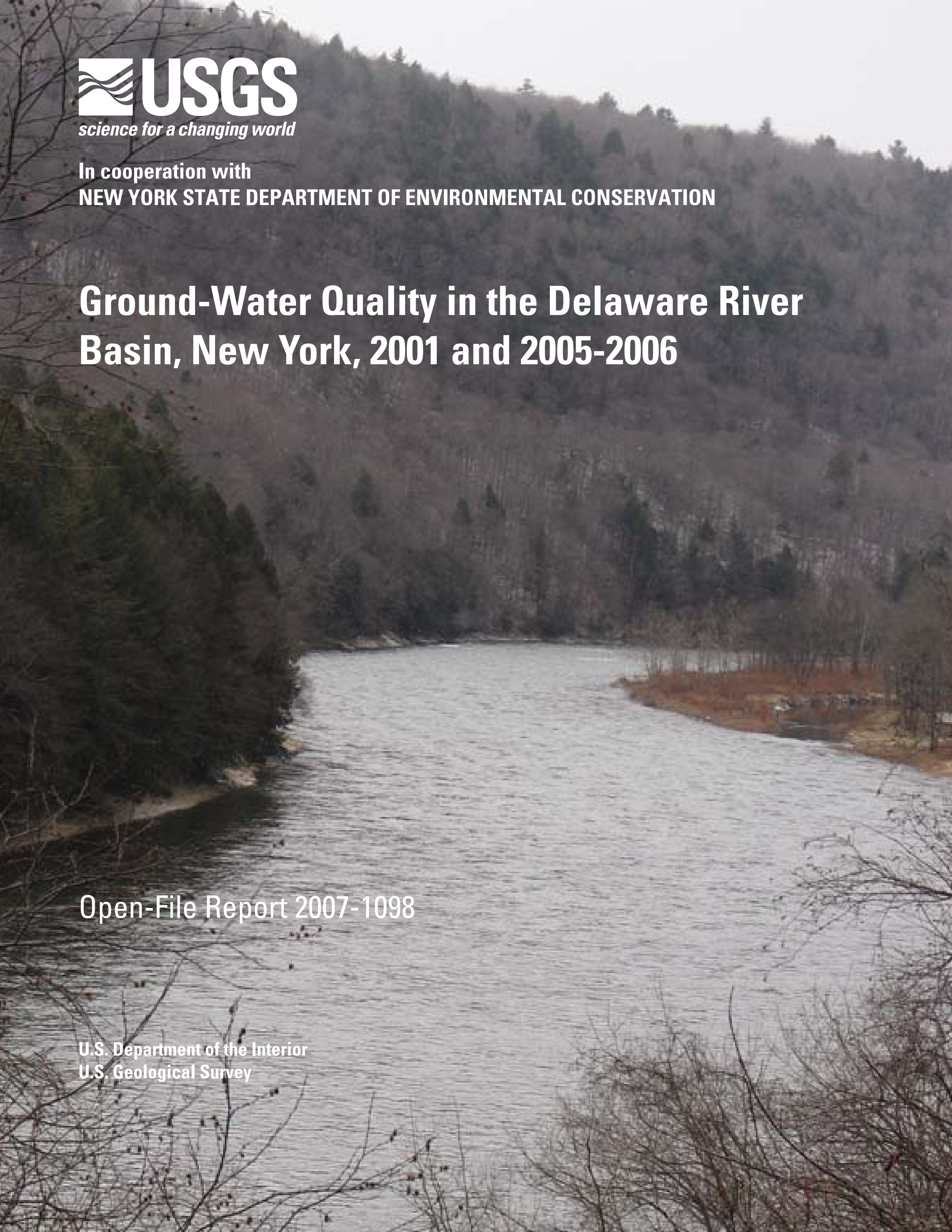

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Ground-Water Quality in the Delaware River Basin, New York, 2001 and 2005-2006

Open-File Report 2007-1098

U.S. Department of the Interior
U.S. Geological Survey

Cover.—Photograph by Elizabeth Nystrom, U.S. Geological Survey.

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By Elizabeth A. Nystrom

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

U.S. Geological Survey, Reston, Virginia 2007

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Conversion Factors

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
foot (ft)	0.3048	meter (m)
	Area	
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
liter (L)	0.2642	gallon (gal)
gallon (gal)	3.785	liter (L)
	Flow rate	
gallon per minute (gal/min)	0.06309	liter per second (L/s)
	Radioactivity	
picocurie per liter (pCi/L)	0.037	becquerel per liter (Bq/L)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=(1.8×°C)+32
Vertical coordinate information is referenced to North American Vertical Datum of 1988 (NAVD 88).
Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviated water-quality units used in this report:
micrometers (µm)
micrograms per liter (µg/L)
milligrams per liter (mg/L)
picoCuries per liter (pCi/L)
microsiemens per centimeter @ 25°C (µS/cm)

Acronyms used in this report:

AMCL	Alternative maximum contaminant level
CFU	Colony-forming units
CIAT	2-chloro-4-isopropylamino-6-amino-*s*-triazine
cICP-MS	Collision/reaction cell inductively coupled plasma-mass spectrometry

CEAT	2-chloro-6-ethylamino-4-amino-*s*-triazine
ESA	Ethanesulfonic acid
GC-MS	Gas chromatography-mass spectrometry
GPS	Global positioning system
HPLC-MS	High-performance liquid chromatography-mass spectrometry
ICP-AES	Inductively coupled plasma-atomic emission spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
ICP-OES	Inductively coupled plasma-optical emission spectrometry
LC-MS	Liquid chromatography-mass spectrometry
MCL	Maximum contaminant level
MTBE	Methyl *tert*-butyl ether
NAWQA	National Water Quality Assessment program
NTU	Nephelometric turbidity units
NWQL	USGS National Water Quality Laboratory
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OA	Oxanilic acid
OGRL	USGS Organic Geochemistry Research Laboratory
PVC	Polyvinyl chloride
SDWS	Secondary drinking water standards
SPE	Solid-phase extraction
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	Volatile organic compound

Ground-Water Quality in the Delaware River Basin, New York, 2001 and 2005-06

By Elizabeth A. Nystrom

Abstract

The Federal Clean Water Act Amendments of 1977 require that States monitor and report on the quality of ground water and surface water. To satisfy part of these requirements, the U.S. Geological Survey and New York State Department of Environmental Conservation have developed a program in which ground-water quality is assessed in 2 to 3 of New York State's 14 major basins each year. To characterize the quality of ground water in the Delaware River Basin in New York, water samples were collected from December 2005 to February 2006 from 10 wells finished in bedrock. Data from 9 samples collected from wells finished in sand and gravel in July and August 2001 for the National Water Quality Assessment Program also are included. Ground-water samples were collected and processed using standard U.S. Geological Survey procedures. Samples were analyzed for more than 230 properties and compounds, including physical properties, major ions, nutrients, trace elements, radon-222, pesticides and pesticide degradates, volatile organic compounds, and bacteria.

Concentrations of most compounds were less than drinking-water standards established by the U.S. Environmental Protection Agency and New York State Department of Health; many of the organic analytes were not detected in any sample. Drinking-water standards that were exceeded at some sites include those for color, turbidity, pH, aluminum, arsenic, iron, manganese, radon-222, and bacteria. pH ranged from 5.6 to 8.3; the pH of nine samples was less than the U.S. Environmental Protection Agency secondary drinking-water standard range of 6.5 to 8.5. Water in the basin is generally soft to moderately hard (hardness 120 milligrams per liter as $CaCO_3$ or less). The cation with the highest median concentration was calcium; the anion with the highest median concentrations was bicarbonate. Nitrate was the predominant nutrient detected but no sample exceeded the 10 mg/L U.S. Environmental Protection Agency maximum contaminant level. The trace elements detected with the highest median concentrations were strontium and iron in unfiltered water and strontium and barium in filtered water. Concentrations of trace elements in several samples exceeded U.S. Environmental Protection Agency secondary drinking-water standards, including aluminum (50-200 micrograms per liter, three wells), arsenic (10 micrograms per liter, one well), iron (300 micrograms per liter, three wells), and manganese (50 micrograms per liter, four wells).

The median concentration of radon-222 was 1,580 picoCuries per liter. Radon-222 is not currently regulated, but the U.S. Environmental Protection Agency has proposed a maximum contaminant level of 300 picoCuries per liter along with an alternative maximum contaminant level

of 4,000 picoCuries per liter, to be in effect in states that have programs to address radon in indoor air. Concentrations of radon-222 exceeded the proposed maximum contaminant level in all 19 of the samples and exceeded the proposed alternative maximum contaminant level in 1 sample. Eleven pesticides and pesticide degradates were detected in samples from ten wells; all were herbicides or herbicide degradates. Three volatile organic compounds were detected, including disinfection byproducts such as trichloromethane and gasoline components or additives such as methyl *tert*-butyl ether. No pesticides, pesticide degradates, or volatile organic compounds were detected above established limits. Coliform bacteria were detected in samples from five wells, four of which were finished in sand and gravel; *Escherichia coli* was not detected in any sample.

Introduction

The Federal Clean Water Act Amendments of 1977 require that States monitor and report biennially on the chemical quality of surface water and ground water within their boundaries (U.S. Environmental Protection Agency, 1997, Section 305(b)). In 2002, the U.S. Geological Survey (USGS), in cooperation with the New York State Department of Environmental Conservation (NYSDEC), developed a program to evaluate ground-water quality throughout the major river basins in New York State on a rotating basis. This program parallels the NYSDEC Rotating Intensive Basin Study program, which evaluates surface-water quality in 2 or 3 of the 14 river basins in the state per year. Ground-water quality was studied in the Mohawk River Basin in 2002 (Butch and others, 2003), in the Chemung River Basin in 2003 (Hetcher-Aguila, 2005), and in the Lake Champlain and upper Susquehanna River Basins in 2004 (Nystrom, 2006; Hetcher-Aguila and Eckhardt, 2006). In 2005-2006, ground-water quality in the St. Lawrence, Delaware, and Genesee River Basins was studied.

Purpose and Scope

This report presents the findings for the 2001 and 2005-2006 ground-water quality studies in the Delaware River Basin. To characterize ground-water quality in the Delaware River Basin, 10 water samples were collected from December 2005 to February 2006 from wells finished in bedrock; 9 samples were collected in July and August 2001 from wells finished in sand and gravel as part of the National Water Quality Assessment (NAWQA) program. This report (1) describes the methods of site selection, sample collection, and chemical analysis used to sample ground water in the Delaware River Basin in 2005-2006 and 2001, and (2) discusses the results by category-- physical properties, major ions, nutrients, trace elements and radionuclides, pesticides, volatile organic compounds (VOCs), and bacteria. Information about the wells sampled and results are presented in tables 1 through 9 at the end of the report.

Hydrogeologic Setting

The Delaware River Basin covers approximately 12,700 mi^2 in New York, Pennsylvania, New Jersey, and Delaware. The headwaters of the Delaware River are in the Catskill Mountains of New York; the river then flows generally south to the Delaware Bay. Geology, topography, population, and land use vary widely in the basin, from the commonly densely populated urban and industrial areas in the gently rolling coastal plain and piedmont province, to the more rural and agricultural ridges and valleys around the Delaware Water Gap and the Catskill Mountains. The Philadelphia metropolitan area is the largest population center in the basin. More information about the basin and its water quality is presented in Fischer and others (2004) and New York State Department of Environmental Conservation (1996).

Only the part of the basin in New York, approximately 19 percent (2,360 mi^2) of the entire basin, is addressed in this study (fig. 1). The Delaware Basin in New York (herein referred to as the basin) is located along the east-central portion of the southern border of New York and covers most of Delaware and Sullivan Counties, parts of Broome, Orange, and Ulster Counties, and small portions of Chenango, Greene, and Schoharie Counties. The basin is mostly rural in nature, with larger population centers in the southern part of the basin at Port Jervis, Liberty, and Monticello. Most of the basin (approximately 86 percent) is forested (fig. 2). Agriculture, including dairy and poultry farming, covers approximately 9 percent of the basin; about 2 percent of the land is developed (land cover calculated from the National Land Cover Dataset, Vogelmann and others, 2001). Approximately 40 percent of the 1,100-mi^2 Catskill State Park is within the basin.

The West Branch Delaware River forms the boundary between New York and Pennsylvania for 9 mi before joining with the East Branch to form the main stem of the Delaware River, which forms the boundary for another 76 mi (New York State Department of Environmental Conservation, 1996). Within the basin, the West Branch Delaware, East Branch Delaware, Mongaup, and Neversink Rivers are the major tributaries to the Delaware River. Drinking water for New York City is diverted out of the basin at three reservoirs: Cannonsville (on the West Branch Delaware River), Pepacton (on the East Branch Delaware River), and Neversink (on the Neversink River). Topography in the southern part of the basin is more rolling than in the northern part of the basin, where rivers have carved deeply incised valleys (fig. 3). Altitudes in the basin range from approximately 420 ft at Port Jervis to more than 4,000 ft in the Catskills.

Bedrock geology in the Delaware River Basin in New York is sedimentary in origin (fig. 4). Most of the basin is underlain by Middle to Upper Devonian sandstones and shales (Isachsen and others, 2000). Wells in sandstone and shale generally produce small to moderate yields of 10 to 100 gal/min (Barksdale, 1970). A thin band of Silurian to Lower Devonian rocks parallels the southeastern edge of the basin. This region, which is less than 10 mi wide, includes carbonate rocks, shales, and conglomerates (Parker and others, 1964).

During the Pleistocene, the entire Delaware River Basin in New York was glaciated. Unsorted till of low permeability was deposited over most of the basin; wells finished in the till generally have low yields. Glaciofluvial deposits were deposited in the large valleys, including outwash and ice-contact deposits (Parker and others, 1964). The outwash and ice-contact sand and gravel are typically well sorted and form important aquifers in the basin that may produce yields of 1,000 gal/min or more (Barksdale, 1970).

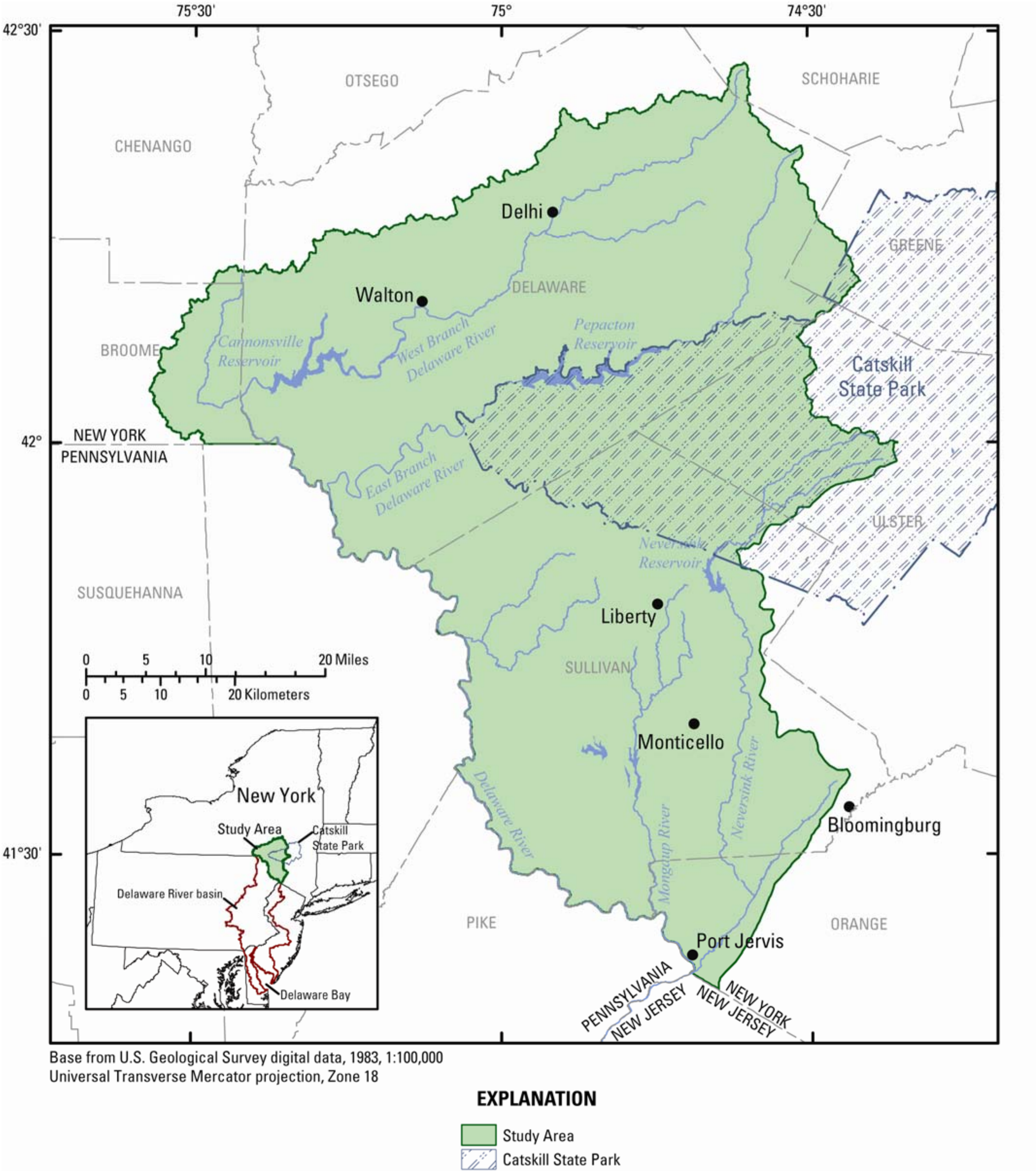

Figure 1. Hydrologic and geographic features of the Delaware River Basin in New York.

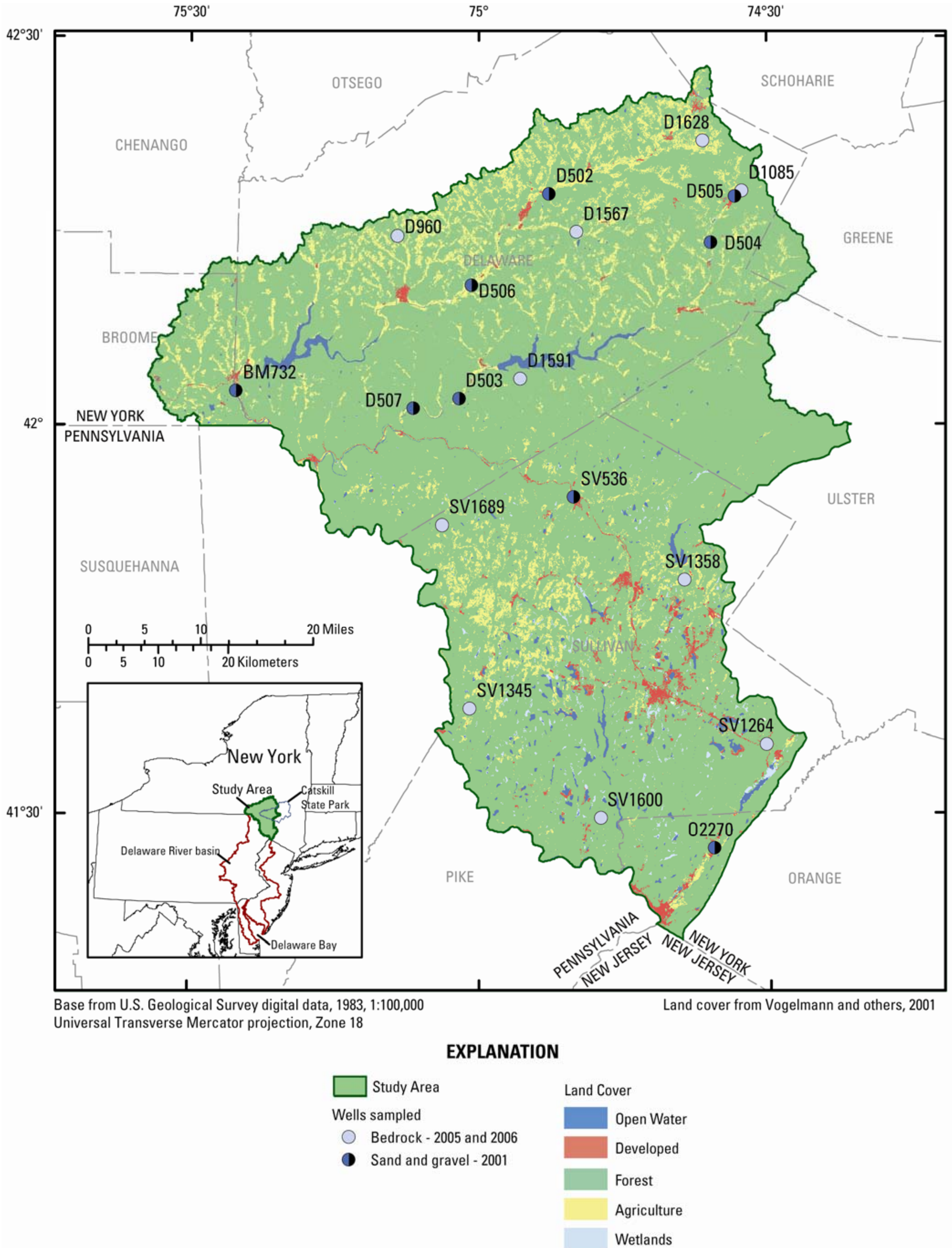

Figure 2. Land cover and locations of wells sampled in the Delaware River Basin in New York.

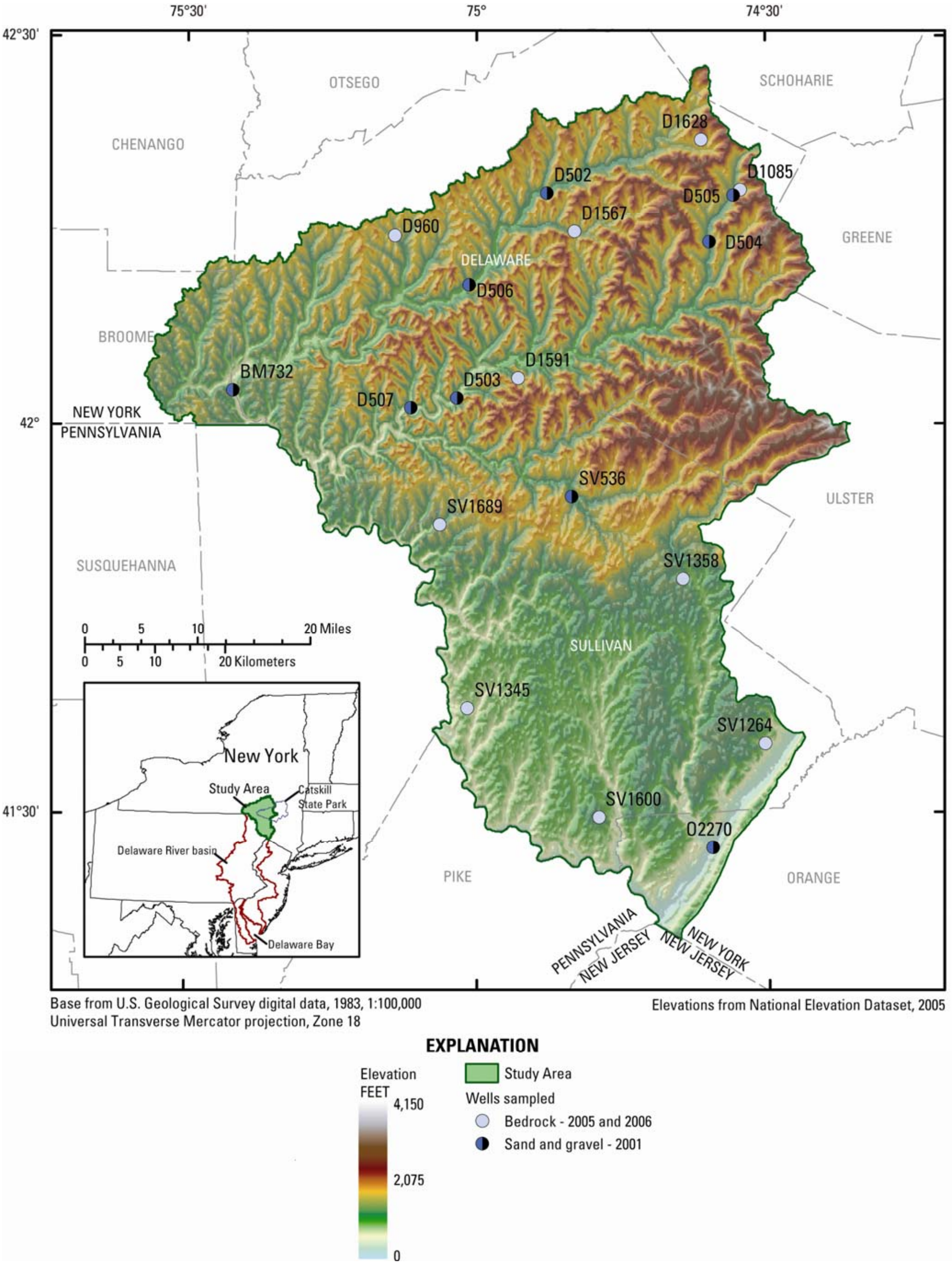

Figure 3. Topography and locations of wells sampled in the Delaware River Basin in New York.

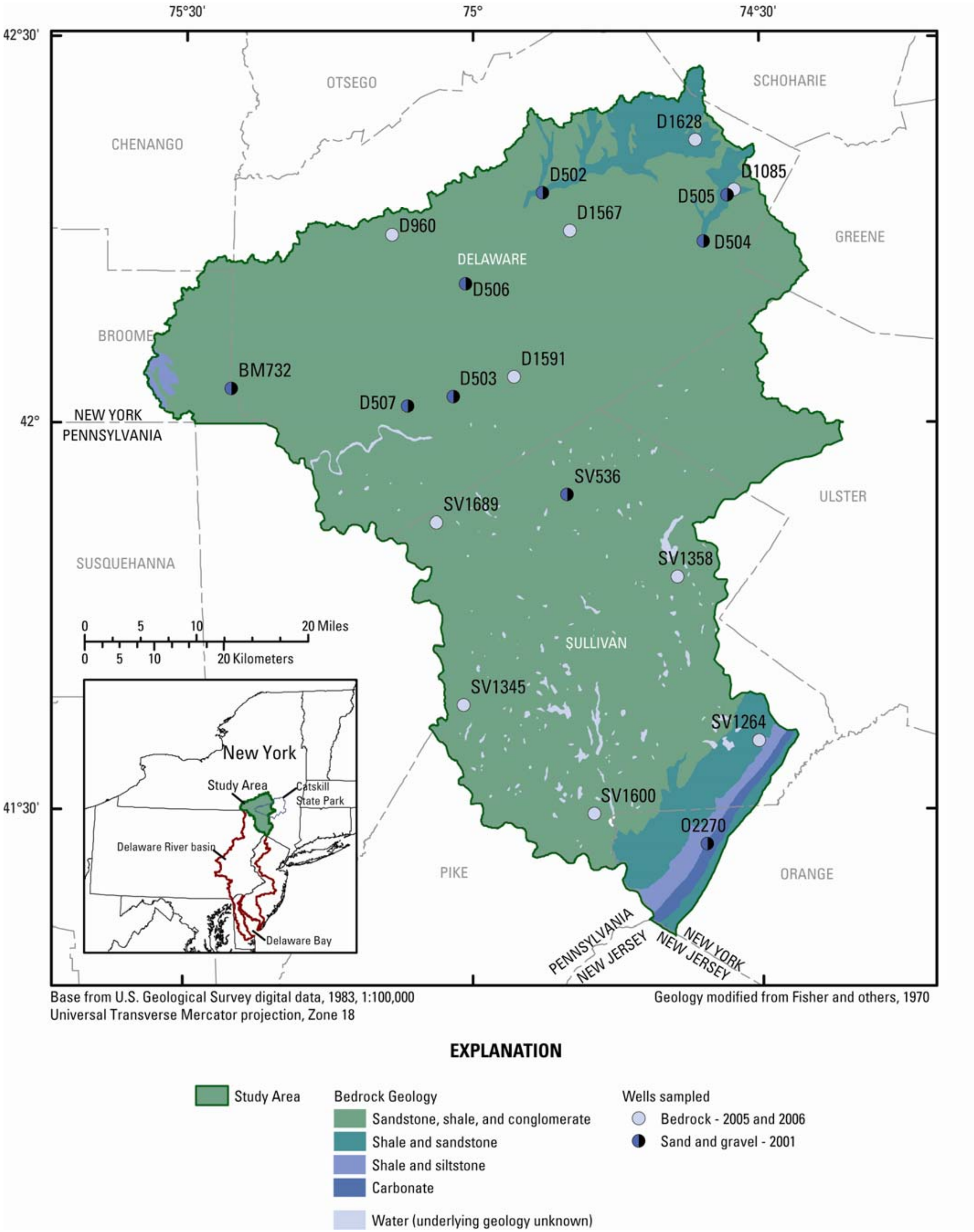

Figure 4. Generalized bedrock geology and locations of wells sampled in the Delaware River Basin in New York.

Methods of Investigation

The methods used in this study, including (1) well-selection criteria, (2) sampling procedures, and (3) analytical methods, were designed to maximize data precision, accuracy, and comparability. Wells were selected on the basis of location, with emphasis on areas of greatest ground water use, and availability of hydrogeologic information about the well. Ground-water sample collection and processing were conducted in accordance with standard USGS procedures (U.S. Geological Survey, variously dated). Samples were analyzed at four laboratories using documented methods. Wherever possible for samples collected in 2005-2006, unfiltered samples were analyzed for all appropriate compounds to best represent ground water used by consumers. Some differences in sample analytes and analysis methods occurred between the samples collected in 2001 and 2005-2006; these differences are noted in the following sections.

Site Selection

The 10 bedrock wells sampled in 2005-2006 were selected on the basis of information from the NYSDEC Water Well program, which began in 2000 and requires that licensed well drillers file a report with NYSDEC containing basic information about each well drilled—such as well depth, casing diameter, and a hydrogeologic log. Potential sampling locations were identified by inspection of well-completion data; well owners were sent a letter that included a request for permission to sample the well and questionnaire about the well. Well owners who gave permission were contacted later by phone to clarify well information and arrange a sampling time. The 10 bedrock wells that were selected include 9 wells that supply water for household use and 1 well that supplies water for a stockyard. The nine sand and gravel wells sampled in 2001 were randomly selected in glaciofluvial sediments based on a technique described by Scott (1990); eight of the nine wells are used for domestic supply, the remaining well was an observation well.

The characteristics of the sampled wells are listed in table 1. The bedrock wells range from 53 to 380 ft deep; most are finished in shale and sandstone. The wells finished in sand and gravel range from 22 to 128 ft deep. Land cover within a 0.5 mi radius of all the wells is predominantly forested, however, other land uses are also significant, especially in the area immediately surrounding the well. Immediate land use around the wells varies from agricultural (for example well O2270) to residential (SV1264) to forested (SV1689) (fig. 2). The design of the well network did not target specific municipalities, industries, or agricultural practices.

Sampling Methods

Eighteen water samples were collected using the pump permanently installed in the well; one well was sampled with a portable pump. Water was collected from a tap as close to the well as feasible, before the pressure tank, where possible, and before any water-treatment system. Samples were collected using one or more 10-ft lengths of Teflon tubing attached to a spigot. After connecting the tubing, the well was purged by running to waste for 20 minutes or until at least one well-casing volume of water had passed the sampling point and readings of field parameters had stabilized. Wells were purged at pumping rates on the order of 5-10 gal/min; recent water use by the well owner allowed purging of less than three well-casing volumes. Purging of one observation well was done using a portable, stainless steel submersible pump with Teflon line. Three casing volumes were purged and field parameters monitored for stability prior to sample collection. During well purging, notes about the well and surrounding land and land use were taken; a global positioning system (GPS) measurement of latitude and longitude also was made. After purging the well, water was directed at approximately 1 to 2 gal/min into a flow-through chamber that contained a multi-parameter meter with temperature, pH, specific conductance, and dissolved-oxygen probes. Field values were then recorded at regular intervals; sampling began when the values of water temperature, pH, specific conductance, and dissolved oxygen concentration had stabilized (U.S. Geological Survey, variously dated).

For sample collection, the flow rate was adjusted to about 1 gal/min; at domestic wells, another spigot was left open during sampling to keep the submersible pump running. The Teflon sampling tube was then disconnected from the multi-parameter meter and connected to a sampling chamber constructed of a polyvinyl chloride (PVC) frame and a clear plastic bag. The sampling chamber was placed on a plastic-box table with a built-in drain. The Teflon tubing and spigot-attachment equipment were cleaned in the laboratory before each day of sampling with a dilute Liquinox solution, followed by tapwater and deionized-water; in 2001, the equipment was then methanol rinsed (in 2005-2006, only the equipment for pesticide filtering was methanol rinsed). A fresh sampling-chamber bag was used at each site. Samples were collected and preserved in the sampling chamber according to standard USGS sampling methods (U.S. Geological Survey, variously dated). Sample bottles for nutrient, major-ion, and some trace-element analyses were filled with water filtered through disposable 0.45-µm-pore-size polyether sulfone capsule filters that were pre-conditioned in the laboratory with deionized water the day of sample collection. Sample bottles for pesticide analysis were filled with water filtered through baked 0.7-µm-pore-size glass fiber filters. Acid preservation was required for trace-element, VOC, and major-ion analyses. Acid preservation was done only after collection of other samples to avoid the possibility of cross contamination by the acid preservative; for example, samples preserved with nitric acid were acidified after the collection of samples for nutrient analysis. Samples for radon analysis were collected through a septum chamber with a glass syringe and injected below scintillation oil contained in a scintillation vial. Water samples analyzed by non-USGS laboratories were collected in bottles provided by the analyzing laboratory.

All samples, except those for radiological analysis, were chilled to 4° C or less after collection. In 2005-2006, samples for bacterial analysis were hand delivered to a New York State Department of Health (NYSDOH) certified laboratory in Bloomingburg, N.Y. (fig. 1), within 6 hours of collection. In 2001, bacterial analyses were done on-site by USGS personnel. The remainder of the samples were shipped overnight to the designated laboratories.

Analytical Methods

Samples were analyzed for 230 physical properties and constituents, including inorganic constituents, nutrients, trace elements, radionuclides, pesticides and their degradates, VOCs, and bacteria. Physical properties, such as water temperature, pH, specific conductance, and dissolved oxygen, were measured at the sampling site. Analyses for inorganic constituents, nutrients, trace elements, radon-222, pesticides and pesticide degradates, and VOCs were conducted at the USGS National Water Quality Laboratory (NWQL) in Denver, Colo.; additional pesticide and pesticide degradate analyses were done at the USGS Organic Geochemistry Research Laboratory (OGRL) in Lawrence, Kans. Other analyses were done at NYSDOH-certified laboratories; including total organic carbon and phenolic compound analyses at Friend Laboratory in Waverly, N.Y., and bacterial analyses at OCL Analytical Services in Lisbon, N.Y.

The 2005-2006 samples were often analyzed with the same methods as were used for analyses of the 2001 samples. Some compounds, however, were analyzed with different methods in 2005-2006 than in 2001, as noted in the following section. In addition, concentrations of some compounds were determined for samples collected in 2005-2006 but not for samples collected in 2001 and vice versa; this is noted in the tables of results.

Anion concentrations were determined by ion-exchange chromatography, and cation analyses were done by inductively coupled plasma-atomic emission spectrometry (ICP-AES), as described in Fishman (1993). Nutrients were analyzed by colorimetry, as described by Fishman (1993) and by Kjeldahl digestion with photometric finish, as described by Patton and Truitt (2000).

Concentrations of most trace elements were determined in unfiltered water in 2005-2006; all trace elements were determined from filtered water in 2001. Mercury analysis was done by cold vapor–atomic fluorescence spectrometry according to methods described by Garbarino and Damrau (2001). Arsenic and chromium in unfiltered water were analyzed by collision/reaction cell inductively coupled plasma-mass spectrometry (cICP-MS) as described by Garbarino and others (2006). Remaining trace elements in unfiltered water were analyzed by ICP-AES as described in Struzeski and others (1996), inductively coupled plasma-optical emission spectrometry (ICP-OES) and inductively coupled plasma-mass spectrometry (ICP-MS), as described by Garbarino and Struzeski (1998). In-bottle digestions for trace-element analyses were done as described by Hoffman and others (1996). Concentrations trace elements in filtered water samples from 2001 were determined by ICP-MS as described by Garbarino (1999) and Faires (1992); filtered samples from 2005-2006 were analyzed by ICP-AES as described by Fishman (1993). Radon-222 was measured by liquid-scintillation counting (ASTM International, 2006).

Samples for pesticide analyses were processed as described by Wilde and others (2004). Pesticides and pesticide-degradates were analyzed at the NWQL by solid-phase extraction (SPE) and gas chromatography-mass spectrometry (GC-MS), high-performance liquid chromatography-mass spectrometry (HPLC-MS) as described by Zaugg and others (1995), Sandstrom and others (2001), and Furlong and others (2001). Acetamide parent compounds and degradation-product analyses were analyzed at the USGS OGRL in 2001 by HPLC-MS as described by Zimmerman and others (2000) and Lee and others (2001) and in 2005-2006 by SPE and liquid chromatography-mass spectrometry (LC-MS) as described by Lee and Strahan (2003). VOCs were analyzed by gas chromatography-mass spectrometry by methods described by Connor and others (1998).

Bacteriological analyses in 2005 and 2006 were completed at OCL Analytical Services, a NYSDOH-certified laboratory in Bloomingburg, N.Y. The samples were collected and processed in accordance with NYSDEC and NYSDOH protocols, except that the tap from which the water sample was collected was not flame sterilized. Samples were tested for total coliform, fecal coliform, and *Escherichia coli (E. coli)* by Standard Methods 9222 B and D (American Public Health Association, 1998). A heterotrophic plate count test (SM 9215 B) also was conducted. Bacteriological analyses in 2001 were conducted by USGS personnel; samples were analyzed for total coliform and *E. coli* with the two step m-ENDO and NA-MUG method as described in Britton and Greeson (1989).

Total organic carbon and total phenols in 2005 and 2006 were analyzed by a NYSDOH-certified laboratory. Total organic carbon analyses were done by U.S. Environmental Protection Agency (USEPA) method 9060 (U.S. Environmental Protection Agency, 2004), and total phenols analyses were done by USEPA method 420.2 (U.S. Environmental Protection Agency, 1983).

One field blank sample and one sequential replicate sample were collected in 2005-2006 for quality assurance in addition to the 10 ground-water samples. Nitrogen-purged VOC/pesticide-grade universal blank water and inorganic-grade blank water supplied by the USGS NWQL were used for the blank sample; blank water was run through a portion of the Teflon tubing used for sampling, and water for filtered-water constituents was pumped through pre-conditioned filters. Blank samples were acidified in the same manner as environmental samples. The results for the blank sample showed no chemical concentrations above the laboratory reporting levels; the color of the blank sample was measured at 5 platinum-cobalt units. The percent-concentration differences from the sequential replicate sample were 5 percent or less for the 34 of the 48 constituents detected in the replicate sample. The largest percent differences between concentration in the ground-water sample and the replicate sample were in compounds at or near the laboratory reporting level and in color (2 platinum-cobalt units in the environmental sample and 5 in the quality-assurance sample, with a laboratory reporting level of 1 platinum-cobalt units) and boron (8.2 µg/L in the environmental sample and 11 µg/L in the quality-assurance sample, with a laboratory reporting level of 7.0 µg/L). Small differences in measured concentrations at or near the laboratory reporting level can account for large percent differences.

Ground-Water Quality in the Delaware River Basin

Ground-water samples were analyzed for more than 230 compounds or properties; most were not detected in any sample above laboratory reporting levels (table 2). The compounds and properties that were detected are reported in tables 3 through 9. Some concentrations of constituents are reported as estimated concentrations; these semi-quantitative values are preceded by an "E" remark code in the tables. Estimated concentrations are typically reported in cases where the detected value is less than established laboratory reporting levels or when recovery of a compound has been shown to be highly variable (Childress and others, 1999). Concentrations of some constituents exceeded maximum contaminant levels (MCLs) or secondary drinking water standards (SDWS) set by USEPA (U.S. Environmental Protection Agency, 2003) or NYSDOH (New York State Department of Health, 1998). MCLs are enforceable standards for finished water at public-water supplies; they are not enforceable for private homeowner wells but are presented here as a standard for evaluation of the water-quality results.

Physical Properties

The color of the samples collected in 2005-2006 ranged from <1 to 18 platinum-cobalt units, with a median of 2 platinum-cobalt units (table 3). One sample exceeded the USEPA SDWS and NYSDOH MCL of 15 platinum-cobalt units. The turbidity of the samples collected in 2001 ranged from 0.4 to 15 nephelometric turbidity units (NTU) with a median turbidity of 2.4 NTU. The turbidity of seven samples exceeded the USEPA MCL and NYSDOH MCL monthly average MCL of 1 NTU. Dissolved oxygen concentrations ranged from 0.1 mg/L to 10.2 mg/L with a median of 5.65 mg/L. The percent saturation of dissolved oxygen ranged from 1 to 96 percent saturation with a median of 55.5 percent. The pH of the samples ranged from 5.6 to 8.3 standard units with a median pH of 6.5. Nine samples had a pH less than the USEPA SDWS range of 6.5 to 8.5 pH units. Specific conductance of the samples ranged from 26 to 349 µS/cm @ 25°C with a median of 153 µS/cm. Water temperature ranged from 5.4 to 15.4 degrees Celsius with a median of 11 degrees Celsius.

Major Ions

Water hardness in the samples collected in 2005-2006 ranged from 12 to 140 mg/L as calcium carbonate ($CaCO_3$) with a median of 55 mg/L as $CaCO_3$ (table 4). Sixty percent (6) of the samples analyzed for hardness were soft (less than 60 mg/L as $CaCO_3$); 30 percent (3) were moderately hard (61 to 120 mg/L as $CaCO_3$), and 10 percent (1) were hard (121 to 180 mg/L as $CaCO_3$) (Hem, 1985). Acid-neutralizing capacity in the samples collected in 2005-2006 ranged from 15 to 186 mg/L as $CaCO_3$ with a median of 66 mg/L as $CaCO_3$. Alkalinity ranged from 14 to

136 mg/L as $CaCO_3$ with a median of 37 mg/L as $CaCO_3$. Alkalinity was generally higher in samples from bedrock wells (median 65.5 mg/L as $CaCO_3$) than in samples from sand and gravel wells (median 22 mg/L as $CaCO_3$).

The cation with the highest concentrations in the ground-water samples was calcium, which ranged from 4.17 mg/L to 35.6 mg/L with a median of 14.4 mg/L. The median concentrations of other cations were: sodium, 7.14 mg/L; magnesium, 2.7 mg/L; and potassium, 0.82 mg/L. The anion with the highest concentrations in the ground-water samples was bicarbonate, which ranged from 17 mg/L to 166 mg/L with a median of 45 mg/L; bicarbonate concentrations were calculated from the alkalinity results. The median concentrations of other anions were: chloride, 9.04 mg/L; sulfate, 8.6 mg/L; and fluoride, 0.1 mg/L. No concentrations of chloride, fluoride, or sulfate exceeded USEPA MCLs or SDWS or NYSDOH MCLs (listed as follows)

	Regulatory limits for ions in drinking water, mg/L		
	USEPA		NYSDOH
	MCL	SDWS	MCL
Chloride		250	250
Fluoride	4	2	2.2
Sulfate	500	250	250

Concentrations of silica in the samples ranged from 4.2 to 11.5 mg/L with a median of 7.96 mg/L. Residue on evaporation at 180°C ranged from 33 to 205 mg/L with a median of 103 mg/L.

Nutrients

Ammonia plus organic nitrogen was detected in six samples, with a maximum concentration of 0.18 mg/L (table 5). Ammonia was detected in 2 samples with a maximum concentration of 0.06 mg/L. Nitrate was the predominant nutrient; nitrate plus nitrite was detected in 15 samples and had a median concentration of 0.45 mg/L; nitrite was not detected. No sample exceeded the USEPA and NYSDOH MCLs of 10 mg/L: the maximum concentration of nitrate plus nitrite was 6.29 mg/L. Orthophosphate was detected in 10 samples at concentrations of 0.01 to 0.05 mg/L as phosphorus; the median detected concentration was 0.02 mg/L as phosphorus. Phosphorus was detected in eight of the nine samples collected in 2001; detected concentrations ranged from 0.004 to 0.054 mg/L. Concentrations of organic carbon in filtered samples from 2001 ranged from 0.2 mg/L to 1.2 mg/L. Organic carbon in unfiltered water was detected at concentrations greater than the laboratory reporting level in only two samples collected in 2005-2006 at concentrations of 1.0 and 1.3 mg/L.

Trace Elements and Radionuclides

Trace-element concentrations (table 6) in samples collected from bedrock wells during 2005-2006 were determined in unfiltered water. The trace elements with the highest median concentrations in unfiltered samples were strontium (217 µg/L) and iron (211.5 µg/L). Trace-element concentrations were determined in filtered samples collected from sand and gravel wells during 2001. The trace elements with the highest median concentrations in filtered samples were strontium (45.1 µg/L) and barium (33 µg/L).

Concentrations of some trace elements exceeded USEPA MCLs or SDWS and/or NYSDOH MCLs, including aluminum, arsenic, iron, and manganese. The USEPA SDWS for aluminum is 50 to 200 µg/L; three samples exceeded the low end of this range but only one sample (1,100 µg/L) also exceeded the high end of this range; all three of these samples were unfiltered. One unfiltered sample had an arsenic concentration, 21 µg/L, which exceeded the USEPA MCL of 10 µg/L. Three samples had iron concentrations greater than established limits; two of the samples were unfiltered and one was filtered. The NYSDOH MCL and USEPA SDWS for iron are 300 µg/L. The concentration of iron in one unfiltered sample was 2,150 µg/L. The concentration of manganese in three unfiltered samples exceeded the USEPA SDWS of 50 µg/L; two filtered samples also had manganese concentrations greater than 50 µg/L. No sample exceeded the NYSDOH MCL for manganese of 300 µg/L.

Radon-222 concentrations in the ground-water samples ranged from 580 pCi/L to 6,350 pCi/L with a median concentration of 1,580 pCi/L. Radon in drinking water is not currently regulated; however, the USEPA has proposed a two-part standard for radon in drinking water: (1) a 300 pCi/L MCL for areas that do not implement an indoor air radon mitigation program, and (2) an alternative MCL (AMCL) of 4,000 pCi/L for areas that do (U.S. Environmental Protection Agency, 1999). Concentrations of radon in all 19 of the samples exceeded the proposed MCL; the concentration of radon in one sample exceeded the proposed AMCL. Uranium concentrations ranged from 0.008 µg/L to 5.12 µg/L with a median of 0.528 in unfiltered water, and from less than 0.02 µg/L to 0.24 µg/L in filtered water. No sample exceeded the 30 µg/L USEPA MCL for uranium.

Pesticides

Eleven pesticides and pesticide degradates were detected in the samples; all were herbicides and herbicide degradates; most were degradates of the triazine and amide broadleaf herbicides atrazine, alachlor, and metolachlor (table 7). Pesticides were detected in samples from ten wells—six sand and gravel and four bedrock. Samples from 7 of the 10 wells had more than one pesticide detected; the three samples that had only one pesticide detection were from wells finished in bedrock. The most commonly detected pesticide was atrazine (five wells). The atrazine degradate 2-chloro-4-isopropylamino-6-amino-*s*-triazine (CIAT) was detected in six wells, and the metolachlor degradate metolachlor ethanesulfonic acid (metolachlor ESA) was detected in five wells. All of the pesticide detections were detected at concentrations of 0.1 µg/L or less, except metolachlor ESA, detected in five samples at concentrations from 0.17 µg/L to 1.27 µg/L. No concentrations of pesticides exceeded established drinking water standards; pesticide degradates are not yet regulated. Caffeine, which was included in the pesticide analysis, was detected in samples from three wells with a maximum estimated concentration of 0.017 µg/L.

Volatile Organic Compounds and Phenolic Compounds

Three VOCs were detected in samples from three sand and gravel wells (table 8). Dichlorodifluoromethane was detected in one well at an estimated concentration of 0.56 µg/L. Methyl *tert*-butyl ether (MTBE) was detected in one well at an estimated concentration of 0.1 µg/L. MTBE is a fuel oxygenate; the NYSDOH MCL for MTBE is 10 µg/L. Trichloromethane (chloroform) was detected in samples from one well at an estimated concentration of 0.03 µg/L. Trichloromethane is a trihalomethane, a group of compounds that are byproducts of chlorination; trihalomethanes include bromodichloromethane, dibromochloromethane, tribromomethane (bromoform), and trichloromethane (chloroform). The USEPA and NYSDOH MCLs for total trihalomethanes is 80 µg/L. Samples from 2005-2006 were analyzed for total phenolic compounds, but none were detected.

Bacteria

Coliform bacteria were detected in samples from five wells (table 9), four of which were sand and gravel wells. Samples from bedrock wells were analyzed for fecal coliform; none was detected. Samples from sand and gravel wells that tested positive for total coliform were also tested for *Escherichia coli* (*E. coli*); no sample tested positive for *E. coli*. Any detection in treated water of coliform bacteria is considered to be above the MCL. The owners of the wells were notified of the results upon receipt from the laboratory. Heterotrophic plate counts for samples collected from bedrock wells ranged from less than 1 colony-forming units (CFU) per mL of sample to more than 86 CFU per mL; the median was 6.5 CFU per mL. The USEPA MCL for the heterotrophic plate count is 500 CFU per mL.

Summary

To characterize the ground-water quality in the Delaware Basin in New York State, 19 ground-water samples were collected in July and August 2001 and from December 2005 to February 2006. Ten bedrock wells and nine sand and gravel wells were sampled for physical properties, major ions, nutrients, trace elements, radon-222, pesticides, VOCs, and bacteria. The bedrock wells were finished in shale and sandstone; the sand and gravel wells were finished in glaciofluvial deposits. Samples were collected using standard USGS protocols and analyzed in the field and at USGS and private NYSDOH-certified laboratories for more than 230 properties and compounds.

Sample color ranged from less than 1 to 18 platinum-cobalt units, and the color of one sample exceeded the USEPA SDWS or NYSDOH MCL of 15 units; sample turbidity ranged from 0.4 to 15 NTU and exceeded the USEPA MCL of 5 NTU in two samples. Sample pH ranged from 5.6 to 8.3, the pH of nine samples was less than the USEPA SDWS range of 6.5 to 8.5. Ground water in the basin is mostly soft or moderately hard (120 mg/L as $CaCO_3$ or less). The cation with the highest median concentration was calcium, and the anion with the highest median concentration was bicarbonate. The predominant nutrient was nitrate, but no concentrations of nitrate exceeded USEPA or NYSDOH standards. The trace elements with the highest median concentrations were strontium, iron, and barium. The concentration of arsenic in one sample exceeded the USEPA MCL of 10 µg/L. Concentrations of aluminum, iron, and manganese exceeded USEPA SDWS and/or NYSDOH MCLs, most commonly iron and manganese in unfiltered water. Concentrations of radon-222 exceeded the USEPA proposed MCL of 300 pCi/L in all samples analyzed and exceeded the proposed AMCL of 4,000 pCi/L in one sample. Eleven pesticides or pesticide degradates were detected in ten samples, most were degradates of triazine and amide broadleaf herbicides detected at concentrations of 0.1 µg/L or less; no concentrations of pesticides or pesticide degradates exceeded established drinking water standards. Caffeine was detected in three samples at estimated concentrations of 0.017 µg/L or less. Three VOCs were detected in three samples, including gasoline additive methyl *tert*-butyl ether, trichloromethane, and dichlorofluoromethane; the maximum VOC concentration was 0.56 µg/L. Coliform bacteria, including total coliform, fecal coliform and *E. coli* were detected in five samples, mostly from sand and gravel wells.

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Table 1. Wells from which ground-water samples were collected in the Delaware River Basin, 2001 and 2005-06.

[Land-cover categories: D, developed; A, agricultural; F, forested; W, wetlands and open water; NA, not applicable]

Well number[1]	Date sampled	Well depth, feet below land surface	Casing depth, feet	Bedrock type	Land cover[2], percentage by category[3]			
					D	A	F	W
Sand and gravel wells (2001)								
BM732	07/26/2001	22	21	NA	14	30	50	7
D502	07/24/2001	25.5	20.3	NA	0	27	71	1
D503	07/30/2001	120	119.4	NA	0	26	69	4
D504	07/31/2001	45	43.8	NA	0	29	71	0
D505	08/14/2001	70.4	52.9	NA	15	38	47	0
D506	08/15/2001	128	116.9	NA	10	46	42	1
D507	08/01/2001	23	23	NA	3	30	65	2
O2270	08/09/2001	28	28	NA	1	42	56	2
SV536	07/23/2001	125	120	NA	11	21	66	2
Bedrock wells (2005-06)								
D960	02/23/2006	104	60	Shale and sandstone	0	35	64	0
D1085	12/13/2005	320	20	Shale and sandstone	2	12	85	0
D1567	12/14/2005	53	22	Shale, sandstone, and conglomerate	0	41	59	0
D1591	01/11/2006	373	208	Shale and sandstone	0	4	96	0
D1628	12/15/2005	230	24	Shale and sandstone	0	27	72	0
SV1264	02/14/2006	380	50	Shale	15	1	85	0
SV1345	02/15/2006	340	61	Shale and sandstone	0	1	95	4
SV1358	01/19/2006	375	42	Shale, sandstone, and conglomerate	0	36	64	0
SV1600	12/14/2005	320	40	Sandstone	0	1	99	1
SV1689	01/19/2006	380	10	Shale and sandstone	0	0	100	0

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

[2] Land cover by category within a 0.5-mile radius of the well, determined from the National Land Cover Data set, Vogelmann and others (2001).

[3] Totals may not equal 100% due to rounding.

Table 2. Constituents analyzed for but not detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[--, not analyzed]

USGS parameter code	Compound	Laboratory reporting level 2001	Laboratory reporting level 2005-06
	Nutrients in filtered water, milligrams per liter as N		
00613	Nitrite, filtered	.006	.008
	Trace elements, micrograms per liter		
01075	Silver, filtered	1.0	--
01077	Silver, unfiltered	--	.16
01057	Thallium, filtered	.04	--
01059	Thallium, unfiltered	--	.2
	Pesticides in filtered water, micrograms per liter		
50470	2,4-D methyl ester	.009	.016
39732	2,4-D	.02	.04
38746	2,4-DB	.02	.02
82660	2,6-Diethylaniline	.002	.006
62850	2-[(2-Ethyl-6-methylphenyl)amino]-2-oxoethanesulfonic acid	--	.02
63781	2-Chloro-*N*-(2,6-diethylphenyl)acetamide	--	.02
50355	2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine	.008	--
49308	3-Hydroxy carbofuran	.006	.008
50295	3-Ketocarbofuran	1.50	--
61029	Acetochlor ethanesulfonic acid	.05	.02
61030	Acetochlor oxanilic acid	.05	.02
62847	Acetochlor sulfynilacetic acid	--	.02
49260	Acetochlor	.004	.006
49315	Acifluorfen	.007	.028
62849	Alachlor ethanesulfonic acid secondary amide	--	.02
61031	Alachlor oxanilic acid	.05	.02
62848	Alachlor sulfynilacetic acid	--	.02
46342	Alachlor	.002	.005
49313	Aldicarb sulfone	.02	.02
49314	Aldicarb sulfoxide	.008	.022
49312	Aldicarb	.04	.04
34253	*alpha*-HCH	.005	.005
82686	Azinphos-methyl	.050	.050
50299	Bendiocarb	.03	.02
82673	Benfluralin	.010	.010
50300	Benomyl	.004	.022
61693	Bensulfuron	.02	.02
38711	Bentazon	.01	.01
04029	Bromacil	.03	.02
49311	Bromoxynil	.02	.03
04028	Butylate	.002	.004
49310	Carbaryl	.03	.02
82680	Carbaryl	.041	.041
49309	Carbofuran	.006	.016
82674	Carbofuran	.020	.020
61188	Chloramben methyl ester	.02	.02
50306	Chlorimuron	.010	.032

Table 2. Constituents analyzed for but not detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.--Continued

[--, not analyzed]

USGS parameter code	Compound	Laboratory reporting level 2001	Laboratory reporting level 2005-06
	Pesticides in filtered water, micrograms per liter--Continued		
04039	Chlorodiamino-*s*-triazine	.01	.04
49306	Chlorothalonil	.04	--
38933	Chlorpyrifos	.005	.005
82687	*cis*-Permethrin	.006	.006
49305	Clopyralid	.01	.02
04041	Cyanazine	.018	.018
04031	Cycloate	.01	.01
49304	Dacthal monoacid	.01	.03
82682	DCPA	.003	.003
63778	Dechloroacetochlor	--	.02
63777	Dechloroalachlor	--	.02
63779	Dechlorodimethenamid	--	.02
63780	Dechlorometolachlor	--	.02
62170	Desulfinyl fipronil	--	.012
39572	Diazinon	.005	.005
38442	Dicamba	.01	.04
49302	Dichlorprop	.01	.03
39381	Dieldrin	.005	.009
61951	Dimethenamid ethanesulfonic acid	.05	.02
62482	Dimethenamid oxanilic acid	.05	.02
61588	Dimethenamid	--	.02
49301	Dinoseb	.01	.04
04033	Diphenamid	.03	.01
82677	Disulfoton	.02	.02
49300	Diuron	.01	.02
82668	EPTC	.002	.004
82663	Ethalfluralin	.009	.009
82672	Ethoprop	.005	.005
49297	Fenuron	.03	.03
62169	Desulfinylfipronil amide	--	.029
62167	Fipronil sulfide	--	.013
62168	Fipronil sulfone	--	.024
62166	Fipronil	--	.016
61952	Flufenacet ethanesulfonic acid	.05	.02
62483	Flufenacet oxanilic acid	.05	.02
62481	Flufenacet	--	.02
61694	Flumetsulam	.01	.04
38811	Fluometuron	.03	.02
04095	Fonofos	.003	.003
63784	Hydroxyacetochlor	--	.02
63783	Hydroxyalachlor	--	.02
64045	Hydroxydimethenamid	--	.02
50407	Imazethapyr	.02	.04
61695	Imidacloprid	.007	.020
39341	Lindane	.004	.004
38478	Linuron	.01	--

Table 2. Constituents analyzed for but not detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.--Continued

[--, not analyzed]

USGS parameter code	Compound	Laboratory reporting level 2001	Laboratory reporting level 2005-06
	Pesticides in filtered water, micrograms per liter--Continued		
82666	Linuron	.035	.035
39532	Malathion	.027	.027
38482	MCPA	.02	--
38487	MCPB	.01	.01
50359	Metalaxyl	.02	.01
38501	Methiocarb	.008	.010
49296	Methomyl	.004	.020
82667	Methyl parathion	.006	.015
39415	Metolachlor	.013	.006
82630	Metribuzin	.006	.006
82671	Molinate	.002	.003
61692	*N*-(4-Chlorophenyl)-*N*'-methylurea	.02	.04
82684	Napropamide	.007	.007
49294	Neburon	.01	.01
50364	Nicosulfuron	.01	.04
49293	Norflurazon	.02	.02
49292	Oryzalin	.02	.01
38866	Oxamyl	.01	.03
34653	*p,p*'-DDE	.003	.003
39542	Parathion	.007	.010
82669	Pebulate	.002	.004
82683	Pendimethalin	.010	.022
82664	Phorate	.011	.011
49291	Picloram	.02	.03
04037	Prometon	.01	.01
82676	Propyzamide	.004	.004
62767	Propachlor oxanilic acid	--	.02
04024	Propachlor	.010	.025
82679	Propanil	.011	.011
82685	Propargite	.02	.02
49236	Propham	.010	.030
50471	Propiconazole	.02	.01
38538	Propoxur	.008	.008
38548	Siduron	.02	.02
04035	Simazine	.011	.005
50337	Sulfometuron	.009	.091
82670	Tebuthiuron	.02	.02
82665	Terbacil	.034	.034
04032	Terbacil	.010	.016
82675	Terbufos	.02	.02
82681	Thiobencarb	.005	.010
82678	Triallate	.002	.006
61159	Tribenuron	.009	--
49235	Triclopyr	.02	.03
82661	Trifluralin	.009	.009

Table 2. Constituents analyzed for but not detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.--Continued

[--, not analyzed]

USGS parameter code	Compound	Laboratory reporting level 2001	Laboratory reporting level 2005-06
	Volatile organic compounds in unfiltered water, micrograms per liter		
32730	Phenolic compounds	--	4
77562	1,1,1,2-Tetrachloroethane	.03	--
34506	1,1,1-Trichloroethane	.03	.1
34516	1,1,2,2-Tetrachloroethane	.09	--
77652	1,1,2-Trichloro-1,2,2-trifluoroethane	.06	.1
34511	1,1,2-Trichloroethane	.06	--
34496	1,1-Dichloroethane	.04	.1
34501	1,1-Dichloroethene	.04	.1
77168	1,1-Dichloropropene	.03	--
49999	1,2,3,4-Tetramethylbenzene	.2	--
50000	1,2,3,5-Tetramethylbenzene	.2	--
77613	1,2,3-Trichlorobenzene	.3	--
77443	1,2,3-Trichloropropane	.16	--
77221	1,2,3-Trimethylbenzene	.1	--
34551	1,2,4-Trichlorobenzene	.2	--
77222	1,2,4-Trimethylbenzene	.06	--
82625	1,2-Dibromo-3-chloropropane	.5	--
77651	1,2-Dibromoethane	.04	--
34536	1,2-Dichlorobenzene	.03	.1
32103	1,2-Dichloroethane	.1	.2
34541	1,2-Dichloropropane	.03	.1
77226	1,3,5-Trimethylbenzene	.04	--
34566	1,3-Dichlorobenzene	.03	.1
77173	1,3-Dichloropropane	.1	--
34571	1,4-Dichlorobenzene	.05	.1
77170	2,2-Dichloropropane	.05	--
77275	2-Chlorotoluene	.03	--
77220	2-Ethyltoluene	.06	--
78109	3-Chloropropene	.07	--
77277	4-Chlorotoluene	.06	--
77356	4-Isopropyltoluene	.07	--
81552	Acetone	7	--
34215	Acrylonitrile	1	--
34030	Benzene	.04	.1
81555	Bromobenzene	.04	--
77297	Bromochloromethane	.04	--
32101	Bromodichloromethane	.05	.1
50002	Bromoethene	.1	--
34413	Bromomethane	.3	--
77041	Carbon disulfide	.07	--
34301	Chlorobenzene	.03	.1
34311	Chloroethane	.1	--
34418	Chloromethane	.2	--
77093	*cis*-1,2-Dichloroethene	.04	.1
34704	*cis*-1,3-Dichloropropene	.09	--
32105	Dibromochloromethane	.2	.2

Table 2. Constituents analyzed for but not detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.--Continued

[--, not analyzed]

USGS parameter code	Compound	Laboratory reporting level 2001	Laboratory reporting level 2005-06
	Volatile organic compounds in unfiltered water, micrograms per liter—Continued		
30217	Dibromomethane	.05	--
34423	Dichloromethane	.2	.2
81576	Diethyl ether	.2	.2
81577	Diisopropyl ether	.10	.2
73570	Ethyl methacrylate	.2	--
81595	Ethyl methyl ketone	1.6	--
34371	Ethylbenzene	.03	.1
39702	Hexachlorobutadiene	.1	--
34396	Hexachloroethane	.2	--
77424	Iodomethane	.12	--
78133	Isobutyl methyl ketone	.4	--
77223	Isopropylbenzene	.03	--
81593	Methyl acrylonitrile	.6	--
49991	Methyl acrylate	1.4	--
81597	Methyl methacrylate	.3	--
50005	Methyl *tert*-pentyl ether	.11	.2
85795	*m*-Xylene plus *p*-xylene	.06	.2
34696	Naphthalene	.5	--
77103	*n*-Butyl methyl ketone	.7	--
77342	*n*-Butylbenzene	.2	--
77224	*n*-Propylbenzene	.04	--
77135	*o*-Xylene	.04	.1
77350	*sec*-Butylbenzene	.03	--
77128	Styrene	.04	.1
50004	*tert*-Butyl ethyl ether	.05	.1
77353	*tert*-Butylbenzene	.06	--
34475	Tetrachloroethene	.10	.1
32102	Tetrachloromethane	.06	.2
81607	Tetrahydrofuran	2	--
34010	Toluene	.05	.1
34546	*trans*-1,2-Dichloroethene	.03	.1
34699	*trans*-1,3-Dichloropropene	.09	--
73547	*trans*-1,4-Dichloro-2-butene	.7	--
32104	Tribromomethane	.06	.2
39180	Trichloroethene	.04	.1
34488	Trichlorofluoromethane	.09	.2
39175	Vinyl chloride	.1	.2

Table 3. Physical properties of ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[mm, millimeters; mg/L, milligrams per liter; µS/cm @ 25°C, microsiemens per centimeter at 25 degrees Celsius; (00080), USGS National Water Information System parameter code; --, not analyzed; < , less than; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Color, platinum-cobalt units (00080)	Turbidity, nephelometric turbidity units (61028)	Air pressure, mm of mercury (00025)	Dissolved oxygen, mg/L (00300)	pH, standard units (00400)	Specific conductance, µS/cm @ 25°C (00095)	Water temperature, degrees Celsius (00010)
Sand and gravel wells (2001)							
BM732	--	**15**	735	2.1	**6.0**	115	11.0
D502	--	**13**	722	6.6	**6.2**	174	15.4
D503	--	**3.7**	737	5.8	**5.8**	221	11.4
D504	--	**1.3**	730	10.2	6.5	153	11.0
D505	--	**1.4**	725	4.5	6.5	74	14.6
D506	--	**4.9**	727	7.6	**6.3**	86	13.0
D507	--	.4	743	7.3	**5.8**	349	12.2
O2270	--	.5	747	5.5	**5.9**	143	15.2
SV536	--	**2.4**	722	.6	7.5	138	11.8
Bedrock wells (2005-06)							
D960	2	--	715	M	8.3	295	10.0
D1085	**18**	--	718	2.5	7.0	191	9.6
D1567	2	--	730	8.2	**5.9**	26	5.4
D1591	8	--	720	.1	7.7	253	9.4
D1628	2	--	707	--	**6.0**	170	11.8
SV1264	< 1	--	732	2.0	7.5	285	10.4
SV1345	5	--	733	1.0	7.0	155	8.9
SV1358	2	--	725	8.6	6.5	135	9.2
SV1600	2	--	729	8.7	**5.6**	48	9.3
SV1689	8	--	728	7.2	6.9	96	8.6

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 4. Concentrations of major ions in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[mg/L, milligrams per liter; CaCO3, calcium carbonate; (00900), USGS National Water Information System parameter code; < , less than; E, estimated value; --, not analyzed]

Well number[1]	Hardness, filtered, mg/L as $CaCO_3$ (00900)	Acid neutralizing capacity, unfiltered, mg/L as $CaCO_3$ (90410)	Alkalinity, filtered, fixed end point, lab, mg/L as $CaCO_3$ (29801)	Alkalinity, filtered, incremental titration, field, mg/L as $CaCO_3$ (39086)	Calcium, filtered, mg/L (00915)	Magnesium, filtered, mg/L (00925)	Potassium, filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)
Sand and gravel wells (2001)								
BM732	--	--	--	18	8.82	2.44	1.08	7.94
D502	--	--	--	29	19.3	4.00	1.24	7.14
D503	--	--	--	20	17.3	7.67	1.07	9.40
D504	--	--	--	44	14.6	2.18	.70	11.0
D505	--	--	--	22	8.53	1.43	.69	3.09
D506	--	--	--	21	7.98	2.70	1.01	3.45
D507	--	--	--	22	13.9	3.24	2.64	43.5
O2270	--	--	--	14	10.3	2.10	.82	11.3
SV536	--	--	--	57	20.0	3.42	.68	2.21
Bedrock wells (2005-06)								
D960	56	136	136	--	14.4	4.74	.78	53.5
D1085	12	78	78	--	4.17	.481	.70	38.7
D1567	19	18	18	--	4.96	1.63	.33	1.84
D1591	81	186	108	--	20.9	6.92	.93	22.8
D1628	66	38	37	--	19.5	4.20	1.21	5.96
SV1264	140	96	95	--	35.6	12.3	.64	6.17
SV1345	92	92	92	--	25.8	6.57	1.00	9.09
SV1358	54	54	53	--	18.8	1.81	1.65	4.16
SV1600	16	15	14	--	4.34	1.20	.41	2.79
SV1689	40	38	38	--	13.2	1.74	.70	4.75

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 4. Concentrations of major ions in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[mg/L, milligrams per liter; CaCO3, calcium carbonate; (00900), USGS National Water Information System parameter code; < , less than; E, estimated value; --, not analyzed]

Well number[1]	Bicarbonate[2], filtered, fixed end point, lab, mg/L (29805)	Bicarbonate[2], filtered, incremental titration, field, mg/L (00453)	Chloride, filtered, mg/L (00940)	Fluoride, filtered, mg/L (00950)	Silica, filtered, mg/L (00955)	Sulfate, filtered, mg/L (00945)	Residue on evaporation, filtered, mg/L (70300)
			Sand and gravel wells (2001)				
BM732	--	22	15.2	< 0.2	4.54	8.6	59
D502	--	35	9.01	< .2	8.27	14.1	128
D503	--	24	34.0	< .2	10.2	11.6	162
D504	--	54	19.0	< .2	7.28	9.7	105
D505	--	27	3.94	< .2	5.19	4.8	41
D506	--	26	5.25	< .2	5.25	8.4	42
D507	--	27	83.9	< .2	4.20	9.1	205
O2270	--	17	24.3	< .2	5.16	9.1	99
SV536	--	70	4.59	.2	4.95	1.6	75
			Bedrock wells (2005-06)				
D960	166	--	25.9	.3	8.96	.7	179
D1085	95	--	9.04	.5	8.78	5.5	122
D1567	22	--	.40	E .1	8.49	6.3	33
D1591	132	--	9.90	E .1	7.96	11.7	139
D1628	45	--	11.3	E .1	6.64	10.1	103
SV1264	116	--	26.4	E .1	9.29	8.6	163
SV1345	112	--	6.65	.2	10.1	8.6	120
SV1358	65	--	4.00	< .1	9.84	6.4	83
SV1600	17	--	1.32	.1	11.5	7.2	41
SV1689	46	--	1.08	E .1	4.72	7.3	60

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

[2] Bicarbonate values calculated from alkalinity.

Table 5. Concentrations of nutrients and organic carbon in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[N, nitrogen; P, phosphorus; mg/L, milligrams per liter; (00623), USGS National Water Information System parameter code; < , less than; E, estimated value; --, not analyzed]

Well number[1]	Ammonia plus organic-N, filtered, mg/L as N (00623)	Ammonia, filtered, mg/L as N (00608)	Nitrate plus nitrite, filtered, mg/L as N (00631)	Nitrite, filtered, mg/L as N (00613)	Ortho-phosphate, filtered, mg/L as P (00671)	Phosphorus, filtered, mg/L (00666)	Organic carbon, filtered, mg/L (00681)	Organic carbon, unfiltered, mg/L (00680)
Sand and gravel wells (2001)								
BM732	< 0.10	< 0.04	0.44	< .006	< 0.02	0.007	E 0.3	--
D502	E .07	< .04	6.29	< .006	< .02	E.004	.4	--
D503	< .10	< .04	4.89	< .006	E .01	.014	.4	--
D504	< .10	< .04	2.02	< .006	E .01	.011	E .3	--
D505	< .10	< .04	.33	< .006	< .02	.006	.4	--
D506	< .10	E .04	.65	< .006	< .02	< .006	E .3	--
D507	E .05	< .04	1.01	< .006	< .02	.006	E .3	--
O2270	< .10	< .04	1.36	< .006	< .02	.010	E .2	--
SV536	< .10	< .04	.21	< .006	.05	.054	1.2	--
Bedrock wells (2005-06)								
D960	E .08	.06	< .06	< .008	E .02	--	--	1.0
D1085	E .05	< .04	.45	< .008	.05	--	--	< 1
D1567	< .10	< .04	.13	< .008	.03	--	--	< 1
D1591	< .10	< .04	< .06	< .008	< .02	--	--	< 1
D1628	.18	< .04	3.58	< .008	E .01	--	--	1.3
SV1264	< .10	< .04	.17	< .008	< .02	--	--	< 1
SV1345	< .10	< .04	< .06	< .008	E .01	--	--	< 1
SV1358	E .06	< .04	.78	< .008	.02	--	--	< 1
SV1600	< .10	< .04	< .06	< .008	.05	--	--	< 1
SV1689	< .10	< .04	.53	< .008	< .02	--	--	< 1

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 6. Concentrations of trace elements and radionuclides in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[µg/L, micrograms per liter; (01106), USGS National Water Information System parameter code; < , less than; --, not analyzed; E, estimated value; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Aluminum, filtered, µg/L (01106)	Aluminum, unfiltered, µg/L (01105)	Antimony, filtered, µg/L (01095)	Antimony, unfiltered, µg/L (01097)	Arsenic, filtered, µg/L (01000)	Arsenic, unfiltered, µg/L (01002)	Barium, filtered, µg/L (01005)	Barium, unfiltered, µg/L (01007)
				Sand and gravel wells (2001)				
BM732	< 1	--	< 0.05	--	< 0.2	--	33	--
D502	< 1	--	E .03	--	E .1	--	77	--
D503	2	--	< .05	--	E .1	--	32	--
D504	< 1	--	.06	--	.6	--	38	--
D505	< 1	--	< .05	--	.2	--	16	--
D506	< 1	--	E .03	--	E .1	--	20	--
D507	2	--	< .05	--	< .2	--	70	--
O2270	1	--	< .05	--	E .1	--	76	--
SV536	< 1	--	< .05	--	E .2	--	8	--
				Bedrock wells (2005-06)				
D960	--	3	--	< .2	--	2.0	--	141
D1085	--	**107**	--	.2	--	8.0	--	25
D1567	--	38	--	< .2	--	.12	--	5
D1591	--	8	--	< .2	--	2.5	--	108
D1628	--	26	--	< .2	--	.37	--	63
SV1264	--	10	--	E .1	--	.30	--	248
SV1345	--	**168**	--	.4	--	1.6	--	114
SV1358	--	3	--	E .1	--	**21.0**	--	134
SV1600	--	3	--	< .2	--	.38	--	29
SV1689	--	**1,100**	--	E .1	--	1.5	--	37

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 6. Concentrations of trace elements and radionuclides in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[µg/L, micrograms per liter; (01106), USGS National Water Information System parameter code; < , less than; --, not analyzed; E, estimated value; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Beryllium, filtered, µg/L (01010)	Beryllium, unfiltered, µg/L (01012)	Boron, filtered, µg/L (01020)	Cadmium, filtered, µg/L (01025)	Cadmium, unfiltered, µg/L (01027)	Chromium, filtered, µg/L (01030)	Chromium, unfiltered, µg/L (01034)	Cobalt, filtered, µg/L (01035)	Cobalt, unfiltered, µg/L (01037)
Sand and gravel wells (2001)									
BM732	< 0.06	--	7	< 0.04	--	< 0.8	--	0.026	--
D502	< .06	--	10	< .04	--	< .8	--	.055	--
D503	< .06	--	8	E .04	--	< .8	--	.031	--
D504	< .06	--	9	< .04	--	< .8	--	.026	--
D505	< .06	--	8	< .04	--	< .8	--	.022	--
D506	< .06	--	8	< .04	--	< .8	--	2.04	--
D507	< .06	--	15	E .02	--	< .8	--	.060	--
O2270	< .06	--	10	< .04	--	< .8	--	.039	--
SV536	< .06	--	< 7	< .04	--	< .8	--	.023	--
Bedrock wells (2005-06)									
D960	--	E .03	203	--	< .04	--	.52	--	.047
D1085	--	E .03	121	--	E .02	--	.71	--	.143
D1567	--	< .06	< 7.0	--	< .04	--	.61	--	.067
D1591	--	< .06	60	--	< .04	--	.50	--	.070
D1628	--	< .06	8.2	--	< .04	--	.56	--	.119
SV1264	--	< .06	14	--	< .04	--	.50	--	.141
SV1345	--	E .04	8.1	--	< .04	--	.88	--	.201
SV1358	--	< .06	9.4	--	< .04	--	.26	--	.050
SV1600	--	< .06	< 7.0	--	< .04	--	.38	--	.081
SV1689	--	.09	15	--	.05	--	1.9	--	2.24

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 6. Concentrations of trace elements and radionuclides in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[µg/L, micrograms per liter; (01106), USGS National Water Information System parameter code; < , less than; --, not analyzed; E, estimated value; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Copper, filtered, µg/L (01040)	Copper, unfiltered, µg/L (01042)	Iron, filtered, µg/L (01046)	Iron, unfiltered, µg/L (01045)	Lead, filtered, µg/L (01049)	Lead, unfiltered, µg/L (01051)	Lithium, filtered, µg/L (01130)	Lithium, unfiltered, µg/L (01132)
Sand and gravel wells (2001)								
BM732	10.6	--	185	--	0.31	--	E 0.2	--
D502	86.8	--	123	--	.38	--	.8	--
D503	11.5	--	12	--	.48	--	2.0	--
D504	21.0	--	35	--	1.03	--	.6	--
D505	< .2	--	< 10	--	< .08	--	E .3	--
D506	< .2	--	**573**	--	< .08	--	.4	--
D507	52.5	--	109	--	1.86	--	E .3	--
O2270	31.6	--	15	--	2.02	--	E .2	--
SV536	2.0	--	E 7	--	< .08	--	.4	--
Bedrock wells (2005-06)								
D960	--	E .5	34	36	--	< .06	--	55.4
D1085	--	22.4	6	154	--	2.12	--	5.8
D1567	--	10.4	E 4	285	--	1.86	--	.9
D1591	--	.9	12	**329**	--	.20	--	26.3
D1628	--	117	< 6	40	--	2.27	--	.8
SV1264	--	1.8	< 6	117	--	.12	--	16.1
SV1345	--	3.4	< 6	290	--	.25	--	8.4
SV1358	--	14.6	< 6	E 3	--	.95	--	21.4
SV1600	--	8.4	E 4	269	--	4.39	--	2.1
SV1689	--	16.0	E 4	**2,150**	--	4.64	--	10.5

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 6. Concentrations of trace elements and radionuclides in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[µg/L, micrograms per liter; (01106), USGS National Water Information System parameter code; < , less than; --, not analyzed; E, estimated value; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Manganese, filtered, µg/L (01056)	Manganese, unfiltered, µg/L (01055)	Mercury, unfiltered, µg/L (71900)	Molybdenum, filtered, µg/L (01060)	Molybdenum, unfiltered, µg/L (01062)	Nickel, filtered, µg/L (01065)	Nickel, unfiltered, µg/L (01067)	Selenium, filtered, µg/L (01145)	Selenium, unfiltered, µg/L (01147)
				Sand and gravel wells (2001)					
BM732	5.9	--	--	< 0.2	--	0.11	--	< 0.3	--
D502	7.7	--	--	< .2	--	< .06	--	E .2	--
D503	9.9	--	--	< .2	--	.68	--	E .2	--
D504	2.0	--	--	< .2	--	< .06	--	< .3	--
D505	11.1	--	--	.4	--	.08	--	< .3	--
D506	**157**	--	--	< .2	--	5.10	--	< .3	--
D507	4.0	--	--	< .2	--	.17	--	< .3	--
O2270	6.3	--	--	< .2	--	< .06	--	E .2	--
SV536	8.2	--	--	< .2	--	< .06	--	E .2	--
				Bedrock wells (2005-06)					
D960	**55.9**	**54.3**	< .01	--	.3	--	.28	--	< .08
D1085	11.1	18.2	E .01	--	6.5	--	.39	--	.38
D1567	1.1	5.2	< .01	--	< .2	--	.31	--	E .06
D1591	29.9	30.2	< .01	--	.5	--	.34	--	< .08
D1628	10.4	13.0	< .01	--	.2	--	.79	--	.13
SV1264	E .5	5.7	< .01	--	E .1	--	.71	--	.47
SV1345	.6	**62.1**	< .01	--	E .2	--	.65	--	.22
SV1358	1.2	1.3	< .01	--	.5	--	.20	--	.17
SV1600	16.8	17.3	E .01	--	< .2	--	.38	--	E .06
SV1689	E .4	**141**	< .01	--	E .1	--	3.27	--	E .06

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 6. Concentrations of trace elements and radionuclides in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[µg/L, micrograms per liter; (01106), USGS National Water Information System parameter code; < , less than; --, not analyzed; E, estimated value; M, presence verified but not quantified. Bold text indicates sample exceeds water quality standards]

Well number[1]	Strontium, filtered, µg/L (01080)	Strontium, unfiltered, µg/L (01082)	Vanadium, filtered, µg/L (01085)	Zinc, filtered, µg/L (01090)	Zinc, unfiltered, µg/L (01092)	Radon-222, unfiltered, picoCuries per liter (82303)	Uranium, filtered, µg/L (22703)	Uranium, unfiltered, µg/L (28011)
				Sand and gravel wells (2001)				
BM732	29.2	--	< 0.2	4.2	--	**1,640**	< 0.02	--
D502	60.2	--	< .2	14.8	--	**1,290**	< .02	--
D503	67.8	--	< .2	7.6	--	**720**	< .02	--
D504	45.5	--	< .2	4.1	--	**1,640**	.06	--
D505	28.7	--	< .2	< 1.0	--	**1,520**	.03	--
D506	20.1	--	E .2	1.7	--	**1,090**	< .02	--
D507	45.1	--	< .2	14.0	--	**1,120**	< .02	--
O2270	48.5	--	< .2	24.0	--	**580**	E .02	--
SV536	28.9	--	< .2	1.7	--	**2,280**	.24	--
				Bedrock wells (2005-06)				
D960	--	257	--	--	< 2	**1,450**	--	.013
D1085	--	48.6	--	--	7	**1,630**	--	1.70
D1567	--	10.4	--	--	3	**1,580**	--	E .008
D1591	--	214	--	--	E 2	**1,980**	--	2.11
D1628	--	56.0	--	--	14	**710**	--	.356
SV1264	--	439	--	--	< 2	**2,000**	--	.518
SV1345	--	364	--	--	E 2	**6,350**	--	4.09
SV1358	--	1280	--	--	E 2	**2,750**	--	5.12
SV1600	--	33.3	--	--	3	**2,740**	--	E .011
SV1689	--	220	--	--	12	**1,280**	--	.539

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 7. Concentrations of pesticides and caffeine detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[µg/L, micrograms per liter; CIAT, 2-chloro-4-isopropylamino-6-amino-s-triazine; CEAT, 2-chloro-6-ethylamino-4-amino-s-triazine; ESA, ethanesulfonic acid; OA, oxanilic acid; (04040), USGS National Water Information System parameter code; < , less than; E, estimated value; --, not analyzed]

Well number[1]	CIAT, filtered, µg/L (04040)	CEAT, filtered, µg/L (04038)	Acetochlor 2nd amide, filtered, µg/L (63782)	Alachlor ESA, filtered, µg/L (50009)	Atrazine, filtered, µg/L (39632)	Caffeine, filtered, µg/L (50305)
			Sand and gravel wells (2001)			
BM732	E 0.004	< 0.04	--	< 0.05	E 0.004	< 0.010
D502	E .022	< .04	--	< .05	.013	< .010
D503	< .006	< .04	--	.08	< .007	< .010
D504	E .002	< .04	--	< .05	E .006	< .010
D505	E .003	< .04	--	< .05	< .007	< .010
D506	E .004	E .01	--	< .05	.011	< .010
D507	< .006	< .04	--	< .05	< .007	< .010
O2270	< .006	< .04	--	< .05	< .007	< .010
SV536	< .006	< .04	--	< .05	< .007	E .004
			Bedrock wells (2005-06)			
D960	< .006	< .08	< .02	< .02	< .007	< .018
D1085	< .006	< .08	< .02	< .02	< .007	E .017
D1567	< .006	< .08	< .02	< .02	< .007	< .018
D1591	< .006	< .08	< .02	< .02	< .007	< .018
D1628	E .017	< .08	.02	< .02	.012	< .018
SV1264	< .006	< .08	< .02	< .02	< .007	< .018
SV1345	< .006	< .08	< .02	< .02	< .007	< .018
SV1358	< .006	< .08	< .02	< .02	< .007	E .004
SV1600	< .006	< .08	< .02	< .02	< .007	< .018
SV1689	< .006	< .08	< .02	< .02	< .007	< .018

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 7. Concentrations of pesticides and caffeine detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.—Continued

[µg/L, micrograms per liter; CIAT, 2-chloro-4-isopropylamino-6-amino-s-triazine; CEAT, 2-chloro-6-ethylamino-4-amino-s-triazine; ESA, ethanesulfonic acid; OA, oxanilic acid; (04040), USGS National Water Information System parameter code; < , less than; E, estimated value; --, not analyzed]

Well number[1]	Hydroxy-metolachlor, filtered, µg/L (63785)	Imazaquin, filtered, µg/L (50356)	Metolachlor ESA, filtered, µg/L (61043)	Metolachlor OA, filtered, µg/L (61044)	Metsulfuron, filtered, µg/L (61697)	Propachlor ESA, filtered, µg/L (62766)
Sand and gravel wells (2001)						
BM732	--	< 0.02	0.17	< 0.05	< 0.03	--
D502	--	< .02	1.27	< .05	< .03	--
D503	--	< .02	.67	< .05	< .03	--
D504	--	< .02	.26	< .05	< .03	--
D505	--	E .02	< .05	< .05	< .03	--
D506	--	< .02	< .05	< .05	< .03	--
D507	--	< .02	< .05	< .05	< .03	--
O2270	--	< .02	< .05	< .05	< .03	--
SV536	--	< .02	< .05	< .05	< .03	--
Bedrock wells (2005-06)						
D960	< .02	< .04	< .02	< .02	< .07	.05
D1085	< .02	< .04	< .02	< .02	< .03	< .05
D1567	< .02	< .04	< .02	< .02	< .03	< .05
D1591	< .02	< .04	< .02	< .02	< .07	< .05
D1628	< .02	< .04	.24	.02	< .03	< .05
SV1264	< .02	< .04	< .02	< .02	< .07	< .05
SV1345	< .02	< .04	< .02	< .02	< .07	< .05
SV1358	.02	< .04	< .02	< .02	< .07	< .05
SV1600	< .02	< .04	< .02	< .02	E .01	< .05
SV1689	< .02	< .04	< .02	< .02	< .07	< .05

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 8. Concentrations of volatile organic compounds detected in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[µg/L, micrograms per liter; (34668), USGS National Water Information System parameter code; < , less than; E, estimated value]

Well number[1]	Dichlorodifluoro-methane, unfiltered, µg/L (34668)	Methyl *tert*-butyl ether, unfiltered, µg/L (78032)	Trichloromethane, unfiltered, µg/L (32106)
Sand and gravel wells (2001)			
BM732	< 0.27	< 0.2	< 0.02
D502	< .27	< .2	< .02
D503	E .56	< .2	< .02
D504	< .27	< .2	< .02
D505	< .27	< .2	E .03
D506	< .27	< .2	< .02
D507	< .27	< .2	< .02
O2270	< .27	E .1	< .02
SV536	< .27	< .2	< .02
Bedrock wells (2005-06)			
D960	< .2	< .2	< .1
D1085	< .2	< .2	< .1
D1567	< .2	< .2	< .1
D1591	< .2	< .2	< .1
D1628	< .2	< .2	< .1
SV1264	< .2	< .2	< .1
SV1345	< .2	< .2	< .1
SV1358	< .2	< .2	< .1
SV1600	< .2	< .2	< .1
SV1689	< .2	< .2	< .1

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

Table 9. Concentrations of bacteria in ground-water samples from the Delaware River Basin, 2001 and 2005-06.

[mL, milliliter; (78943), USGS National Water Information System parameter code; --, not analyzed; < , less than; E, estimated value; > , greater than. Bold text indicates sample exceeds water quality standards]

Well number[1]	Heterotrophic plate count, unfiltered, colonies per mL (78943)	Escherichia coli, unfiltered, colonies per 100 mL (50278)	Fecal coliform, unfiltered, colonies per 100 mL (31625)	Total coliform, unfiltered, colonies per 100 mL (31501)
Sand and gravel wells (2001)				
BM732	--	< 1	--	**E 8**
D502	--	< 1	--	**> 80**
D503	--	--	--	< 1
D504	--	--	--	< 1
D505	--	--	--	< 1
D506	--	--	--	< 1
D507	--	--	--	< 1
O2270	--	< 1	--	**E 2**
SV536	--	< 1	--	**E 2**
Bedrock wells (2005-06)				
D960	1	--	< 1	< 1
D1085	5	--	< 5	< 20
D1567	6	--	< 20	< 20
D1591	29	--	< 1	< 1
D1628	7	--	< 5	< 20
SV1264	< 1	--	< 1	< 1
SV1345	34	--	< 1	< 1
SV1358	3	--	< 1	< 1
SV1600	38	--	< 20	< 20
SV1689	86	--	< 1	**3**

[1] BM, Broome County; D, Delaware County; O, Orange County; SV, Sullivan County.

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