy Schist	05-18-1982
BA Bc 268	39-39-29	76-44-13	BA-73-6575	New Freedom	620	Prettyboy Schist	05-07-1979
BA Bc 270	39-39-18	76-41-31	BA-81-2191	New Freedom	790	Prettyboy Schist	12-20-1983
BA Bc 271	39-38-18	76-41-15	BA-81-3519	New Freedom	690	Prettyboy Schist	03-04-1986
BA Bc 272	39-38-03	76-42-01	BA-88-1530	New Freedom	760	Prettyboy Schist	09-15-1989
BA Bc 273	39-37-55	76-40-28	BA-88-0280	New Freedom	660	Prettyboy Schist	02-06-1989
BA Bc 274	39-36-39	76-43-55	BA-81-1708	Hereford	610	Prettyboy Schist	07-05-1983
BA Bc 275	39-35-34	76-40-16	BA-88-2684	Hereford	620	Piney Run Formation	09-19-1990
BA Bd 224	39-35-20	76-37-19	BA-81-8015	Phoenix	530	Loch Raven Schist	04-26-1988
BA Bd 225	39-39-02	76-37-13	BA-88-2525	Norrisville	580	Prettyboy Schist	07-27-1990
BA Bd 226	39-39-36	76-35-21	BA-81-8768	Norrisville	700	Prettyboy Schist	10-01-1988
BA Bd 227	39-39-28	76-38-13	BA-81-2738	New Freedom	590	Prettyboy Schist	06-14-1984
BA Bd 229	39-37-41	76-38-06	BA-81-4748	New Freedom	400	Pleasant Grove Schist	03-25-1986
BA Bd 231	39-37-32	76-35-41	BA-81-7350	Norrisville	520	Loch Raven Schist	10-26-1987

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Driller	Use of water	Topographic position	Well depth (ft below land surface)	Bottom of grout (ft below land surface)	Bottom of casing (ft below land surface)
BA Ab 51	James	H	H	150	55	55
BA Ab 52	Barber Bros.	H	S	100	24	24
BA Ac 151	Jones	H	S	198	57	57
BA Ad 145	Reider/Harr	H	H	240	40	40
BA Ad 146	James	H	H	100	48	48
BA Ad 147	Harr	H	S	200	64	64
BA Ad 148	Kyker	H	S	403	40	40
BA Ad 149	Reider	H	S	300	73	73
BA Ae 19	Leonard	H	S	225	65	65
BA Bb 136	Reichart	H	S	200	19	20
BA Bb 138	Jones	H	H	120	20	37
BA Bb 139	Phillips	H	S	200	24	24
BA Bb 140	James	H	H	116	35	35
BA Bb 141	Leonard	H	S	125	39	39
BA Bb 143	Kyker	H	S	252	84	86
BA Bb 144	--	H	S	110	48	48
BA Bb 145	Caswell	H	S	225	72	72
BA Bb 147	Harr	H	H	200	55	55
BA Bb 148	Campbell	H	S	300	28	28
BA Bb 151	Reichart	U	S	200	38	41
BA Bc 267	Caswell	H	H	150	39	39
BA Bc 268	James	Z	S	120	63	63
BA Bc 270	Harr	H	H	250	84	84
BA Bc 271	Harr	H	S	300	50	50
BA Bc 272	Jones	H	S	385	29	29
BA Bc 273	Jones	H	S	350	95	95
BA Bc 274	Barber Bros.	H	S	325	69	69
BA Bc 275	Harr	Z	S	225	49	49
BA Bd 224	Campbell	H	H	105	32	32
BA Bd 225	Harr	H	S	150	21	21
BA Bd 226	Jones	H	S	300	70	70
BA Bd 227	Harr	H	H	200	20	20
BA Bd 229	Jones	H	S	147	23	23
BA Bd 231	Reichart	H	S	150	19	20

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Casing diameter (inches)	Casing material	Discharge (gallons per minute)	Pumping water level (ft below land surface)	Static water level (ft below land surface)	Pumping period (hours)	Specific capacity (gallons per minute per ft)	Drawdown (ft)
BA Ab 51	6	S	5	66	66	6	--	0
BA Ab 52	6	S	12	42	32	3	1.2	10
BA Ac 151	5	S	14	80	62	3	0.78	18
BA Ad 145	6	S	5	220	21	2	0.03	199
BA Ad 146	6	S	10	52	50	6	5	2
BA Ad 147	6	P	16.6	63	51	3	1.38	12
BA Ad 148	6	S	1.5	398	31	7.5	0	367
BA Ad 149	6	S	2	212	61	6	0.01	151
BA Ae 19	6	S	9	67	40	6	0.33	27
BA Bb 136	6	S	4	200	18	1	0.02	182
BA Bb 138	6	S	10	91	30	6	0.16	61
BA Bb 139	6	S	6	119	33.9	3	0.07	85.4
BA Bb 140	6	S	6	55	40	6	0.4	15
BA Bb 141	6	S	12	100	70	6	0.4	30
BA Bb 143	6	S	7	62.4	26.6	6	0.2	35.8
BA Bb 144	6	S	20	21	15	3	3.33	6
BA Bb 145	6	S	9	174	35	3	0.06	139
BA Bb 147	6	S	3	45	40	6	0.6	5
BA Bb 148	6	S	1	100	35	6	0.02	65
BA Bb 151	6	S	9	52	42	3	0.9	10
BA Bc 267	6	S	10	125	30	3	0.11	95
BA Bc 268	6	S	10	120	50	1	0.14	70
BA Bc 270	6	S	11.5	236	70	3	0.07	166
BA Bc 271	6	S	6.22	278	48	6	0.03	230
BA Bc 272	6	P	2	330	38	6	0.01	292
BA Bc 273	6	P	2	250	36	7	0.01	214
BA Bc 274	6	S	2	270	29	7	0.01	251
BA Bc 275	6	S	10	200	35	1	0.06	165
BA Bd 224	6	S	10	53	53	3	--	0
BA Bd 225	6	S	18	46	35	3	1.64	11
BA Bd 226	6	P	12	74	27	3	0.26	47
BA Bd 227	6	S	23	58	49	3	2.56	9
BA Bd 229	6	P	5	130	47	3	0.06	83
BA Bd 231	6	S	8.5	107	18	6	0.1	89

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Watershed	Subshed	Land use at site	Land-use category at site	Dominant land use within 1,000 ft of site	Dominant land-use category within 1,000 ft of site
BA Ab 51	Prettyboy	Walker Run	21	A	21	A
BA Ab 52	Prettyboy	Poplar Run	11	R	41	F
BA Ac 151	Loch Raven	Little Falls	41	F	41	F
BA Ad 145	Deer Creek	Deer Creek	21	A	21	A
BA Ad 146	Loch Raven	Third Mine Branch	41	F	41	F
BA Ad 147	Deer Creek	Harris Mill	21	A	21	A
BA Ad 148	Deer Creek	Deer Creek	21	A	21	A
BA Ad 149	Deer Creek	Harris Mill	41	F	41	F
BA Ae 19	Deer Creek	Plumtree Branch	192	R	192	R
BA Bb 136	Prettyboy	Grave Run	21	A	21	A
BA Bb 138	Loch Raven	Blackrock Run	11	R	11	A
BA Bb 139	Prettyboy	Prettyboy Direct Drainage	11	R	42	F
BA Bb 140	Prettyboy	Prettyboy Direct Drainage	21	A	21	A
BA Bb 141	Prettyboy	Georges Run	41	F	41	F
BA Bb 143	Prettyboy	Peggy's Run	21	A	21	A
BA Bb 144	Loch Raven	Blackrock Run	21	A	21	A
BA Bb 145	Loch Raven	Blackrock Run	11	R	11	R
BA Bb 147	Prettyboy	Murphy Run	42	F	21	A
BA Bb 148	Prettyboy	Prettyboy Direct Drainage	21	A	21	A
BA Bb 151	Prettyboy	Peggy's Run	21	A	21	A
BA Bc 267	Prettyboy	Prettyboy Branch	21	A	21	A
BA Bc 268	Prettyboy	Prettyboy Direct Drainage	21	A	41	F
BA Bc 270	Loch Raven	Owl Branch	41	F	11	R
BA Bc 271	Loch Raven	Owl Branch	11	R	11	R
BA Bc 272	Loch Raven	Gunpowder Falls	11	R	11	R
BA Bc 273	Loch Raven	Gunpowder Falls	21	A	21	A
BA Bc 274	Prettyboy	Prettyboy Branch	21	A	21	A
BA Bc 275	Loch Raven	Mingo Branch	14	C	14	C
BA Bd 224	Loch Raven	Gunpowder Falls	41	F	41	F
BA Bd 225	Loch Raven	Third Mine Branch	42	F	41	F
BA Bd 226	Loch Raven	Second Mine Branch	21	A	21	A
BA Bd 227	Loch Raven	Fourth Mine Branch	42	F	21	F
BA Bd 229	Loch Raven	Little Falls	11	R	41	F
BA Bd 231	Loch Raven	First Mine Branch	41	F	41	F

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	USGS site identification number	Phase of study	Comments
BA Ab 51	394206076470201	I,II(T,N)	
BA Ab 52	394011076465601	I	
BA Ac 151	394057076423301	I	2 open intervals
BA Ad 145	394130076360101	I,II(N)	
BA Ad 146	394019076374501	I,II(T,O)	
BA Ad 147	394243076383201	I,II(N)	
BA Ad 148	394303076355401	I	
BA Ad 149	394250076370801	I	
BA Ae 19	394013076343001	I	
BA Bb 136	393937076482101	I	
BA Bb 138	393543076451301	I	
BA Bb 139	393843076462401	I,II(T)	
BA Bb 140	393746076470001	I	
BA Bb 141	393723076471401	I,II(T)	
BA Bb 143	393607076485001	I	
BA Bb 144	393544076463401	I	
BA Bb 145	393540076455801	I	
BA Bb 147	393641076493501	I,II(T)	
BA Bb 148	393707076450801	I	
BA Bb 151	393643076480201	I	
BA Bc 267	393633076443801	I,II(N,M)	
BA Bc 268	393929076441301	I	
BA Bc 270	393918076412801	I	
BA Bc 271	393818076411501	I	
BA Bc 272	393803076420101	I	
BA Bc 273	393755076402801	I	
BA Bc 274	393639076435501	I,II(T)	
BA Bc 275	393534076401601	I	
BA Bd 224	393520076372201	I,II(T)	
BA Bd 225	393902076371301	I	
BA Bd 226	393936076352101	I	
BA Bd 227	393928076381301	I	
BA Bd 229	393741076380601	I	
BA Bd 231	393732076354101	I	

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Latitude	Longitude	Well permit number	USGS 7.5′ quadrangle	Elevation (ft)	Geologic unit	Date of construction
BA Bd 232	39-35-54	76-38-44	BA-92-0818	Hereford	600	Piney Run Formation	09-02-1992
BA Bd 233	39-37-32	76-39-24	BA-88-0212	New Freedom	580	Pleasant Grove Schist	02-10-1993
BA Bd 234	39-37-39	76-39-18	BA-88-0204	New Freedom	590	Pleasant Grove Schist	12-22-1992
BA Bd 235	39-37-36	76-39-10	BA-88-0246	New Freedom	570	Pleasant Grove Schist	10-04-1993
BA Bd 236	39-37-42	76-39-07	BA-88-0236	New Freedom	560	Pleasant Grove Schist	01-26-1993
BA Bd 237	39-37-38	76-39-14	BA-88-0207	New Freedom	590	Pleasant Grove Schist	12-14-1992
BA Bd 238	39-37-36	76-39-04	BA-88-0243	New Freedom	570	Pleasant Grove Schist	11-24-1992
BA Be 36	39-35-46	76-34-12	BA-88-1435	Phoenix	670	Loch Raven Schist	10-16-1989
BA Be 38	39-35-21	76-34-48	BA-73-1558	Phoenix	470	Setters Formation	07-19-1974
BA Ca 66	39-33-55	76-50-19	BA-73-5581	Hampstead	790	Prettyboy Schist	04-18-1978
BA Ca 69	39-32-22	76-51-05	BA-81-1461	Hampstead	650	Prettyboy Schist	04-20-1983
BA Cb 126	39-32-41	76-47-24	BA-73-5061	Hampstead	570	Pleasant Grove Schist	12-08-1977
BA Cb 133	39-30-28	76-46-53	BA-81-0622	Hampstead	500	Baltimore Gneiss	03-30-1982
BA Cb 134	39-32-43	76-45-09	BA-73-8150	Hampstead	630	Piney Run Formation	04-23-1981
BA Cb 136	39-31-15	76-45-45	BA-81-1142	Hampstead	440	Baltimore Gneiss	01-13-1983
BA Cb 137	39-34-03	76-45-42	BA-81-5968	Hampstead	630	Pleasant Grove Schist	01-12-1987
BA Cb 138	39-32-37	76-49-56	BA-88-1126	Hampstead	690	Prettyboy Schist	06-12-1989
BA Cb 139	39-32-28	76-49-32	BA-81-6420	Hampstead	660	Pleasant Grove Schist	04-07-1987
BA Cb 141	39-34-56	76-49-48	BA-81-3257	Hampstead	830	Prettyboy Schist	01-25-1985
BA Cb 142	39-32-21	76-48-34	BA-73-4878	Hampstead	625	Pleasant Grove Schist	12-30-1977
BA Cb 143	39-31-14	76-46-27	BA-92-0543	Hampstead	440	Cockeysville Marble	07-14-1992
BA Cb 144	39-30-36	76-45-29	BA-81-7098	Hampstead	430	Cockeysville Marble	09-21-1987
BA Cc 253	39-34-27	76-41-22	BA-81-1011	Hereford	630	Loch Raven Schist	09-29-1982
BA Cc 254	39-34-18	76-43-53	BA-73-6158	Hereford	630	Piney Run Formation	10-02-1978
BA Cc 255	39-30-02	76-43-45	BA-81-2875	Hereford	510	Baltimore Gneiss	07-27-1984
BA Cc 256	39-31-17	76-44-01	BA-73-5148	Hereford	350	Baltimore Gneiss	11-29-1977
BA Cc 257	39-30-58	76-44-17	BA-73-3369	Hereford	410	Baltimore Gneiss	08-20-1976
BA Cc 258	39-33-40	76-44-25	BA-88-1375	Hereford	590	Piney Run Formation	08-03-1989
BA Cc 259	39-31-58	76-43-13	BA-81-0953	Hereford	350	Cockeysville Marble	08-23-1982
BA Cd 229	39-31-50	76-37-45	BA-81-4411	Hereford	300	Baltimore Gneiss	02-19-1986
BA Cd 230	39-34-26	76-36-16	BA-81-7321	Phoenix	470	Baltimore Gneiss	10-29-1987
BA Cd 231	39-34-02	76-35-09	BA-81-4682	Phoenix	600	Baltimore Gneiss	03-13-1986
BA Cd 232	39-34-36	76-38-13	BA-81-2436	Hereford	480	Baltimore Gneiss	04-03-1984
BA Cd 234	39-33-52	76-36-53	BA-81-5224	Phoenix	400	Baltimore Gneiss	08-07-1986
BA Cd 235	39-33-13	76-37-37	BA-81-7150	Hereford	410	Baltimore Gneiss	09-23-1987

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Driller	Use of water	Topographic position	Well depth (ft below land surface)	Bottom of grout (ft below land surface)	Bottom of casing (ft below land surface)
BA Bd 232	Jones	H	H	200	69	69
BA Bd 233	Barber Bros.	H	S	200	40	72
BA Bd 234	Barber Bros.	H	H	175	40	60
BA Bd 235	Barber Bros.	H	S	175	40	69
BA Bd 236	Barber Bros.	H	S	200	52	67
BA Bd 237	Barber Bros.	H	H	175	40	60
BA Bd 238	Barber Bros.	H	S	200	36	36
BA Be 36	Harr	H	F	300	35	35
BA Be 38	Harr	H	S	175	57	57
BA Ca 66	Maryland	H	S	210	94	94
BA Ca 69	Jones	H	S	148	40	40
BA Cb 126	Harr	H	S	175	28	28
BA Cb 133	Harr	H	H	300	60	61
BA Cb 134	Harr	H	H	300	55	55
BA Cb 136	Harr	H	S	100	60	60
BA Cb 137	Reider	H	H	160	78	78
BA Cb 138	Campbell	H	S	205	70	70
BA Cb 139	Campbell	H	H	255	68	68
BA Cb 141	Reider	H	H	200	69	69
BA Cb 142	Water, Inc.	H	S	180	19	19
BA Cb 143	Jones	R	S	165	39	39
BA Cb 144	Phillips	H	H	220	21	21
BA Cc 253	Harr	H	H	300	53	53
BA Cc 254	Harr	H	S	175	62	62
BA Cc 255	Harr	H	S	250	30	30
BA Cc 256	Water, Inc.	H	S	172	31	31
BA Cc 257	Harr	H	H	225	40	40
BA Cc 258	Caswell	H	H	350	69	69
BA Cc 259	Jones	H	V	254	110	253
BA Cd 229	Harr	H	S	200	36	36
BA Cd 230	Jones	H	H	220	31	32
BA Cd 231	Reider	H	F	260	59	60
BA Cd 232	Jones	H	H	400	28	28
BA Cd 234	Reider	H	H	200	45	47
BA Cd 235	Harr	I	S	200	20	20

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Casing diameter (inches)	Casing material	Discharge (gallons per minute)	Pumping water level (ft below land surface)	Static water level (ft below land surface)	Pumping period (hours)	Specific capacity (gallons per minute per ft)	Drawdown (ft)
BA Bd 232	6	P	9	190	62	1	0.07	128
BA Bd 233	6	P	9	160	40	3	0.07	120
BA Bd 234	6	P	12	74	66	3	1.5	8
BA Bd 235	6	P	15	65	50	3	1	15
BA Bd 236	6	P	9	160	32	3	0.07	128
BA Bd 237	6	P	11	116	65	3	0.22	51
BA Bd 238	6	P	12	129	55	3	0.16	74
BA Be 36	6	S	3	250	25	6	0.01	225
BA Be 38	6	S	4	28	24	6	1	4
BA Ca 66	6	S	3	85	38	6	0.06	47
BA Ca 69	6	S	14	30	19	3	1.27	11
BA Cb 126	6	S	6	150	32	4	0.05	118
BA Cb 133	6	S	13.6	106	61.2	4	0.3	45.3
BA Cb 134	6	S	2.16	207	50.8	6	0.01	156
BA Cb 136	6	S	75	85	22	3	1.19	63
BA Cb 137	6	S	5	122	32	3	0.06	90
BA Cb 138	6	S	15	55	46	3	1.67	9
BA Cb 139	6	S	8	51	46	3	1.6	5
BA Cb 141	6	S	5	165	55	3	0.05	110
BA Cb 142	6	S	3	40	35	6	0.6	5
BA Cb 143	6	P	15	35	30	3	3	5
BA Cb 144	6	S	5	220	33	3	0.03	187
BA Cc 253	6	S	2.72	282	37	6	0.01	245
BA Cc 254	6	S	8	125	64	6	0.13	61
BA Cc 255	6	S	12	81.9	34	3	0.25	47.9
BA Cc 256	6	S	5	60	40	6	0.25	20
BA Cc 257	6	S	2	210	14	6	0.01	196
BA Cc 258	6	S	3.46	239	37	7	0.02	202
BA Cc 259	6	S	10	45	41	12	2.5	4
BA Cd 229	6	S	15	92.3	66.4	3	0.58	25.9
BA Cd 230	6	P	2	140	35	7	0.02	105
BA Cd 231	6	S	22	259	49	4	0.1	210
BA Cd 232	6	S	1	132	15	6	0.01	117
BA Cd 234	6	S	8	140	43	3	0.08	97
BA Cd 235	6	S	6.25	182	51	3	0.05	131

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Watershed	Subshed	Land use at site	Land-use category at site	Dominant land use within 1,000 ft of site	Dominant land-use category within 1,000 ft of site
BA Bd 232	Loch Raven	Panther Branch	21	A	21	F
BA Bd 233	Loch Raven	Gunpowder Falls	11	R	--	R
BA Bd 234	Loch Raven	Little Falls	11	R	--	R
BA Bd 235	Loch Raven	Gunpowder Falls	11	R	--	R
BA Bd 236	Loch Raven	Little Falls	11	R	--	R
BA Bd 237	Loch Raven	Little Falls	11	R	--	R
BA Bd 238	Loch Raven	Little Falls	11	R	--	R
BA Be 36	Little Gunpowder	Little Gunpowder Falls	22	A	191	R
BA Be 38	Loch Raven	Charles Run	21	A	21	A
BA Ca 66	Liberty	Aspen Run	21	A	21	A
BA Ca 69	Liberty	Board Run	21	A	21	A
BA Cb 126	Loch Raven	Piney Run	41	F	21	A
BA Cb 133	Loch Raven	McGill Run	21	A	21	A
BA Cb 134	Loch Raven	Indian Run-Loch Raven	21	A	21	A
BA Cb 136	Loch Raven	Piney Run	21	A	21	A
BA Cb 137	Loch Raven	Indian Run-Loch Raven	21	A	41	F
BA Cb 138	Loch Raven	McGill Run	21	A	21	A
BA Cb 139	Loch Raven	McGill Run	21	A	21	A
BA Cb 141	Loch Raven	Little Piney Run	21	A	21	A
BA Cb 142	Loch Raven	McGill Run	21	A	21	A
BA Cb 143	Loch Raven	McGill Run	21	A	21	A
BA Cb 144	Loch Raven	Western Run-Loch Raven	21	A	21	A
BA Cc 253	Loch Raven	Piney Creek	192	R	41	F
BA Cc 254	Loch Raven	Blackrock Run	11	R	11	R
BA Cc 255	Loch Raven	Deadman's Run	41	F	21	A
BA Cc 256	Loch Raven	Western Run-Loch Raven	21	A	21	A
BA Cc 257	Loch Raven	Western Run-Loch Raven	21	A	21	A
BA Cc 258	Loch Raven	Blackrock Run	21	A	43	F
BA Cc 259	Loch Raven	Blackrock Run	21	A	21	A
BA Cd 229	Loch Raven	Carroll Branch	192	R	41	F
BA Cd 230	Loch Raven	Gunpowder Falls	11	R	11	R
BA Cd 231	Loch Raven	Carroll Branch	191	R	21	A
BA Cd 232	Loch Raven	Gunpowder Falls	11	R	11	R
BA Cd 234	Loch Raven	Gunpowder Falls	41	F	11	R
BA Cd 235	Loch Raven	Gunpowder Falls	41	F	41	F

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	USGS site identification number	Phase of study	Comments
BA Bd 232	393554076384401	I	
BA Bd 233	393732076392401	II(T,N,C)	
BA Bd 234	393739076391801	II(T,N,C)	
BA Bd 235	393733076391301	II(T,N,C)	
BA Bd 236	393742076390701	II(T,N,C)	
BA Bd 237	393738076391401	II(T,N,C)	
BA Bd 238	393736076390401	II(T,N,C)	
BA Be 36	393546076341201	I	
BA Be 38	393519076344701	I	
BA Ca 66	393355076501901	I	
BA Ca 69	393222076510501	I	
BA Cb 126	393241076472401	I	
BA Cb 133	393028076465301	I,II(N)	
BA Cb 134	393243076450901	I,II(T,N)	
BA Cb 136	393119076454501	I,II(T,N,M)	
BA Cb 137	393403076454201	I,II(N,M)	
BA Cb 138	393237076495601	I,II(M)	
BA Cb 139	393228076493201	I	
BA Cb 141	393456076494601	I,II(N)	
BA Cb 142	393221076483401	I,II(M)	
BA Cb 143	393114076462701	I	
BA Cb 144	393036076452901	I	
BA Cc 253	393427076412201	I,II(T,M)	
BA Cc 254	393418076435301	I	
BA Cc 255	393002076334501	I	
BA Cc 256	393117076440101	I	
BA Cc 257	393058076441701	I	
BA Cc 258	393340076442501	I	
BA Cc 259	393158076431301	I	
BA Cd 229	393150076374201	I,II(N)	
BA Cd 230	393426076361401	I	
BA Cd 231	393402076350901	I	
BA Cd 232	393442076375301	I	
BA Cd 234	393352076365301	I	
BA Cd 235	393313076373701	I,II(N)	

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Latitude	Longitude	Well permit number	USGS 7.5′ quadrangle	Elevation (ft)	Geologic unit	Date of construction
BA Cd 236	39-32-26	76-37-18	BA-88-0227	Phoenix	360	Baltimore Gneiss	11-10-1988
BA Cd 238	39-32-21	76-37-57	BA-81-5104	Hereford	420	Baltimore Gneiss	09-09-1986
BA Cd 239	39-31-55	76-38-53	BA-88-0139	Hereford	450	Baltimore Gneiss	01-16-1989
BA Cd 241	39-30-19	76-39-14	BA-94-0644	Hereford	320	Baltimore Gneiss	01-24-1995
BA Ce 309	39-30-10	76-33-43	BA-81-2893	Phoenix	470	Loch Raven Schist	09-05-1984
BA Ce 311	39-30-01	76-34-23	BA-81-7360	Phoenix	500	Loch Raven Schist	11-04-1987
BA Ce 312	39-30-35	76-33-15	BA-81-5726	Phoenix	570	Loch Raven Schist	10-28-1986
BA Ce 313	39-31-43	76-33-26	BA-81-7265	Phoenix	540	Loch Raven Schist	09-30-1987
BA Da 120	39-27-31	76-51-06	BA-73-7138	Reisterstown	590	Piney Run Formation	11-27-1979
BA Da 122	39-27-03	76-51-03	BA-73-4136	Reisterstown	680	Piney Run Formation	- -1977
BA Da 123	39-25-38	76-51-01	BA-81-5292	Reisterstown	620	Loch Raven Schist	07-03-1986
BA Db 259	39-28-03	76-45-50	BA-81-2286	Reisterstown	500	Loch Raven Schist	04-13-1984
BA Db 261	39-28-43	76-47-28	BA-73-6638	Reisterstown	510	Cockeysville Marble	07-25-1979
BA Dc 444	39-29-31	76-41-03	BA-81-4198	Cockeysville	390	Cockeysville Marble	10-09-1985
BA Dc 445	39-28-41	76-40-02	BA-88-3383	Cockeysville	320	Cockeysville Marble	06-01-1991
BA Dc 446	39-28-07	76-44-04	BA-88-1777	Cockeysville	650	Loch Raven Schist	12-28-1989
BA Dc 447	39-25-37	76-42-33	BA-81-2964	Cockeysville	450	Loch Raven Schist	08-30-1984
BA Dc 448	39-27-30	76-42-03	BA-73-4431	Cockeysville	530	Loch Raven Schist	06-30-1977
BA Dc 449	39-28-08	76-41-24	BA-81-7841	Cockeysville	400	Loch Raven Schist	06-08-1988
BA Dc 450	39-26-50	76-43-39	BA-73-3741	Cockeysville	610	Loch Raven Schist	02-22-1977
BA Dc 451	39-26-20	76-44-01	BA-81-5657	Cockeysville	460	Cockeysville Marble	10-16-1981
BA Dd 300	39-29-28	76-38-06	BA-81-2635	Cockeysville	490	Loch Raven Schist	08-01-1984
BA De 633	39-28-59	76-32-36	BA-73-8070	Towson	450	Loch Raven Schist	03-26-1981
BA De 635	39-26-53	76-31-20	BA-81-7014	Towson	420	Loch Raven Schist	09-30-1987
BA De 636	39-29-59	76-31-04	BA-92-0935	Towson	590	Loch Raven Schist	09-25-1992
BA De 637	39-28-35	76-33-34	BA-73-3110	Towson	490	Loch Raven Schist	07-23-1976
BA De 638	39-25-46	76-33-45	BA-88-0116	Towson	400	Loch Raven Schist	01-04-1989
BA De 639	39-27-13	76-30-01	BA-81-7103	Towson	310	Cockeysville Marble	09-08-1987
BA De 640	39-26-35	76-31-25	BA-94-0559	Towson	360	Cockeysville Marble	06-22-1994
BA De 641	39-26-36	76-31-25	BA-94-0516	Towson	360	Loch Raven Schist	06-22-1994
BA Df 351	39-26-05	76-25-46	BA-81-0626	White Marsh	250	Baltimore Mafic Complex	04-22-1982
BA Df 352	39-28-14	76-27-11	BA-81-3997	White Marsh	460	Loch Raven Schist	07-30-1985
BA Df 353	39-25-38	76-29-14	BA-73-1879	White Marsh	310	Oella Formation	03-03-1975
BA Df 354	39-28-06	76-27-54	BA-88-0585	White Marsh	280	Cockeysville Marble	02-02-1989
BA Df 355	39-29-04	76-29-42	BA-73-7928	White Marsh	330	Loch Raven Schist (Hydes Marble Member)	02-02-1981

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Driller	Use of water	Topographic position	Well depth (ft below land surface)	Bottom of grout (ft below land surface)	Bottom of casing (ft below land surface)
BA Cd 236	Jones	H	S	223	49	49
BA Cd 238	Harr	H	S	300	31	31
BA Cd 239	Harr	H	S	200	46	46
BA Cd 241	--	H	S	300	30	30
BA Ce 309	Jones	H	V	275	20	21
BA Ce 311	Harr	H	S	300	40	40
BA Ce 312	Harr	H	S	105	60	60
BA Ce 313	Harr	H	S	250	67	67
BA Da 120	Harr	H	H	100	60	60
BA Da 122	Edmondson	H	H	160	39	40
BA Da 123	Harr	H	H	200	60	60
BA Db 259	Harr	H	V	100	42	42
BA Db 261	Harr	H	S	250	79	79
BA Dc 444	Easterday	U	S	300	34	88
BA Dc 445	Harr	H	G	300	90	90
BA Dc 446	Harr	H	F	200	40	40
BA Dc 447	Westminster	H	S	276	110	112
BA Dc 448	Jones	H	S	325	41	41
BA Dc 449	Harr	H	V	250	20	20
BA Dc 450	Dillon	H	S	150	28	28
BA Dc 451	Harr	H	V	125	20	20
BA Dd 300	Harr	H	S	150	20	20
BA De 633	Reider	H	S	110	48	48
BA De 635	Harr	H	S	250	40	40
BA De 636	Jones	H	H	305	39	39
BA De 637	Harr	H	H	125	62	62
BA De 638	Harr	H	S	98	37	37
BA De 639	Harr	R	V	225	80	80
BA De 640	--	H	H	1050	42	42
BA De 641	--	H	H	400	37	37
BA Df 351	Barber Bros.	H	H	175	36	36
BA Df 352	Jones	H	S	173	30	30
BA Df 353	Harr	H	S	100	21	21
BA Df 354	Jones	H	V	150	124	124
BA Df 355	Jones	H	V	100	60	60

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Casing diameter (inches)	Casing material	Discharge (gallons per minute)	Pumping water level (ft below land surface)	Static water level (ft below land surface)	Pumping period (hours)	Specific capacity (gallons per minute per ft)	Drawdown (ft)
BA Cd 236	6	P	8	130	20	3	0.07	110
BA Cd 238	6	S	1.15	237	41	6	0.01	196
BA Cd 239	6	S	6	137	53	3	0.07	84
BA Cd 241	6	P	7	201	54	3	0.05	147
BA Ce 309	6	S	3	270	40	3	0.01	230
BA Ce 311	6	S	2.61	271	25.3	6	0.01	246
BA Ce 312	6	S	14.3	66.3	20	3	0.31	46.3
BA Ce 313	6	S	6	198	21	4	0.03	177
BA Da 120	6	S	9.41	91.3	46.3	3	0.21	45
BA Da 122	6	S	6	84.8	44.8	8	0.15	40
BA Da 123	6	S	10	175	36	3	0.07	139
BA Db 259	6	S	13.6	87	7	3	0.17	80
BA Db 261	6	S	5.52	186	57.5	6	0.04	128
BA Dc 444	6	S	5	72	44	6	0.18	28
BA Dc 445	6	S	11	90	31	3	0.19	59
BA Dc 446	6	S	12	180	35	3	0.08	145
BA Dc 447	6	S	8	184	24	3	0.05	160
BA Dc 448	6	S	4	268	73	6	0.02	195
BA Dc 449	6	S	3	178	6	6	0.02	172
BA Dc 450	6	S	7	120	40	6	0.09	80
BA Dc 451	6	S	25	105	30	3	0.33	75
BA Dd 300	6	S	14.3	38.3	31.8	3	2.2	6.5
BA De 633	6	S	20	54	52	3	10	2
BA De 635	6	S	10	89.6	29.3	3	0.17	60.3
BA De 636	6	P	2	295	48	1	0.01	247
BA De 637	6	S	6	47	42	6	1.2	5
BA De 638	6	S	13	30	14	3	0.81	16
BA De 639	6	S	4	205	30	3	0.02	175
BA De 640	6	S	0.69	241	31	7	0	210
BA De 641	6	P	1.17	220	35	7	0.01	185
BA Df 351	6	S	3	150	18	6	0.02	132
BA Df 352	6	S	10	162	27	3	0.07	135
BA Df 353	6	S	10	25	23	6	5	2
BA Df 354	6	P	12	73	35	3	0.32	38
BA Df 355	6	S	50	75	17	2	0.86	58

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Watershed	Subshed	Land use at site	Land-use category at site	Dominant land use within 1,000 ft of site	Dominant land-use category within 1,000 ft of site
BA Cd 236	Loch Raven	Carroll Branch	41	F	41	A
BA Cd 238	Loch Raven	Gunpowder Falls	11	R	41	R
BA Cd 239	Loch Raven	Piney Creek	21	A	21	A
BA Cd 241	Loch Raven	Western Run-Loch Raven	41	F	11	R
BA Ce 309	Loch Raven	Overshot Run	11	R	11	R
BA Ce 311	Loch Raven	Overshot Run	22	A	22	A
BA Ce 312	Loch Raven	Overshot Run	41	F	21	A
BA Ce 313	Little Gunpowder	Parker Branch	41	F	41	F
BA Da 120	Liberty	Norris Run	41	F	41	F
BA Da 122	Liberty	Timber Run	11	R	11	R
BA Da 123	Liberty	Liberty Reservoir	41	F	41	A
BA Db 259	Loch Raven	Councilman's Run	21	A	21	A
BA Db 261	Loch Raven	Councilman's Run	21	A	41	F
BA Dc 444	Loch Raven	Oregon Run	21	F	--	F
BA Dc 445	Loch Raven	Beaver Dam Run	21	A	21	A
BA Dc 446	Loch Raven	Beaver Dam Run	21	A	21	A
BA Dc 447	Jones Falls	Jones Falls (North Branch)	41	F	11	R
BA Dc 448	Loch Raven	Beaver Dam Run	11	R	11	R
BA Dc 449	Loch Raven	Beaver Dam Run	41	F	41	F
BA Dc 450	Jones Falls	Jones Falls (North Branch)	11	R	11	R
BA Dc 451	Jones Falls	Jones Falls (North Branch)	41	F	11	R
BA Dd 300	Loch Raven	Western Run-Loch Raven	11	R	11	R
BA De 633	Loch Raven	Dulaney Valley Branch	41	F	11	R
BA De 635	Lower Gunpowder	Cowen Run	43	F	41	F
BA De 636	Little Gunpowder	Long Green Creek	11	R	11	R
BA De 637	Loch Raven	Jenkins Run	11	R	11	R
BA De 638	Loch Raven	Rush Brook	12	R	12	R
BA De 639	Lower Gunpowder	Cowen Run	11	R	11	R
BA De 640	Lower Gunpowder	Cowen Run	11	R	--	R
BA De 641	Lower Gunpowder	Cowen Run	11	R	--	R
BA Df 351	Lower Gunpowder	Lower Gunpowder Falls	21	A	21	A
BA Df 352	Lower Gunpowder	Haystack Branch	41	F	41	F
BA Df 353	Lower Gunpowder	Lower Gunpowder Falls	21	A	21	A
BA Df 354	Lower Gunpowder	Haystack Branch	21	A	21	A
BA Df 355	Lower Gunpowder	Long Green Creek	21	A	21	A

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	USGS site identification number	Phase of study	Comments
BA Cd 236	393219076371901	I	
BA Cd 238	393221076375701	I	
BA Cd 239	393155076385301	I	
BA Cd 241	393019076391401	I	
BA Ce 309	393008076334001	I	
BA Ce 311	393002076354001	I	
BA Ce 312	393035076331701	I	
BA Ce 313	393143076332601	I	
BA Da 120	392731076510601	I	
BA Da 122	392703076510301	I,II(N)	
BA Da 123	392538076510101	I	
BA Db 259	392803076455001	I	
BA Db 261	392843076473101	I	
BA Dc 444	392931076410301	II(O)	USGS monitor well
BA Dc 445	392841076400201	I,II(T,M)	
BA Dc 446	392807076440401	I	
BA Dc 447	392537076423301	I	
BA Dc 448	392730076420301	I,II(T)	
BA Dc 449	392808076412401	I	
BA Dc 450	392650076433901	I	
BA Dc 451	392620076440101	I	
BA Dd 300	392928076380601	I,II(T,N)	
BA De 633	392859076323601	I,II(T,N,M)	
BA De 635	392656076312001	I	
BA De 636	392959076310401	I,II(T,N)	
BA De 637	392837076333401	I	
BA De 638	392546076334501	I	
BA De 639	392713076300101	I	
BA De 640	392635076312501	II(T)	Contributing aquifer: Loch Raven Schist
BA De 641	392636076312501	II(T)	
BA Df 351	392605076254601	I	
BA Df 352	392814076271101	I	
BA Df 353	392538076291401	I	
BA Df 354	392806076275401	I,II(T)	
BA Df 355	392904076291201	I	

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Latitude	Longitude	Well permit number	USGS 7.5′ quadrangle	Elevation (ft)	Geologic unit	Date of construction
BA Dg 117	39-26-10	76-24-17	BA-93-0153	White Marsh	230	Baltimore Mafic Complex	10-25-1993
BA Ea 90	39-22-06	76-50-32	BA-81-1609	Ellicott City	490	Baltimore Gneiss	05-26-1983
BA Ea 91	39-24-10	76-51-40	BA-73-3430	Reisterstown	500	Sykesville Formation	09-16-1976
BA Ea 92	39-23-41	76-52-18	BA-88-1713	Reisterstown	540	Baltimore Mafic Complex	11-17-1989
BA Ea 93	39-23-58	76-50-09	BA-88-2364	Reisterstown	580	Loch Raven Schist	04-23-1990
BA Ea 95	39-21-59	76-52-01	BA-81-8345	Ellicott City	430	Baltimore Gneiss	07-20-1988
BA Eb 291	39-20-25	76-46-53	BA-81-6263	Ellicott City	465	Mt. Washington Amphibolite	02-12-1987
BA Ec 203	39-24-30	76-41-03	BA-73-2093	Cockeysville	450	Slaughterhouse Gneiss	08-25-1975
BA Ec 204	39-24-34	76-40-43	BA-81-6853	Cockeysville	420	Slaughterhouse Gneiss	10-22-1987
BA Ec 205	39-24-46	76-43-41	BA-73-7440	Cockeysville	410	Cockeysville Marble	06-09-1980
BA Fb 81	39-18-54	76-47-37	BA-73-0130	Ellicott City	230	Hollofield Layered Ultramafite	09-13-1972

Well name	Driller	Use of water	Topographic position	Well depth (ft below land surface)	Bottom of grout (ft below land surface)	Bottom of casing (ft below land surface)
BA Dg 117	--	H	V	300	40	58
BA Ea 90	Westminster	H	V	203	30	32.9
BA Ea 91	Leonard	H	V	250	26	26
BA Ea 92	Easterday	T	V	420	37	41
BA Ea 93	Phillips	H	S	120	51	51
BA Ea 95	Harr	H	S	200	60	60
BA Eb 291	Jones	H	H	200	61	102
BA Ec 203	Reider	H	S	190	36	36
BA Ec 204	Harr	H	S	300	20	20
BA Ec 205	Dillon	H	S	305	20	22
BA Fb 81	Dillon	H	S	125	20	28

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	Casing diameter (inches)	Casing material	Discharge (gallons per minute)	Pumping water level (ft below land surface)	Static water level (ft below land surface)	Pumping period (hours)	Specific capacity (gallons per minute per ft)	Drawdown (ft)
BA Dg 117	8	S	2	260	10	6	0.01	250
BA Ea 90	6	S	4.6	38	10	3	0.16	28
BA Ea 91	6	S	5	230	22	6	0.02	208
BA Ea 92	6	S	4	420	80	4	0.01	340
BA Ea 93	6	S	10	34	12	3	0.45	22
BA Ea 95	6	S	7	136	25	3	0.06	111
BA Eb 291	6	P	8	190	30	3	0.05	160
BA Ec 203	6	S	4	50	27	6	0.17	23
BA Ec 204	6	S	2	236	35	6	0.01	201
BA Ec 205	6	S	10	50	12	3	0.26	38
BA Fb 81	6	S	5	100	80	6	0.25	20

Well name	Watershed	Subshed	Land use at site	Land-use category at site	Dominant land use within 1,000 ft of site	Dominant land-use category within 1,000 ft of site
BA Dg 117	Lower Gunpowder	Lower Gunpowder Falls	41	F	11	R
BA Ea 90	Patapsco	Mardella Run	21	A	41	F
BA Ea 91	Liberty	Locust Run	41	F	41	F
BA Ea 92	Liberty	Liberty Reservoir	41	F	21	A
BA Ea 93	Liberty	Locust Run	41	F	41	F
BA Ea 95	Patapsco	Patapsco River (N.Br.)	41	F	41	F
BA Eb 291	Patapsco	Ben's Run	22	A	41	F
BA Ec 203	Jones Falls	Jones Falls	11	R	11	R
BA Ec 204	Jones Falls	Jones Falls	22	A	22	R
BA Ec 205	Jones Falls	Jones Falls	11	R	21	A
BA Fb 81	Patapsco	Patapsco River	11	R	41	F

Table B1, continued.
Well characteristics and site information for wells sampled during this study.

Well name	USGS site identification number	Phase of study	Comments
BA Dg 117	392610076241701	I	2 casing strings
BA Ea 90	392206076503201	I	
BA Ea 91	392410076514001	I	
BA Ea 92	392341076521801	I,II(T,O)	
BA Ea 93	392358076500901	I,II(M)	
BA Ea 95	392159076520101	I,II(N)	
BA Eb 291	392025076465301	I	2 casing strings
BA Ec 203	392430076410301	I	
BA Ec 204	392434076404301	I	
BA Ec 205	392446076434101	I,II(T)	
BA Fb 81	391857076474301	I,II(M)	

Table B2.
Spring characteristics and site information for springs sampled during this study.

Spring name	Latitude	Longitude	USGS 7.5′ quadrangle	Elevation (ft)	Geologic unit	Use of water
BA Be 37	39-37-08	76-34-55	Phoenix	590	Loch Raven Schist	U
BA Dc 59	39-26-20	76-43-58	Cockeysville	460	Cockeysville Marble	Q
BA Bc 264	39-38-41	76-43-09	New Freedom	570	Prettyboy Schist	U
BA Bb 150	39-36-39	76-48-06	Hampstead	620	Prettyboy Schist	I
BA Ac 152	39-40-23	76-40-10	New Freedom	580	Prettyboy Schist	H
BA Cd 237	39-32-12	76-36-59	Phoenix	390	Baltimore Gneiss	U
BA De 632	39-29-23	76-32-49	Towson	520	Loch Raven Schist	H

Spring name	Watershed	Subshed	Land use at site	Land-use category at site	Dominant land use within 1,000 ft of site	Dominant land-use category within 1,000 ft of site
BA Be 37	Loch Raven	First Mine Branch	21	A	21	A
BA Dc 59	Jones Falls	Jones Falls (North Branch)	11	R	11	R
BA Bc 264	Prettyboy	Frog Hollow	41	F	41	F
BA Bb 150	Prettyboy	Peggy's Run	21	A	21	A
BA Ac 152	Loch Raven	Beetree Run	21	A	41	F
BA Cd 237	Loch Raven	Carroll Branch	21	A	21	A
BA De 632	Loch Raven	Fitzhugh Run	11	R	11	R

Spring name	USGS site identification number	Improvements	Phase of study	Comments
BA Be 37	393708076345501	Small springhouse	I	
BA Dc 59	392620076440001	Collecting pond	I	
BA Bc 264	393841076430901	Cement enclosure with pipe	I,II(N,T)	
BA Bb 150	393639076480601	Springhouse	--	Large variation in water quality within collecting basin
BA Ac 152	394023076401001	Springhouse	I	
BA Cd 237	393212076365901	Small springhouse	I	
BA De 632	392923076324901	Pit with pump	I	

APPENDIX C

LOCATIONS OF WELLS AND SPRINGS

o Well location

Spring location

Base maps from U.S. Geological Survey 7-1/2 minute quadrangles

Contour interval 20 feet

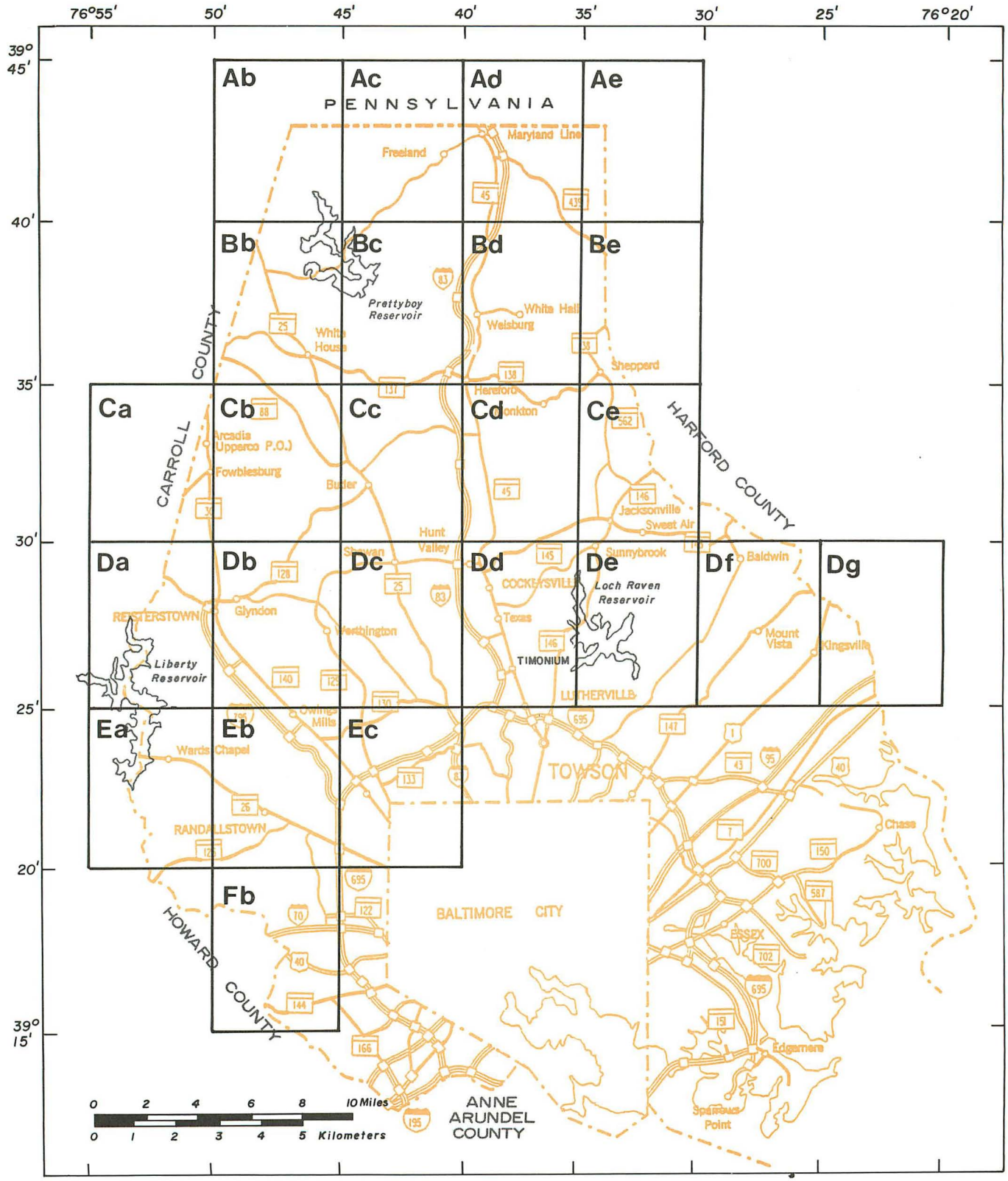
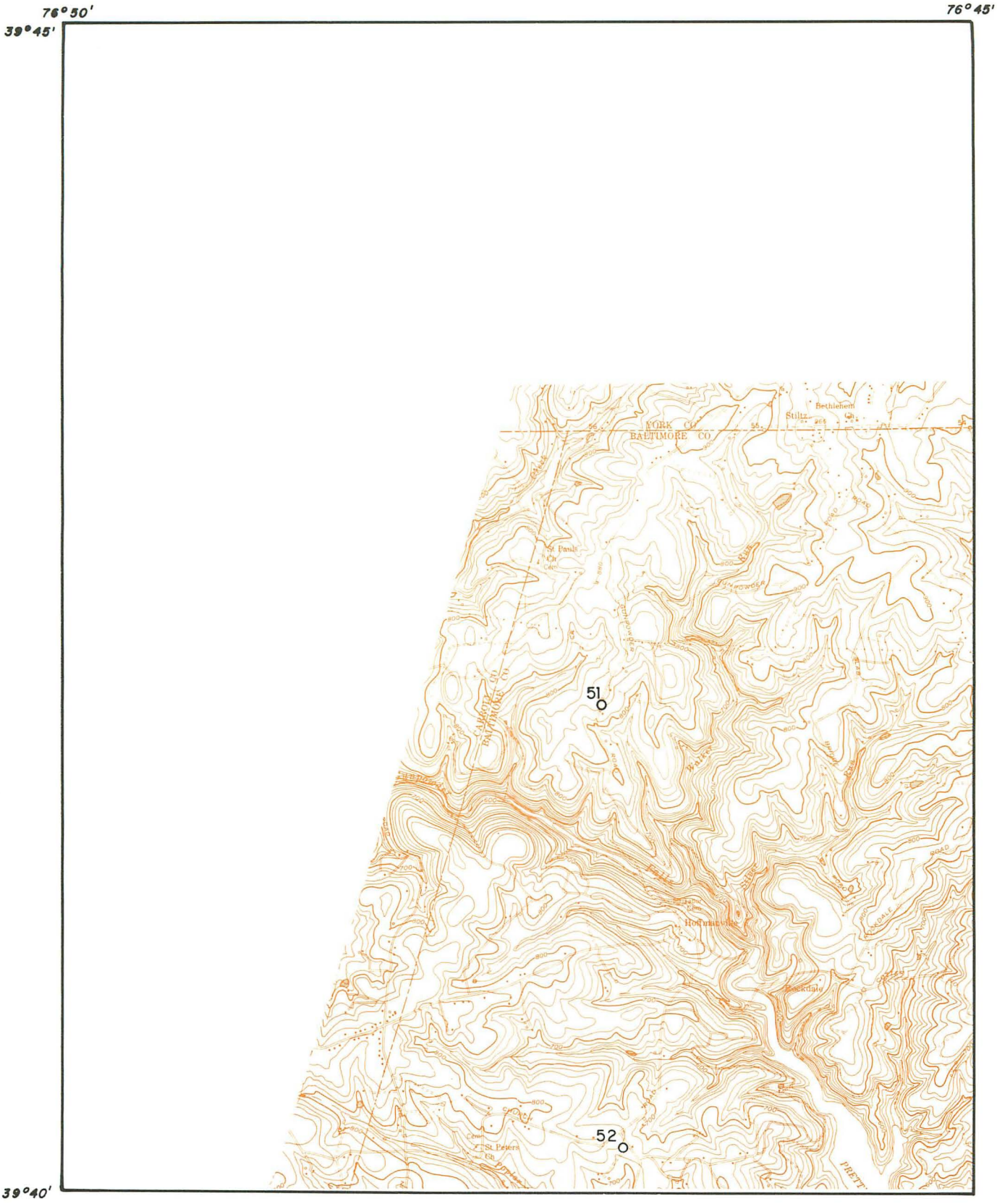


Figure 40. Map showing locations of 5-minute quadrangles.



Ab

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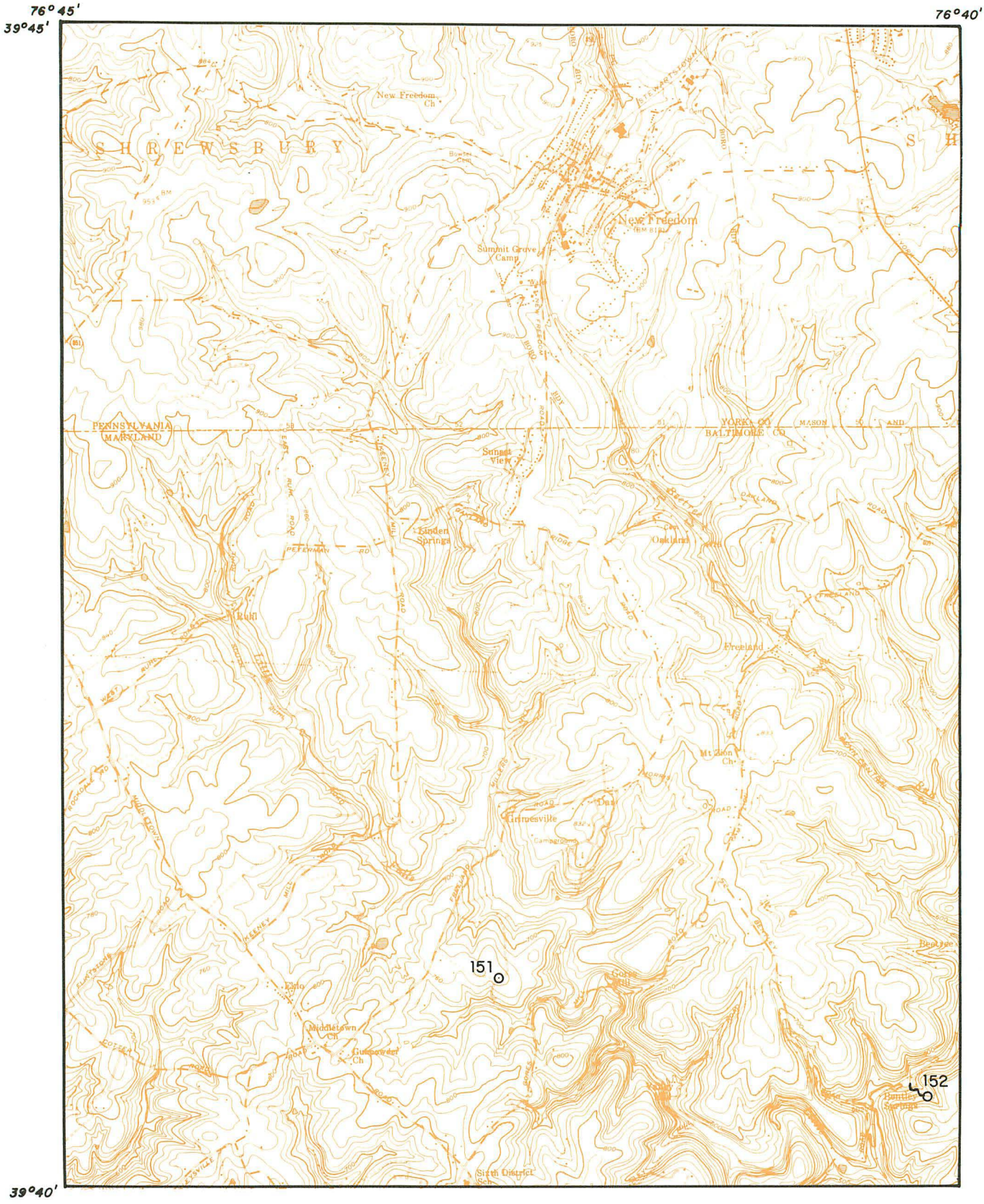
1 .5 0 1 KILOMETER



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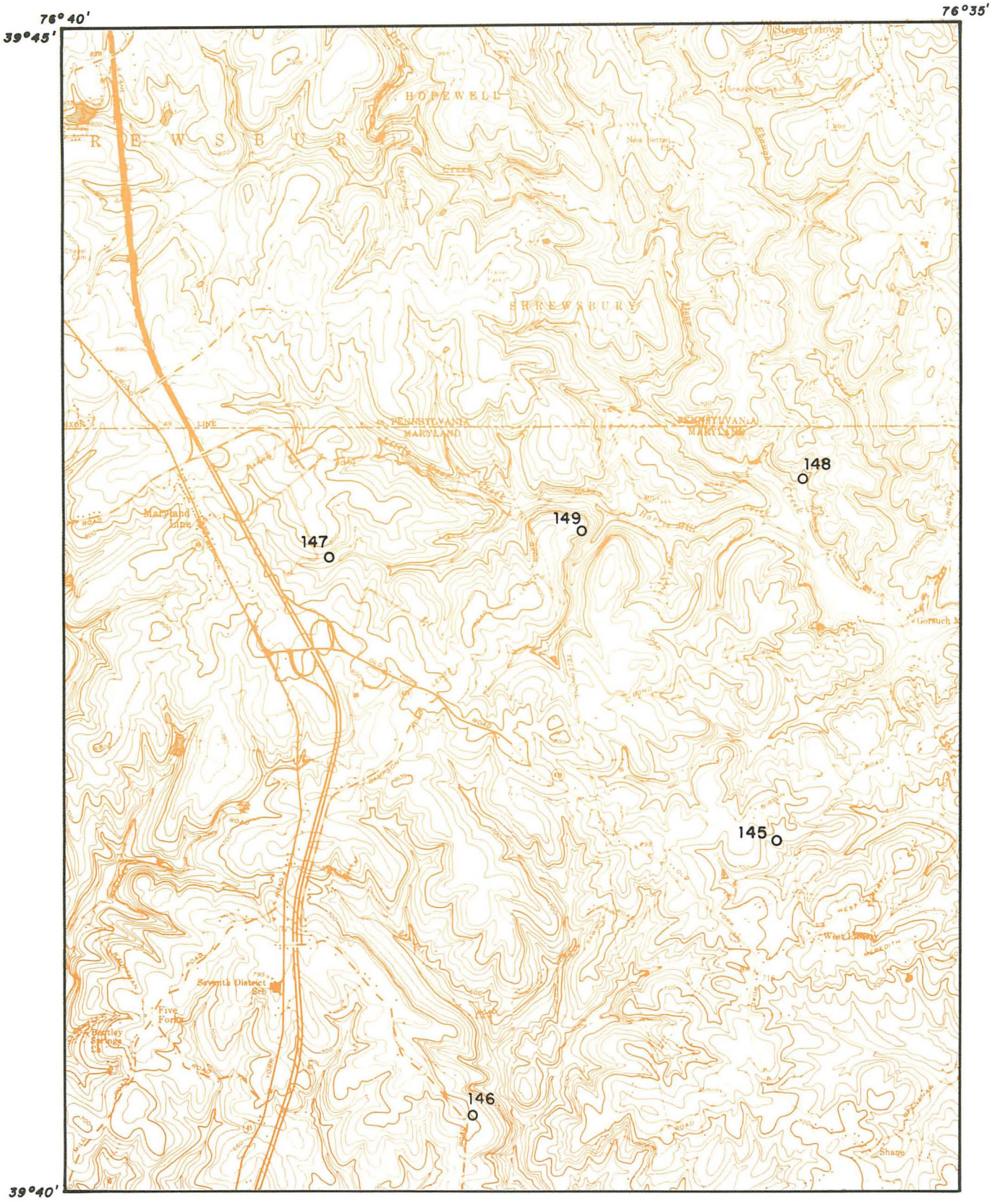

Ad

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Ae

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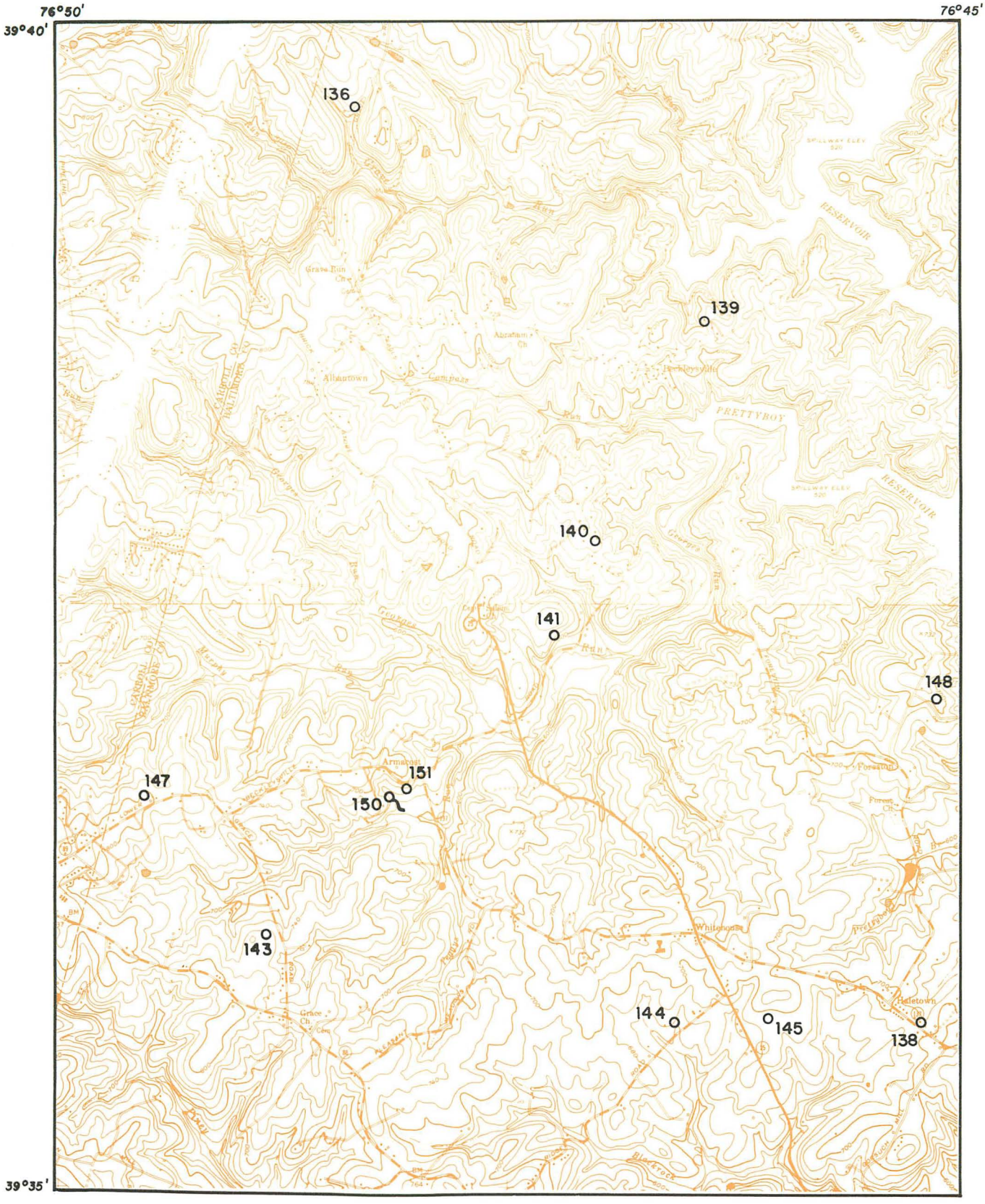
1 .5 0 1 KILOMETER

Be



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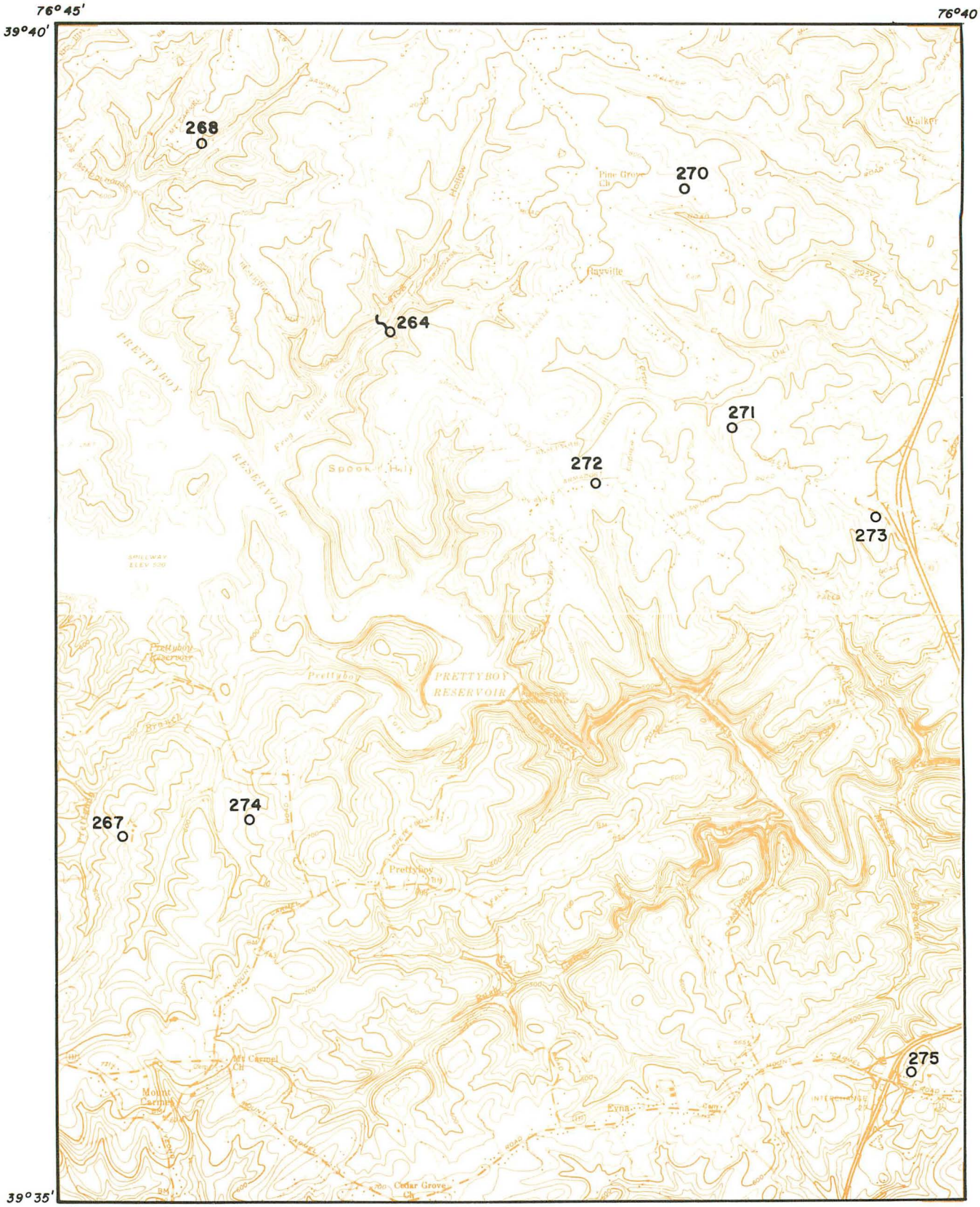

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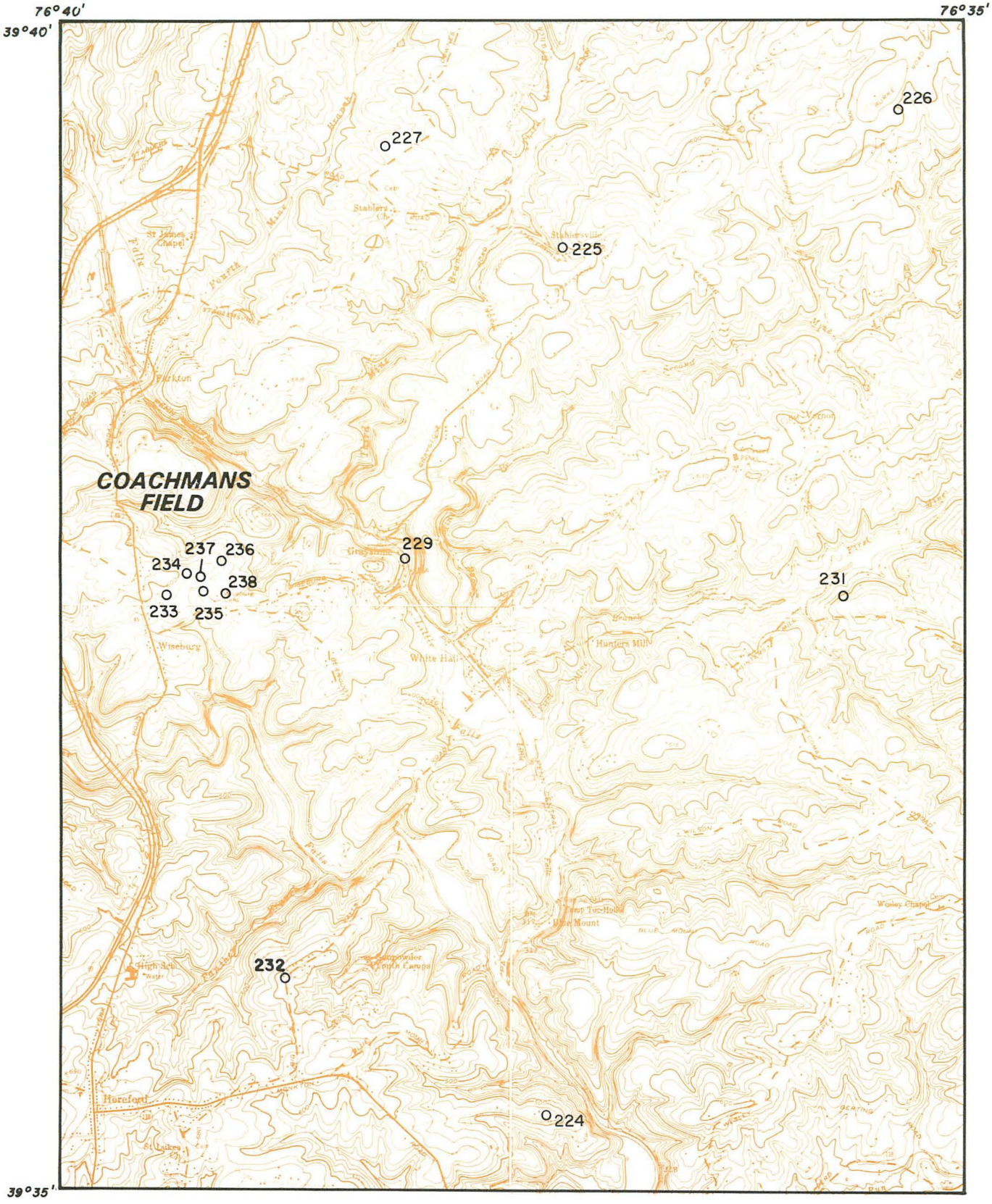

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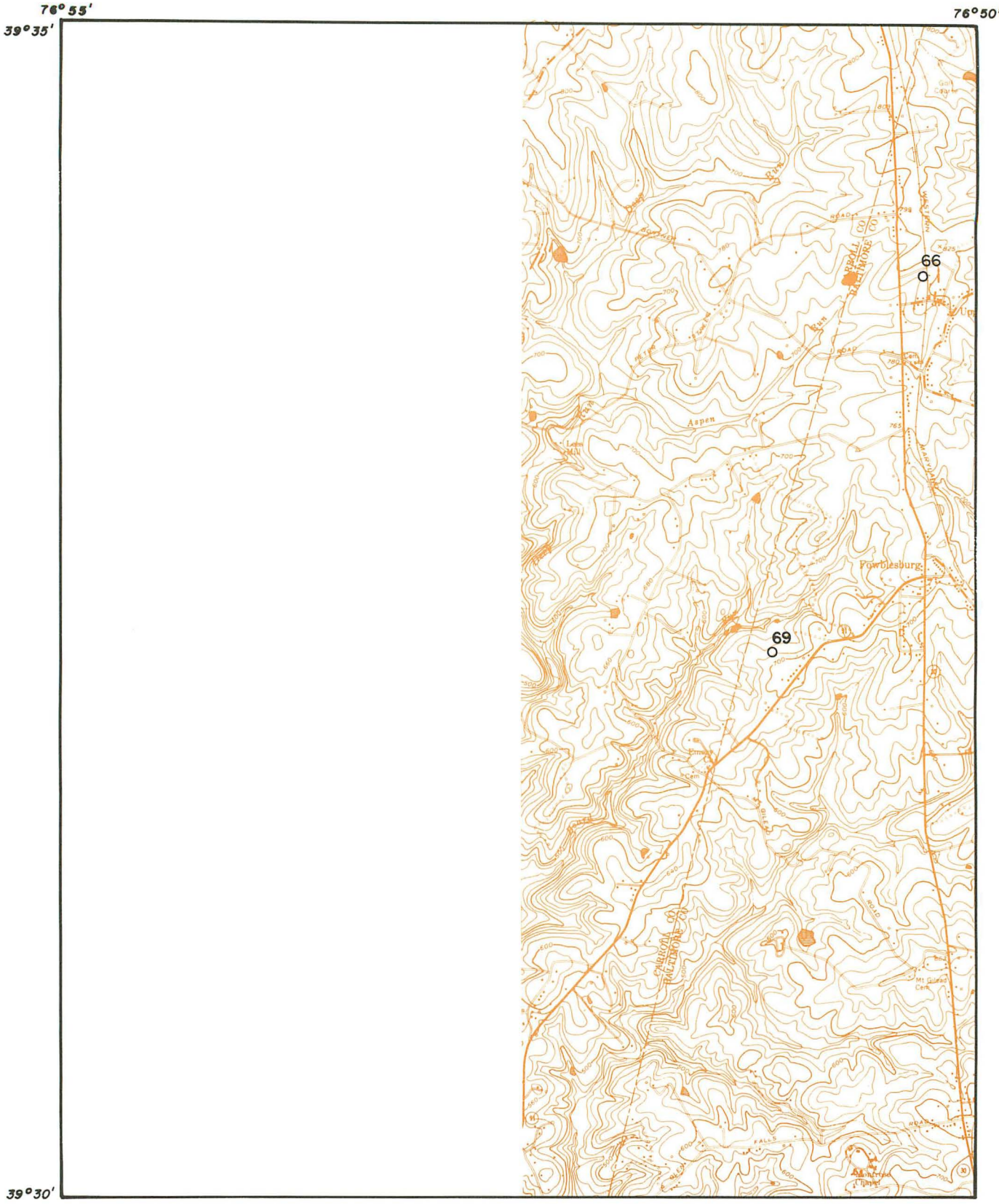

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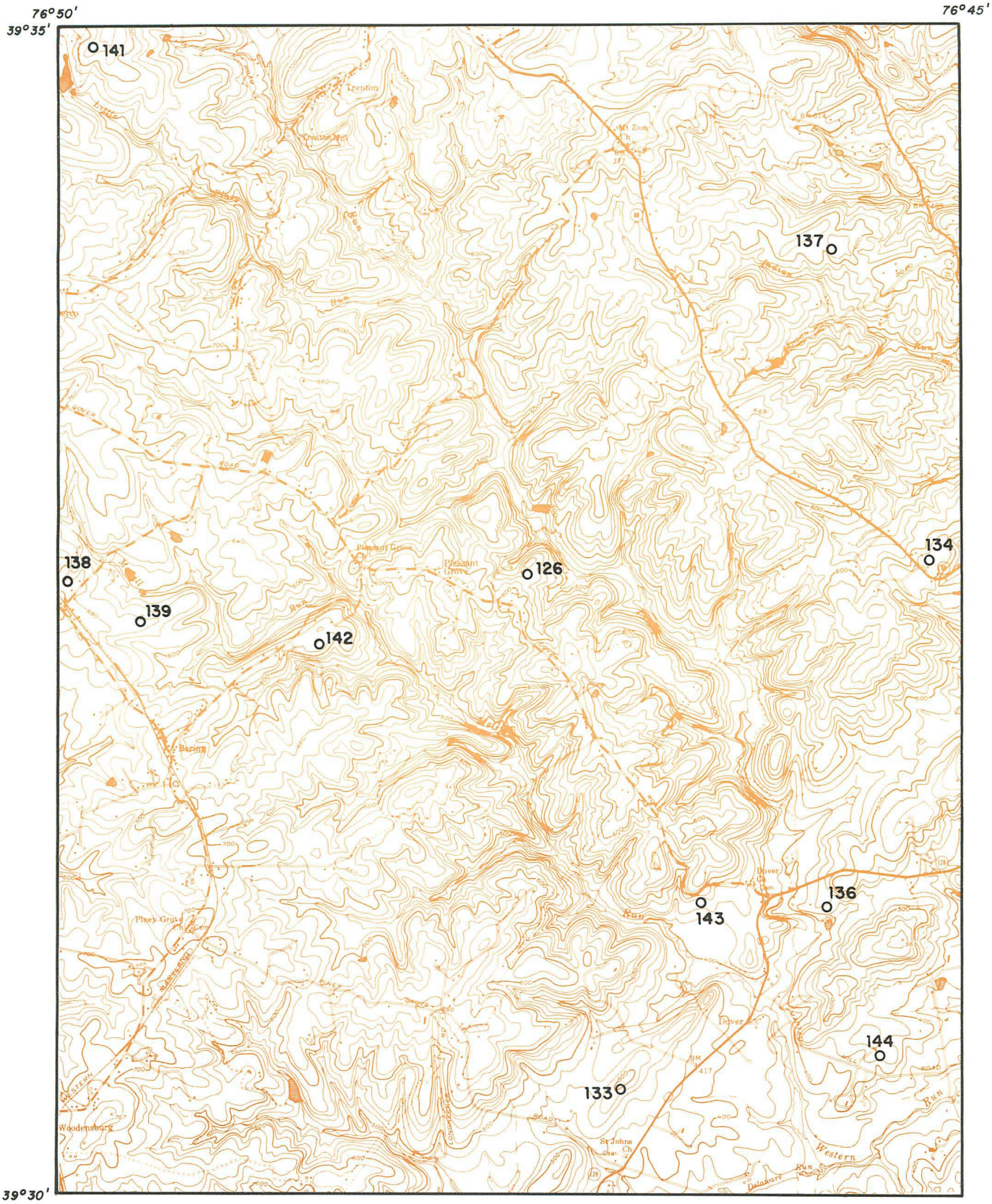

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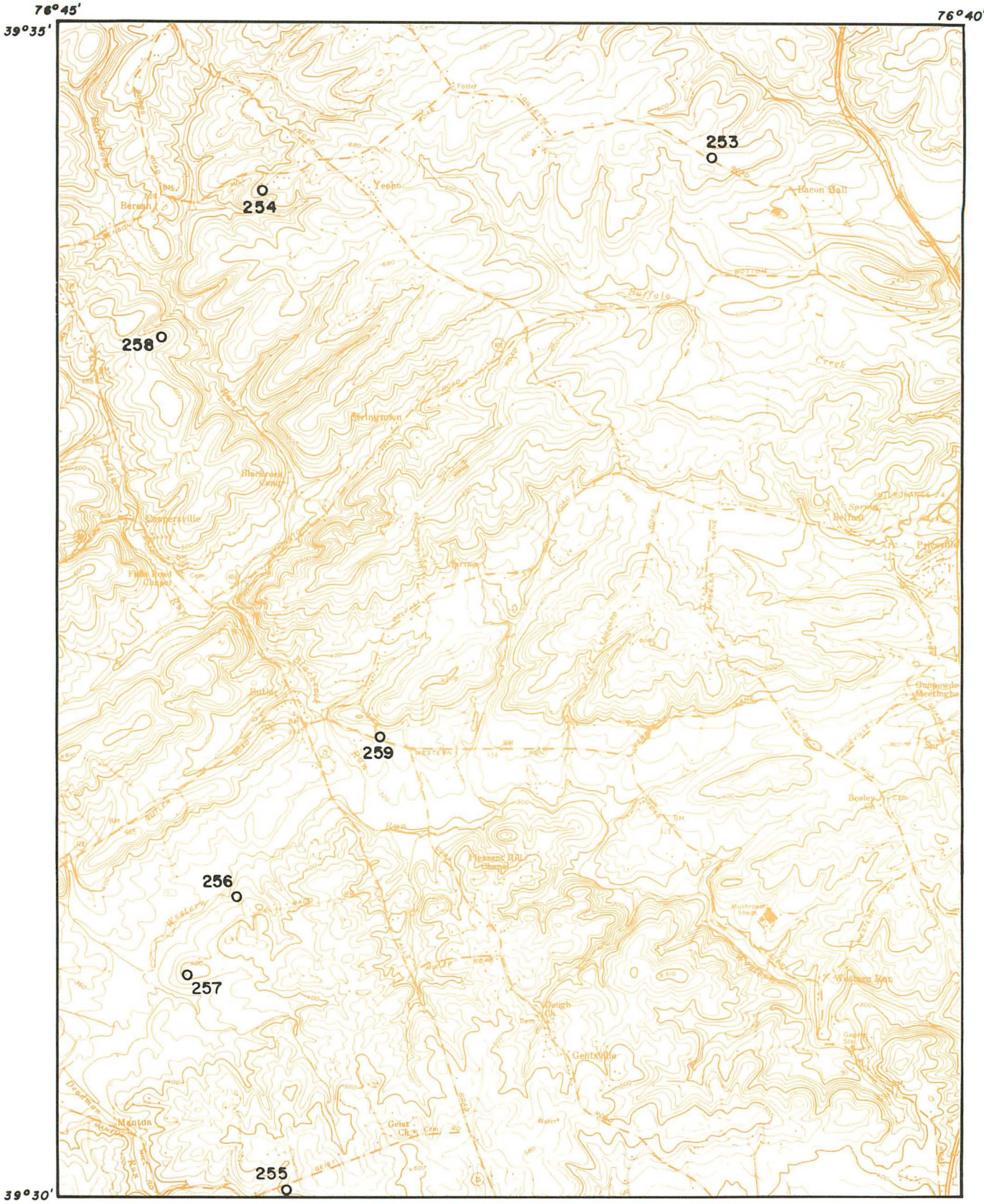

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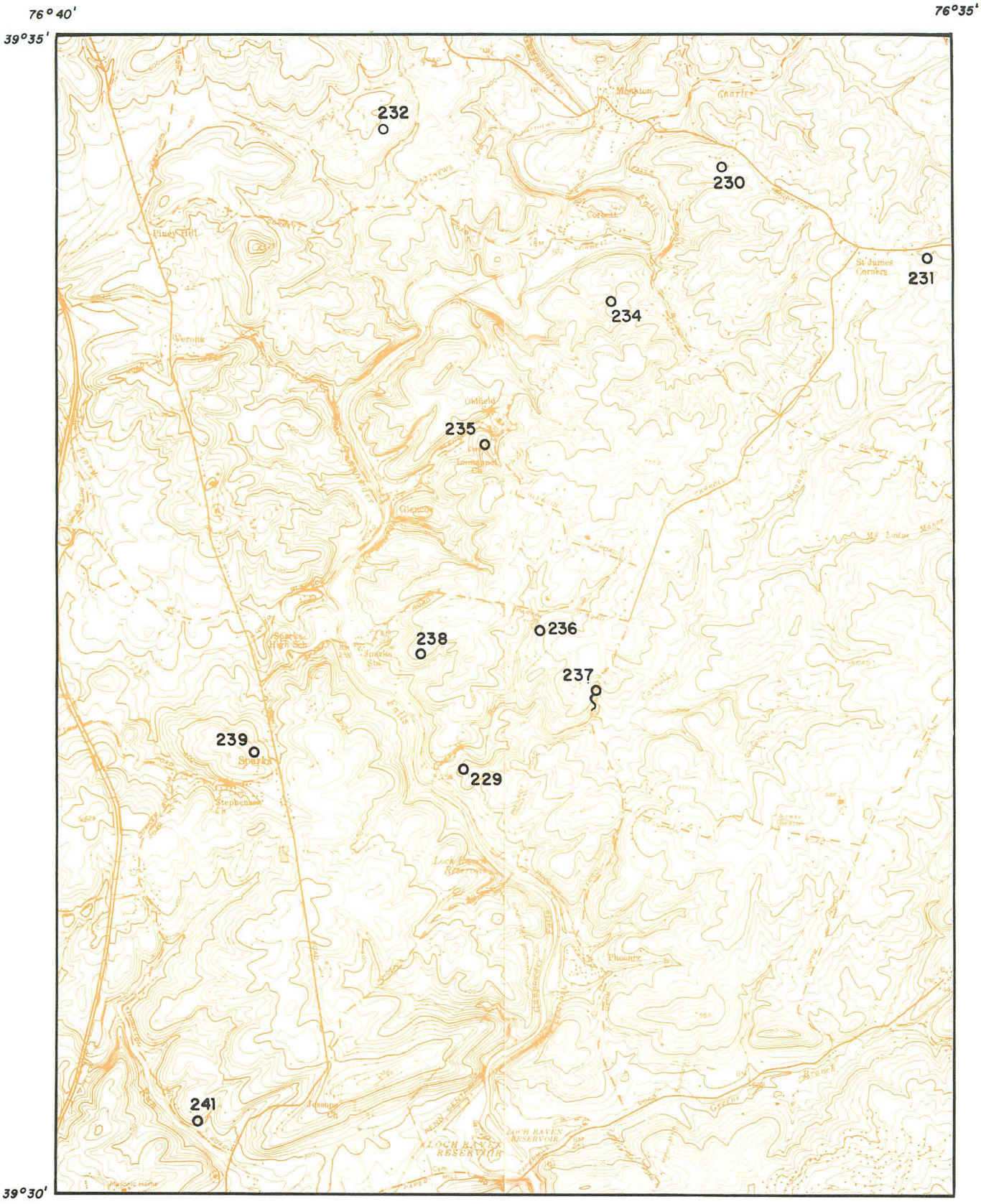


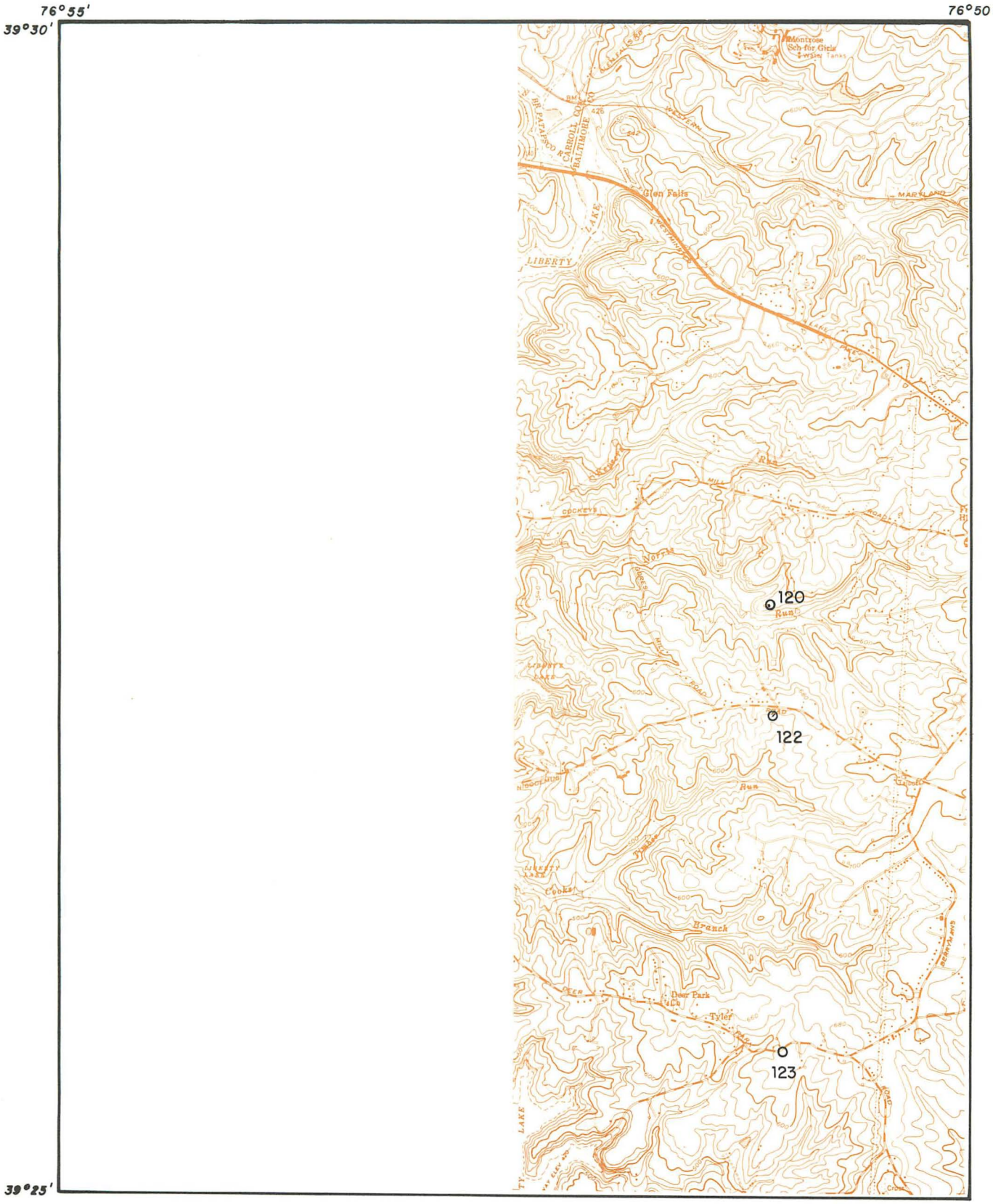
Cd

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

76°35'
76°30'
39°35'
39°30'
Taylor
Ebenezer Ch
Elkridge Harford Hunt Club
HARFORD CO
BALTIMORE CO
Nelson
Branch
St James Ch
Manor
HESS ROAD
Hess
Good Will Ch
Little
Yellow Branch
Glynmalira Ch
Parker
JARRETTSVILLE
STANSBURY MILL
313
Saw mill
Branch
Gunpowder
Falls
GREEN GLADE ROAD
Jacksonville
Microwave Tower
Chestnut Grove Ch
Sweet Air
St Johns Ch
312
Fairview Ch
Sunnybrook
309
311
Hillendale Golf Course
CARROLL MANOR ROAD
OLD YORK ROAD
1 .5 0 1 MILE
1 .5 0 1 KILOMETER

Ce



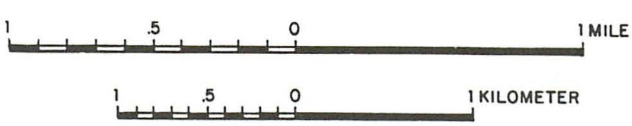
Da

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

76°50'
76°45'
39°30'
39°25'
261
259
Glen Morris
Emory Grove
Glyndon
Reisterstown
Sacred Heart Ch
St Georges
St Lukes Cem
Worthington
Richleigh Sch
Hannah More Academy
Gwynnbrook
Gwynnbrook State Game Farm
Delight
Belltown
Owings Mills Sch
Owings Mills
Rosewood State Training Sch
St Thomas Ch
Delaware
Gwynns
Falls
WORTHINGTON VALLEY
The Caves
WORTHINGTON AVENUE
Substation
Water
Sewage Disposal
Reservoir
Swimming Pool
Cem
Mt Pleasant Ch

Db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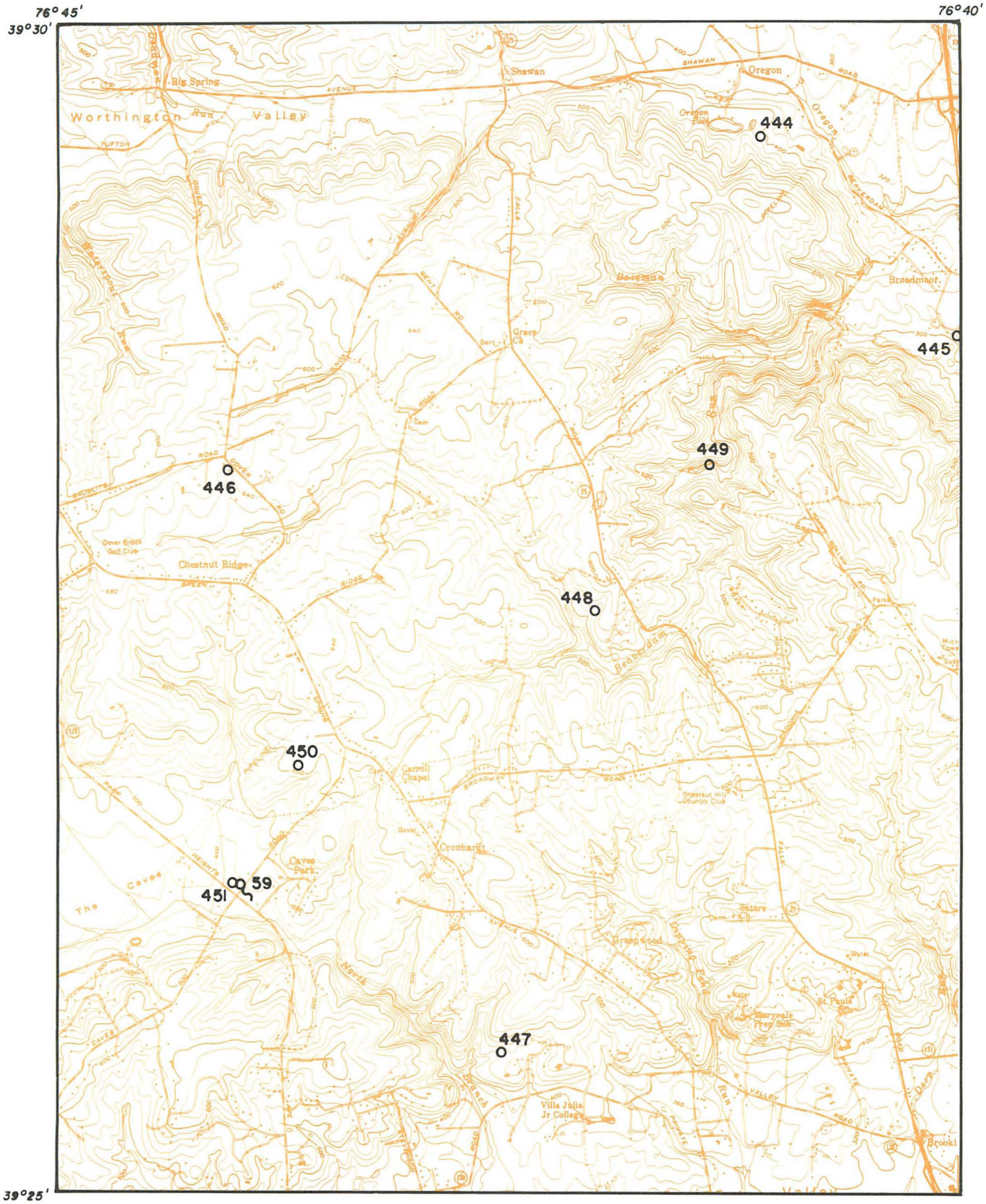

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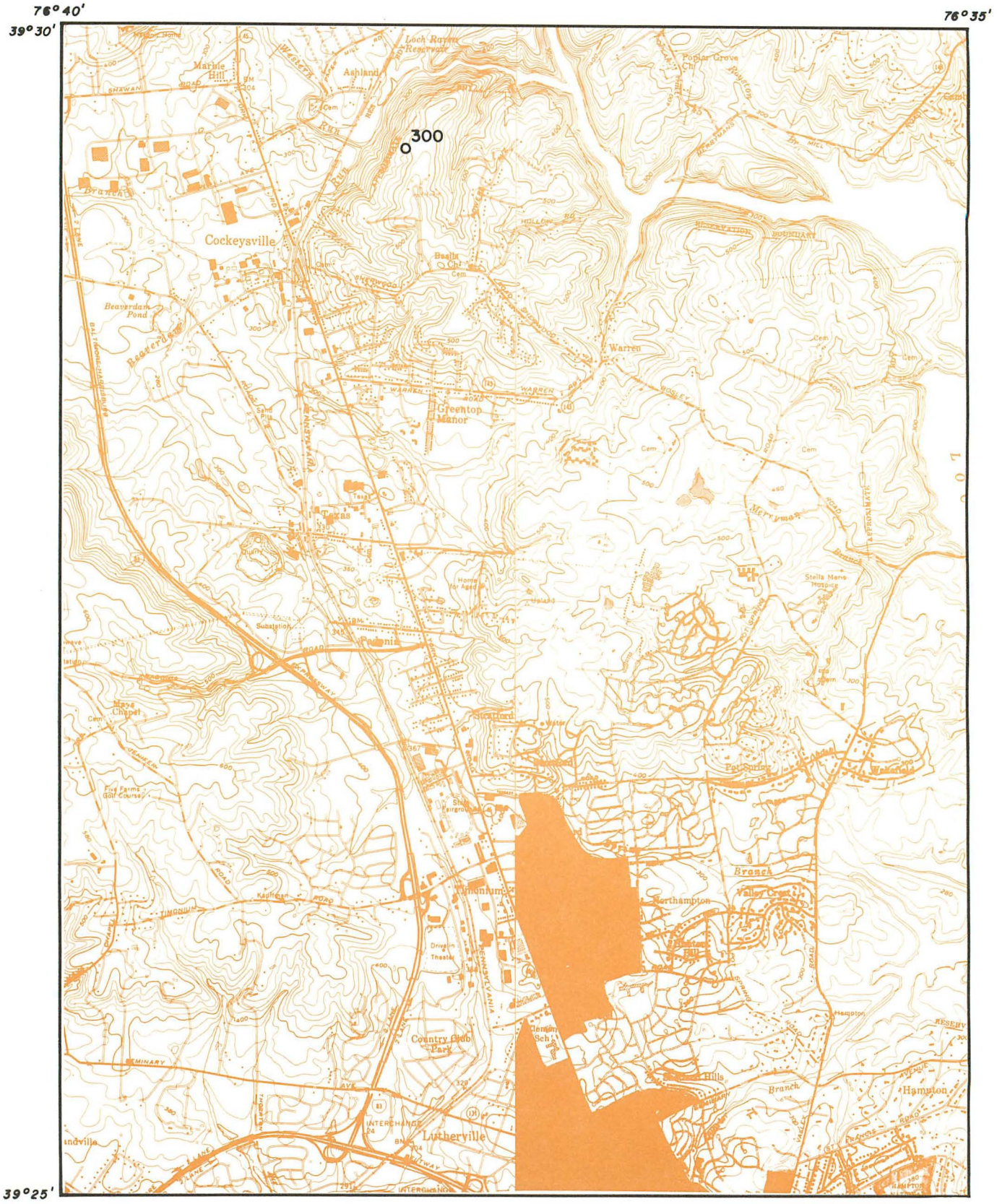

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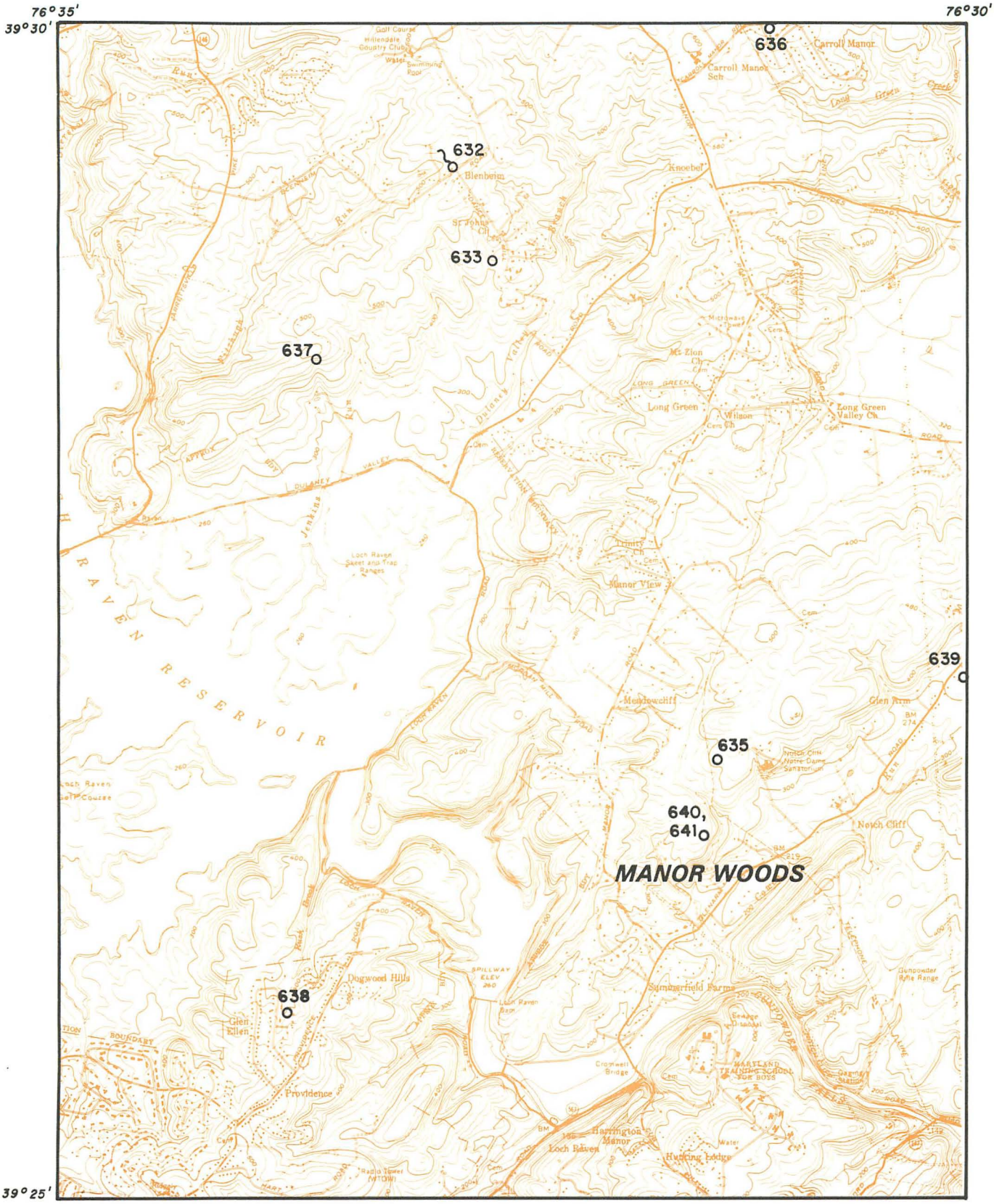

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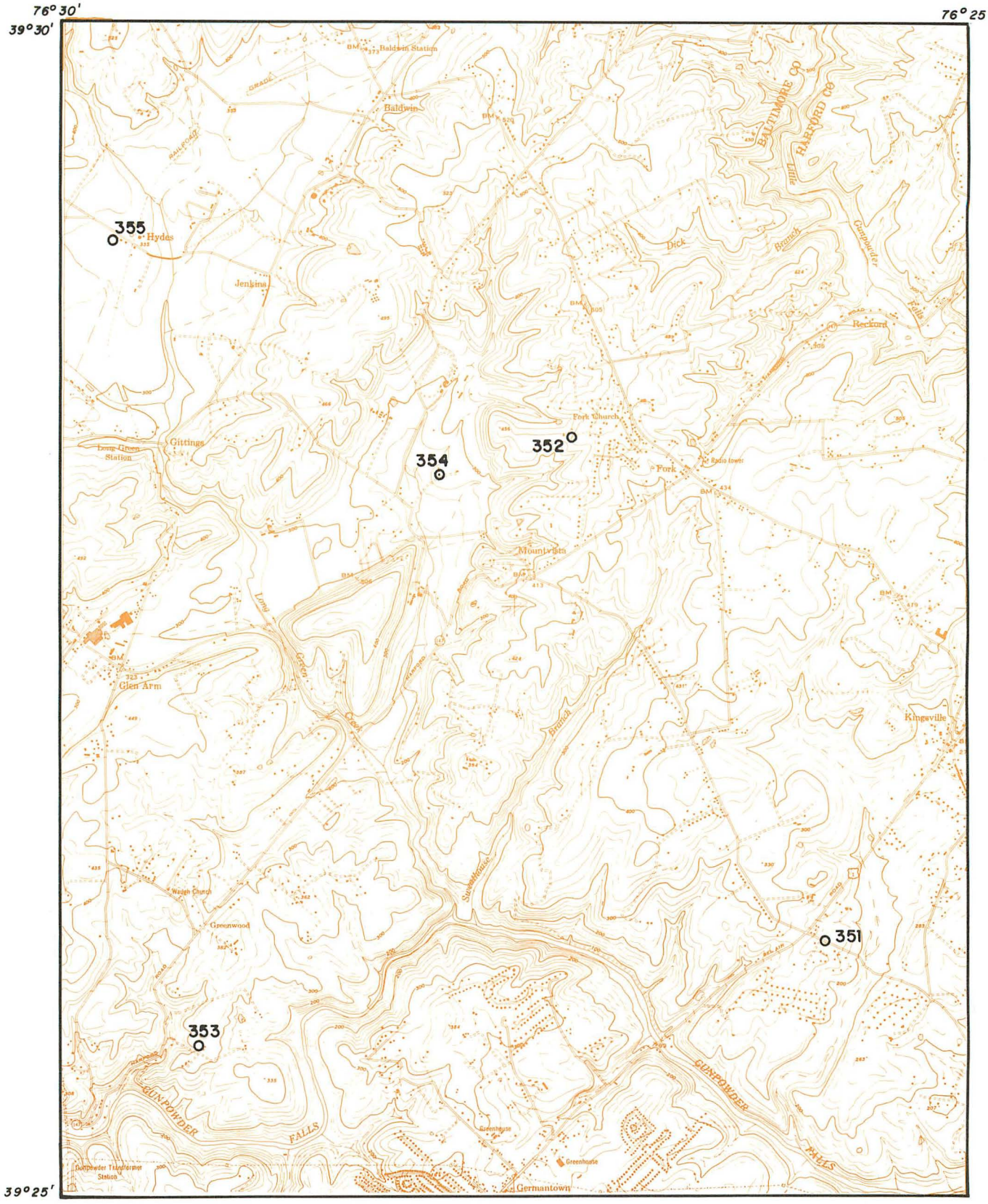

Df

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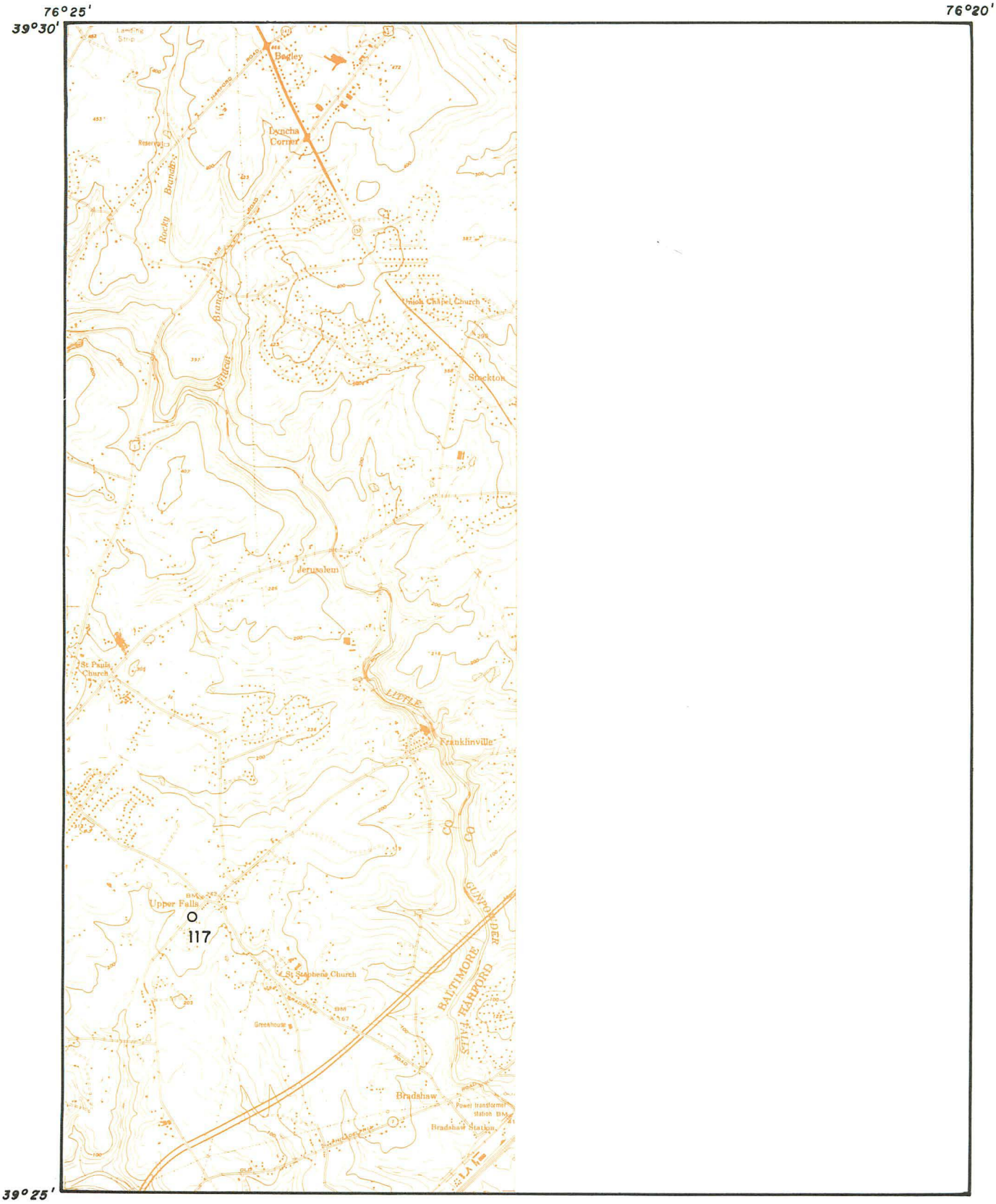
1 .5 0 1 KILOMETER



Dg

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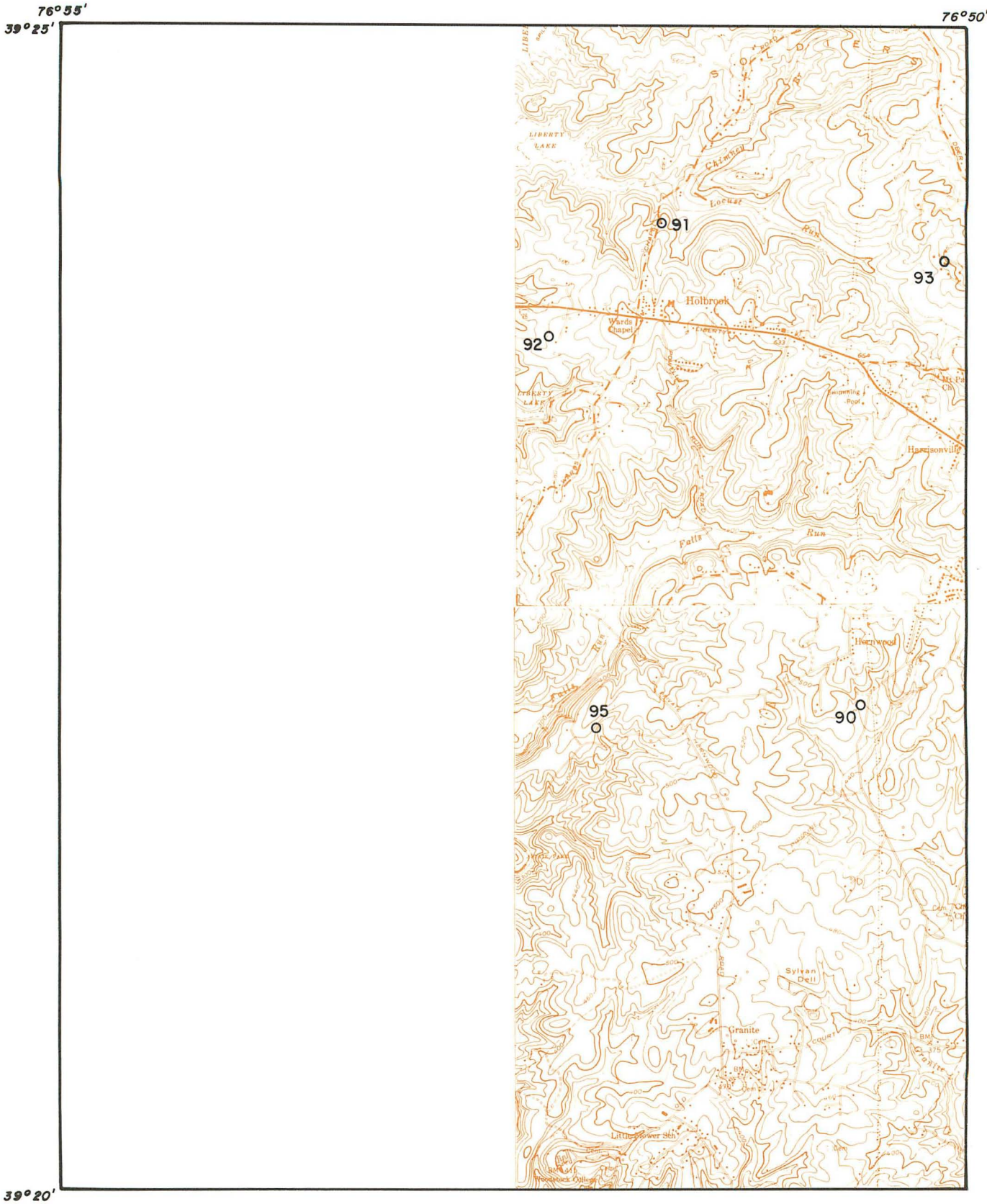
1 .5 0 1 KILOMETER



Ea

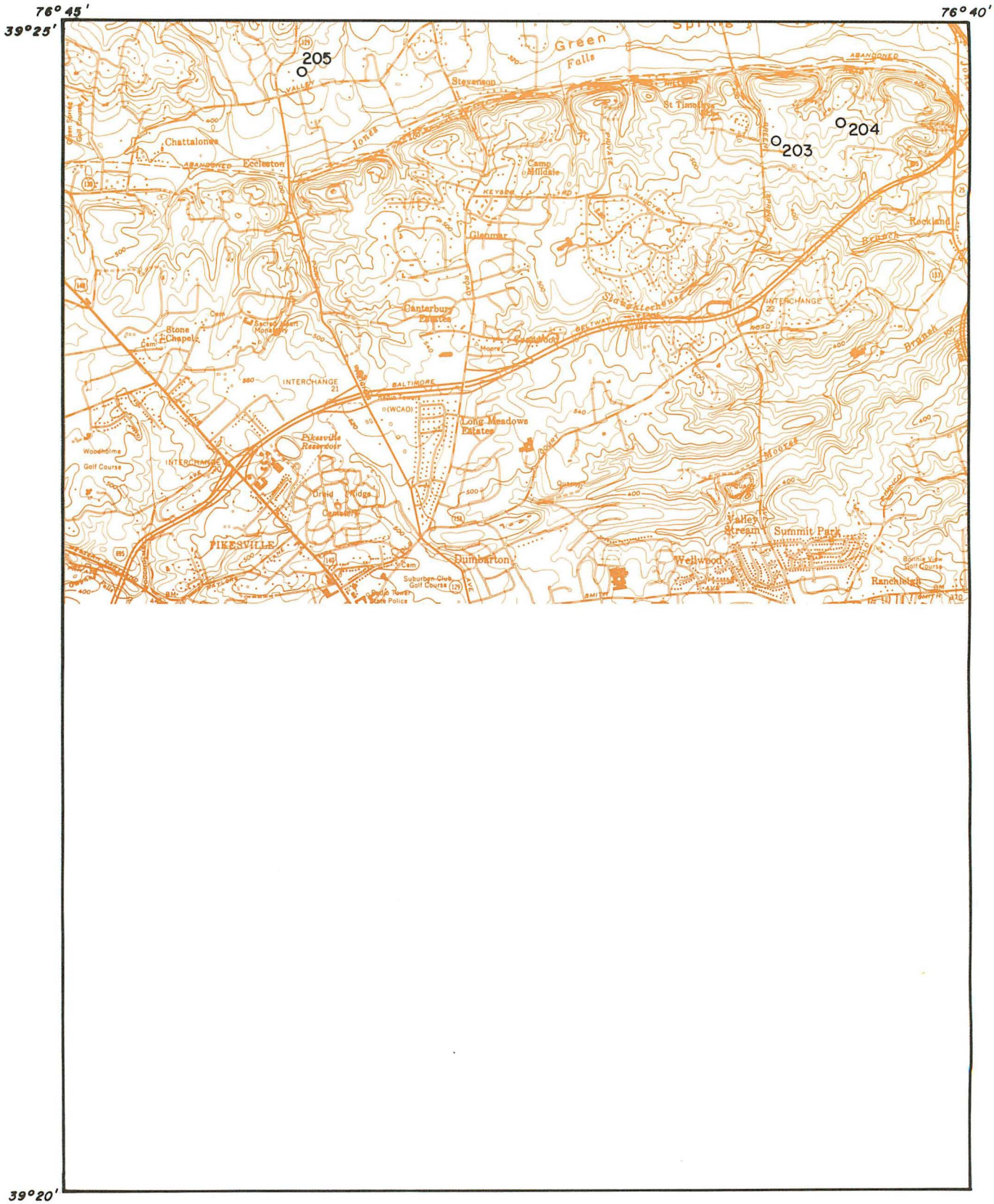
1 .5 0 1 MILE

1 .5 0 1 KILOMETER

Eb

1 .5 0 1 MILE

1 .5 0 1 KILOMETER



Ec

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

Fb

1 .5 0 1 MILE

1 .5 0 1 KILOMETER

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