



# Water Resources Data New Jersey Water Year 2002

## Volume 3. Water-Quality Data

Water-Data Report NJ-02-3



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



Prepared in cooperation with the New  
Jersey Department of Environmental  
Protection and with other agencies

# CALENDAR FOR WATER YEAR 2002

2001

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OCTOBER							NOVEMBER							DECEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6					1	2	3							1
7	8	9	10	11	12	13	4	5	6	7	8	9	10	2	3	4	5	6	7	8
14	15	16	17	18	19	20	11	12	13	14	15	16	17	9	10	11	12	13	14	15
21	22	23	24	25	26	27	18	19	20	21	22	23	24	16	17	18	19	20	21	22
28	29	30	31				25	26	27	28	29	30		23	24	25	26	27	28	29
														30	31					

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2002

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JANUARY							FEBRUARY							MARCH						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
		1	2	3	4	5						1	2						1	2
6	7	8	9	10	11	12	3	4	5	6	7	8	9	3	4	5	6	7	8	9
13	14	15	16	17	18	19	10	11	12	13	14	15	16	10	11	12	13	14	15	16
20	21	22	23	24	25	26	17	18	19	20	21	22	23	17	18	19	20	21	22	23
27	28	29	30	31			24	25	26	27	28			24	25	26	27	28	29	30
														31						

APRIL							MAY							JUNE						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
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7	8	9	10	11	12	13	5	6	7	8	9	10	11	2	3	4	5	6	7	8
14	15	16	17	18	19	20	12	13	14	15	16	17	18	9	10	11	12	13	14	15
21	22	23	24	25	26	27	19	20	21	22	23	24	25	16	17	18	19	20	21	22
28	29	30					26	27	28	29	30	31		23	24	25	26	27	28	29
														30						

JULY							AUGUST							SEPTEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6					1	2	3	1	2	3	4	5	6	7
7	8	9	10	11	12	13	4	5	6	7	8	9	10	8	9	10	11	12	13	14
14	15	16	17	18	19	20	11	12	13	14	15	16	17	15	16	17	18	19	20	21
21	22	23	24	25	26	27	18	19	20	21	22	23	24	22	23	24	25	26	27	28
28	29	30	31				25	26	27	28	29	30	31	29	30					

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# United States Department of the Interior

## U.S. GEOLOGICAL SURVEY

Water Resources Division  
Mountain View Office Park  
810 Bear Tavern Road, Suite 206  
West Trenton, New Jersey 08628

I am pleased to announce the release of our Annual report "Water Resources Data for New Jersey, Water Year 2002". This report was prepared by the U.S. Geological Survey, in cooperation with the State of New Jersey as well as many local and federal government agencies.

This report is again being published in three volumes:

Volume 1.--Surface-water streamflow data.

Volume 2.--Ground-water level data.

Volume 3 --Water-quality data.

This volume contains a summary of the hydrologic conditions for the 2002 water year (October 1, 2001 - September 30, 2002), a listing of current water-resources projects in the New Jersey District, a bibliography of recent reports, articles and fact sheets, and records of ground-water levels in 184 wells.

During 2002, the U.S. Geological Survey, in cooperation with the New Jersey Department of Environmental Protection (NJDEP), expanded its Drought Monitoring Network. In order to make ground-water level data available in the shortest time possible, satellite telemetry was added to 8 more wells. This brings the total number of real-time ground-water level sites to 15.

The New Jersey District of the U.S. Geological Survey has made a home page available on the world wide web. Real-time data for more than 68 stream-gaging stations, 15 ground-water wells and 3 continuous water-quality sites around the State are presented. Also, peak-flow files and historical data for many gaging stations, ground-water wells, water-quality sites, monthly hydrologic conditions, and links to other sites of interest can be accessed. This information is available at:

**<http://nj.usgs.gov/>**

Copies of this report in paper or microfiche are for sale through the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161. Data also can be provided by file transfer (ftp), or on floppy disk. When ordering, refer to U.S. Geological Survey Water-Data Report NJ-02-1 (for Volume 1), NJ-02-2 (for Volume 2), or NJ-02-3 (for Volume 3). For further information on this report, or to change or remove your address from our mailing list, please contact Walter D. Jones at the above address, telephone (609) 771-3900, or send e-mail to [wjones@usgs.gov](mailto:wjones@usgs.gov).

Sincerely,

William R. Bauersfeld, Chief  
Hydrologic Data Assessment Program

**UNITED STATES DEPARTMENT OF THE INTERIOR**

**GALE A. NORTON, *Secretary***

**GEOLOGICAL SURVEY**

**Charles G. Groat, *Director***

For information on the water program in New Jersey write to

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## PREFACE

This volume of the annual hydrologic data report of New Jersey is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of water quality provide the hydrologic information needed by state, local, and federal agencies, and the private sector for developing and managing our Nation's land and water resources.

Hydrologic data for New Jersey are contained in 3 volumes:

Volume 1. Surface-Water Data  
Volume 2. Ground-Water Data  
Volume 3. Water-Quality Data

This report is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey who collected, compiled, analyzed, verified, and organized the data and who typed, edited, and assembled the report. The authors had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to U.S. Geological Survey policy and established guidelines. The following individuals contributed significantly to the completion of the report.

Jacob Gibs

Robert D. Schopp

Word processing of the report was done by H.L. Hoppe and H.A. Heckathorn. W.H. Ellis, G.L. Simpson, and D.K. Sun drafted the illustrations.

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This report was prepared in cooperation with the State of New Jersey and with other agencies under the general supervision of William R. Bauersfeld, Chief of the Hydrologic Data Assessment Program; under the general supervision of David A. Stedfast, Associate District Chief; Rick Kropp, District Chief, New Jersey; and Catherine L. Hill, Regional Hydrologist, Northeastern Region.

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13. ABSTRACT <i>(Maximum 200 words)</i> <b>Water-resources data for the 2002 water year for New Jersey are presented in three volumes, and consists of records of stage, discharge, and quality of streams; stage and contents of lakes and reservoirs; and levels and quality of ground water. Volume 3 contains a summary of surface- and ground-water hydrologic conditions for the 2002 water year, a listing of current water-resources projects in New Jersey, a bibliography of water-related reports, articles, and fact sheets for New Jersey completed by the Geological Survey in recent years, water-quality records of chemical analyses from 118 continuing-record surface-water stations, 15 miscellaneous ground-water sites, and records of daily statistics of temperature and other physical measurements from 6 continuous-recording stations. Locations of water-quality stations are shown in figures 12-14. Locations of miscellaneous water-quality sites are shown in figures 40-41. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating federal, state, and local agencies in New Jersey.</b>			
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**WATER-QUALITY STATIONS, IN DOWNSTREAM ORDER, FOR WHICH  
RECORDS ARE PUBLISHED IN THIS VOLUME**

Note.--Data for miscellaneous sites for surface- and ground-water quality are published in separate sections of the data report.

[Letter after station name designates type of data: (c) general chemical, (m) microbiological, (s) suspended sediment, (t) continuous physical measurements, (w) whole-water-recoverable metals, (v) volatile organic compounds, (p) pesticide, (h) bed material, (WMA #) NJDEP watershed management area.]

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Tuckahoe River near Estell Manor (csvp).....	01411290	295

**WATER-QUALITY STATIONS, IN DOWNSTREAM ORDER, FOR WHICH  
RECORDS ARE PUBLISHED IN THIS VOLUME--Continued**

Tuckahoe River at Head of River (cmsvp).....	01411300	298
<b>(WMA 16 - DELAWARE BAY (PART OF ZONE 6) &amp; TRIBUTARIES)</b>		
<u>FISHING CREEK BASIN</u>		
Fishing Creek at Rio Grande (cs) .....	01411400	301
<u>DENNIS CREEK BASIN</u>		
Dennis Creek:		
Dennis Creek Tributary 2 at Dennisville (csvp).....	01411427	303
<u>WEST CREEK BASIN</u>		
West Creek near Leesburg (cmsvp) .....	01411444	306
<b>(WMA 17 - DELAWARE BAY (PART OF ZONE 6) &amp; TRIBUTARIES)</b>		
<u>MAURICE RIVER BASIN</u>		
Maurice River:		
Still Run at Little Mill Road, near Clayton (cmsvp).....	01411452	309
Scotland Run:		
Indian Branch near Malaga (cms) .....	01411466	312
Maurice River at Norma (cmswh) .....	01411500	314
Buckshutem Creek:		
Gravelly Run at Laurel Lake (cmsvp) .....	01411955	317
<u>COHANSEY RIVER BASIN</u>		
Cohansey River at Seely (cmsw).....	01412800	320
Barrett Run at Bridgeton (cmsvp) .....	01413013	322
<b>(WMA 1 - UPPER DELAWARE (ZONE 1C, ZONE 1D, AND THE UPPER PART OF ZONE 1E) &amp; TRIBUTARIES)</b>		
<u>DELAWARE RIVER BASIN</u>		
Delaware River at Montague (cms) .....	01438500	325
Flat Brook near Flatbrookville(cms) .....	01440000	327
Dunnfield Creek at Dunnfield (cmswvph) .....	01442760	329
Delaware River at Portland, PA (cms) .....	01443000	333
Paulins Kill at Warbasse Junction Road, near Lafayette (cmsvp) .....	01443250	335
Paulins Kill at Blairstown (cmswh).....	01443500	338
Pequest River:		
Bear Brook at Dark Moon Road, near Johnsonburg (cmswh).....	01445160	341
Honey Run near Hope (cmsvp) .....	01445900	344
Pequest River at Belvidere (cmsw).....	01446400	347
Musconetcong River at Riegelsville (cms).....	01457400	349
<b>(WMA 11 - UPPER DELAWARE &amp; TRIBUTARIES - LOCKATONG, ALEXAUKEN CREEK, ASSUNPINK CREEK)</b>		
Delaware River at Riegelsville (cms) .....	01457500	351
Nishisakawick Creek near Frenchtown (cms).....	01458570	353
Delaware River at Lumberville, PA (cms) .....	01461000	355
Wickecheoke Creek near Sergeantsville (cmswvp).....	01461282	357
Delaware River at Trenton (cmswvpt).....	01463500	360
Assunpink Creek:		
Miry Run at Route 533, at Mercerville (cmsw).....	01463850	379
Assunpink Creek at Peace Street, at Trenton (cmsvp).....	01464020	381
<b>(WMA 20 - LOWER DELAWARE (UPPER PART OF ZONE 2) &amp; TRIBUTARIES)</b>		
Crosswicks Creek:		
North Run at Cookstown (cmsvp).....	01464380	384
Crosswicks Creek at Groveville Road, at Groveville (cmsvp).....	01464504	387
Doctors Creek at Allentown (cmsw) .....	01464515	390
Blacks Creek at Chesterfield (cmswh).....	01464527	392
<i>Little Neshaminy Creek at Valley Road, near Neshaminy, PA (csp) [site not within WMA 20].....</i>	<i>01464907</i>	<i>395</i>
<b>(WMA 19 - LOWER DELAWARE (LOWER PART OF ZONE 2 AND UPPER PART OF ZONE 3) &amp; TRIBUTARIES)</b>		
Rancocas Creek:		
South Branch Rancocas Creek:		
Southwest Branch Rancocas Creek:		
Little Creek at Chairville (cms) .....	01465893	398
North Branch Rancocas Creek:		
North Branch Mt. Misery Brook:		
Mount Misery Brook at Upton (cmsvp) .....	01466100	400
Greenwood Branch:		
McDonalds Branch in Lebanon State Forest (cmsvp) .....	01466500	403
Greenwood Branch at New Lisbon (cms) .....	01466900	406
North Branch Rancocas Creek at Iron Works Park, at Mount Holly (cmswh) .....	01467005	408
Cooper River at Haddonfield (cmsw).....	01467150	411

**WATER-QUALITY STATIONS, IN DOWNSTREAM ORDER, FOR WHICH  
RECORDS ARE PUBLISHED IN THIS VOLUME--Continued**

North Branch Cooper River at Kresson (cmswvp).....	01467155	413
<b>(WMA 18 - LOWER DELAWARE (LOWER PART OF ZONE 3, ZONE 4, ZONE 5, AND PART OF ZONE 6) &amp; TRIBUTARIES)</b>		
Big Timber Creek:		
North Branch Big Timber Creek at Glendora (cmsw).....	01467359	416
Schuylkill River:		
<i>French Creek near Phoenixville, PA (csp) [site not within WMA 18]</i> .....	01472157	418
<i>Schuylkill River at Philadelphia, PA (csp) [site not within WMA 18]</i> .....	01474500	421
Mantua Creek:		
Edwards Run at Jefferson (cmsvp) .....	01475090	424
Raccoon Creek near Swedesboro (cmswh) .....	01477120	427
Salem River at Woodstown (cms) .....	01482500	430
Major Run at Sharptown (cmsvp).....	01482530	432

## DISCONTINUED CONTINUOUS WATER-QUALITY STATIONS

The following stations have been discontinued as continuous water-quality stations. Daily records of temperature, specific conductance, pH, dissolved oxygen or sediment were collected and published for the period of record shown for each station.

Station name	Station number	Drainage area (mi <sup>2</sup> )	Type of record	Period of record (water years)
Passaic River at Millington, NJ	01379000		Temp.	1997-98
Passaic River near Chatham, NJ	01379500	100	Sed.	1964-68
			Temp.	1967-68
Rockaway River at Longwood Valley, NJ	01379680		Temp.	1997-98
Green Pond Brook at Picatinny Arsenal, NJ	01379773	7.65	Temp., S.C., pH, D.O.	1984-86
Green Pond Brook at Wharton, NJ	01379790*	12.6	Temp., S.C., pH, D.O.	1984-85
Passaic River at Two Bridges, NJ	01382000	361	Temp., S.C., pH, D.O.	1963-74
				1969-74
Wanaque River at Wanaque, NJ	01387000	90.4	Temp.	1964-80
Ramapo River near Mahwah, NJ	01387500	118	Sed.	1964-65
Pompton River near Two Bridges, NJ	01389000	372	Temp., S.C., pH, D.O.	1969-74
Passaic River at Little Falls, NJ	01389500	762	Sed.	1964-65
			Temp., S.C.	1981-86
Saddle River at Ridgewood, NJ	01390500		Temp.	1997-98
Rahway River at Washington Park, at Springfield, NJ	01394200		Temp.	1997-98
South Branch Raritan River near High Bridge, NJ	01396500	65.3	Temp.	1961-79
			S.C.	1969-79
Mulhockaway Creek at Van Syckel, NJ	01396660		Temp.	1997-98
Spruce Run at Clinton, NJ	01396800	41.3	Temp.	1969, 1971-80
South Branch Raritan River at Stanton, NJ	01397000	147	Temp., S.C.	1969-79
			Sed.	1960-63
Neshanic River at Reaville, NJ	01398000		Temp.	1997-98
South Branch Rockaway Creek, at Whitehouse, NJ	01399690	13.2	Temp., S.C.	1977-78
			Sed.	1977
Rockaway Creek at Whitehouse, NJ	01399700	37.1	Temp., S.C.	1977-78
Raritan River near Manville, NJ	01400510	497	Temp., S.C., pH, D.O.	1968-74
Baldwins Creek at Baldwin Lake, near Pennington, NJ	01400932	2.52	Temp.	1963-66
			Sed.	1963-69
Stony Brook at Princeton, NJ	01401000	44.5	Temp.	1957-70, 1997-98
			Sed.	1960-70
Beden Brook near Rocky Hill, NJ	01401600		Temp.	1997-98
Millstone River near Manville, NJ	01402900	287	Temp., S.C., pH, D.O.	1968-74
Raritan River at Queens Bridge	01403300		Temp.	1997-98
Bound Brook at Middlesex, NJ	01403900		Temp., S.C.	1996-98
Raritan River near South Bound Brook, NJ	01404100	862	Temp., S.C., pH, D.O.	1969-77
Manasquan River at Squankum, NJ	01408000	44	Temp., S.C., pH, D.O.	1969-74
Toms River near Toms River, NJ	01408500	123	Temp., S.C.	1964-66, 1975-81
				1975-81
Oyster Creek near Brookville, NJ	01409095	7.43	Temp., D.O.	1975-76
			S.C., pH	1975-77
West Branch Wading River near Jenkins, NJ	01409810	84.1	Temp., S.C.	1978-81
Great Egg Harbor River at Sicklerville, NJ	01410784		Temp., S.C.	1996-98
Great Egg Harbor River trib. at Sicklerville, NJ	01410787	1.64	Sed.	1974-78
Fourmile Branch at New Brooklyn, NJ	01410810	7.74	Sed.	1974-78
Great Egg Harbor River at Folsom, NJ	01411000	57.1	Temp.	1961-75, 1977-80
			S.C.	1969-75, 1977-80
			Sed.	1966-70, 1979
Delaware Bay at Ship John Shoal Lighthouse, NJ	01412350	---	Temp.	1970-86
Maurice River at Norma, NJ	01411500	112.0	Temp.	1967-68, 1980-87, 1993-94
			S.C.	1980-87, 1993-94
			pH	1993-94
			Sed.	1965-68

\* Unpublished records are available in the files of the District office.

## DISCONTINUED CONTINUOUS WATER-QUALITY STATIONS--Continued

Station name	Station number	Drainage area (mi <sup>2</sup> )	Type of record	Period of record (water years)
Delaware River at Port Jervis, NY	01434000		Temp.	1957-60, 1973-94 1999-2001
Delaware River near Delaware Water Gap, PA	01440200	3850	Sed.	1964-65, 1972
Delaware River at Dunnfield, NJ	01442750	4150	Temp. Sed.	1967-76 1966-76
Jordan Creek near Schnecksville, PA	01451800		Temp.	1999, 2001
Delaware and Raritan Canal Feeder at Raven Rock, NJ	01460300		Temp., S.C., Turb.	1998-99
Delaware and Raritan Canal Feeder at Lower Ferry Road at Trenton, NJ	01460400		Temp., S.C., Turb.	1998-99
Delaware and Raritan Canal Feeder at Port Mercer, NJ	01460440		Temp., S.C., Turb.	1998-99
Delaware and Raritan Canal Feeder at Griggstown, NJ	01460530		Temp., S.C., Turb.	1998-99
Delaware and Raritan Canal Feeder at Ten Mile Lock near Manville, NJ	01460565		Temp., S.C., Turb.	1998-99
Delaware and Raritan Canal Feeder at New Brunswick, NJ	01460600		Temp., S.C., Turb.	1998-99
Delaware River at Trenton, NJ	01463500	6780	Sed.	1949-82
Delaware River at Marine Terminal, at Trenton, NJ	01464040	6870	Temp., S.C.	1973-76
Crosswicks Creek near Extonville, NJ	01464500	81.5	Temp. Sed.	1967-70 1965-70
Little Neshaminy Creek at Valley Road, near Neshaminy, PA	01464907		Temp.	1999, 2001
McDonalds Branch in Lebanon State Forest, NJ	01466500	2.35	Temp. S.C. pH, D.O.	1960-92 1968-92 1984-92
Rancocas Creek at Willingboro, NJ	01467016	315	Temp., S.C., D.O. pH	1969-74 1970-72 1970-74
Cooper River at Haddonfield, NJ	01467150	17.0	Temp.  Sed.	1968-69 1999-2001 1968-69
French Creek near Phoenixville, PA	01472157		Temp.	1999-2001
Schuylkill River at Philadelphia, PA	01474500		S.C. Temp.	1999 1999-2001
Raccoon Creek near Swedesboro, NJ	01477120	26.9	Temp.  Sed.	1966-73 1999-2001 1966-69

Type of record: Temp. (temperature), S.C. (specific conductance), pH (pH), D.O. (dissolved oxygen), Sed. (sediment).

## **INTRODUCTION**

The Water Resources Division of the U.S. Geological Survey (USGS), in cooperation with Federal, State, and local agencies, collects a large amount of data pertaining to the water resources of New Jersey each water year. These data, accumulated over many water years, constitute a valuable data base for developing an improved understanding of the water resources of the State. To make these data readily available to interested parties outside the USGS, the data are published annually in this report series, titled "Water Resources Data-New Jersey."

This report series includes records of stage, discharge, and water quality in streams; stage, contents, and water quality in lakes and reservoirs; and water levels and water quality in ground-water wells. This volume contains water-quality records, containing various chemical analyses from 118 continuing-record surface-water stations. Locations of these stations are shown in figures 12-14. Additional water-quality data were collected at various sites that are not part of the systematic data collection program. Miscellaneous data were collected at 15 ground-water sites. Locations of these sites are shown in figures 40 and 41. The data in this report represent that part of the National Water Information System (NWIS) data collected by the USGS and cooperating Federal, State, and local agencies in New Jersey.

This series of annual reports for New Jersey began with the 1961 water year with a report that contained only data relating to the quantities of surface water. For the 1964 water year, a similar report was introduced that contained only data relating to water quality. For water years 1975 through 1989, the report format was changed to present, in one volume, data on quantities of surface water, quality of surface and ground water, and ground-water levels. Beginning with the 1977 water year, these data were published in two volumes based on drainage basins. Beginning with the 1990 water year, the format was changed to include all surface-water discharge and surface-water quality records in Volume 1 and all ground-water level and ground-water quality records in Volume 2.

Prior to introduction of this series and for several water years concurrent with it, water-resources data for New Jersey were published in U.S. Geological Survey Water-Supply Papers. Data on stream discharge and stage and on lake or reservoir contents and stage, through September 1960, were published annually under the title "Surface-Water Supply of the United States, Part 1B." For water years 1961 through 1970, the data were published in two 5-year reports. Data on chemical quality, temperature, and suspended sediment for water years 1941 through 1970 were published annually under the title "Quality of Surface Waters of the United States," and water levels for water years 1935 through 1974 were published under the title "Ground-Water Levels in the United States." The above-mentioned Water-Supply Papers can be consulted in the libraries of the principal cities of the United States and can be purchased from U.S. Geological Survey, Branch of Information Services, Box 25286,

Denver, CO 80225-0286, (303) 202-4610.

Publications similar to this report are produced annually by the USGS for all States. These reports have an identification number consisting of the two-letter State abbreviation, the last two digits of the water year, and the volume number. For example, this volume is identified as "U.S. Geological Survey Water-Data Report NJ-02-3." For archiving and general distribution purposes, the reports for water years 1971 through 1974 also are identified as water-data reports. Water-data reports are available for purchase in paper copy or in microfiche from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

Additional information, including current prices, for ordering specific reports can be obtained from the District Chief, USGS, New Jersey District, at the address given on the back of the title page of this report or by telephone ((609) 771-3900).

## **COOPERATION**

The U.S. Geological Survey and agencies of the State of New Jersey have had joint-funding agreements for the collection of water-resource records since 1921. Organizations that assisted in collecting the data in this report through joint-funding agreements with the USGS are--

New Jersey Department of Environmental Protection,  
Bradley M. Campbell, Commissioner

North Jersey District Water Supply Commission,  
Michael Barnes, General Manager

Passaic Valley Water Commission, Joseph A. Bella,  
Executive Director

Delaware River Basin Commission, Carol R. Collier,  
Executive Director

The New Jersey Department of Environmental  
Protection aided in collecting records.

Organizations that supplied data are acknowledged in station descriptions.

## SUMMARY OF HYDROLOGIC CONDITIONS

### Surface Water Quality

#### **Yearly Trend of Precipitation, Stream Discharge, and Physical Water-Quality Characteristics Monitored at Several Index Stations**

New Jersey has been experiencing ongoing drought conditions for more than four years. The 2002 water year (October 2001 to September 2002) with a total of 33.99 inches of precipitation was the third driest water year since 1896. Precipitation was below average for 7 months during the 2002 water year (fig. 1) (Statewide Monthly Precipitation 1895-2002, Climate Data, N.J. State Climatologist, Rutgers University; accessed at <http://climate.rutgers.edu/stateclim/data/index.html>). During four of the seven months, deficits of precipitation greater than 2.3 inches occurred, and during two months, deficits greater than 1.2 inches occurred. March, April, May, June, and September had above average precipitation; June had the greatest surplus, 1.2 inches. September 2001 to February 2002 was the driest consecutive 6 months of any 6-month interval on record (Statewide Monthly Precipitation 1895-2002, Climate Data). Overall, precipitation was 10.73 inches (76 percent) below normal during the 2002 water year. Streamflow was below normal throughout much of the year. Monthly mean discharge values for November, February, and March set new minimum monthly mean values for the period of record at index stations High Bridge and Folsom (fig.2). Trenton was the only index station that recorded above normal streamflow at any time during the water year; it occurred during the months of May and June.

The substantial yearlong precipitation and streamflow deficits, and their resultant effects on solute concentrations, are evident in the plot of monthly mean values of specific conductance (SC) at the continuous water-quality monitoring station on the Delaware River at Trenton (fig. 3). Ten of the 12 monthly mean values of SC for the 2002 water year were above long-term (1968-2001) mean-monthly values. During May and June, the months of above normal statewide precipitation and streamflow at Trenton, monthly mean SC values were below the long-term mean-monthly values. During November and January, two of the months with the lowest mean discharge values for the water year, SC values exceeded the highest monthly mean values for the period of record.

Water year 2002 was the warmest water year on record with an average ambient temperature of 55.9°F (13.3°C), 3.8°F (2.1°C) above normal for the State. The long-term (1895-2001) mean-monthly ambient temperature values were exceeded every month, except May (Statewide Monthly Precipitation 1895-2002, Climate Data). Monthly mean water temperature values measured at the Delaware River at Trenton followed a similar trend. Long-term mean-monthly values were exceeded every month, except May and June (fig. 4). Additionally, the December monthly mean value exceeded the maximum for the period of record by 0.6°C. The monthly means for February, April, and

August also were high but did not exceed their respective monthly maximums.

Dissolved oxygen (DO) concentrations generally exhibit an inverse relation to water temperature. As water temperature decreases, oxygen concentration increases; as water temperature increases, oxygen concentration decreases. DO, therefore, varies seasonally; yearly maximums occur in winter, and yearly minimums occur in summer. As expected, the highest monthly median of daily maximum DO concentrations, 15.1 milligrams per liter (mg/L), occurred in January when the monthly mean water temperature was at its lowest, 2.6°C (fig. 5). The lowest monthly median of daily minimum DO concentrations, 8.8 mg/L, and the highest monthly mean water temperature, 27.0°C, occurred in July. No monthly medians of DO minimums and maximums during water year 2002 exceeded long-term extremes for the period of record.

### **Ambient Stream Monitoring Network**

The United States Geological Survey (USGS) in cooperation with the New Jersey Department of Environmental Protection (NJDEP), operates the cooperative Ambient Stream Monitoring Network (ASMN), which is designed to determine statewide water-quality status and trends, measure water-quality near the downstream end of each NJDEP Watershed Management Area (WMA), define background water quality in each of the four physiographic provinces of New Jersey, and measure nonpoint source contributions from major land-use areas and atmospheric deposition. The ASMN consists of 112 stations located throughout the 20 WMAs. Five stations are located on the Delaware River main stem—the border between New Jersey and Pennsylvania—and are excluded from the following statistical plots of the ASMN data. The remaining 107 stations are segregated into 5 distinct types that together are used to define the surface-water quality in the State. Six background stations are located on reaches of streams that remain relatively unaffected by human activity in order to develop a baseline water-quality database. Twenty-three Watershed-Integrator (WI) stations are located at the farthest downstream point, not affected by tide, in one of the large drainage basins in each WMA except two, WMA 9 and 16. The WI stations provide information on the sum of point and nonpoint source contributions to surface water quality within each WMA. Land Use Indicator (LUI) stations are used to monitor the effects of the dominant land use in each WMA and provide data on nonpoint source loading of contaminants to streams. Of the 43 LUI stations, 15 are designated undeveloped, 9 agriculture, 13 urban, and 6 mixed. Forty statewide-status (SS) stations, two in each WMA, are chosen randomly to obtain a statistical basis that can be used to estimate values of water-quality indicators statewide. In water year 2002, five of the SS stations were co-located at existing WI or LUI stations; the data from the co-located stations are included in the statistical plots for the WI and LUI station categories. Water-column samples were collected at each station to assess water-quality constituents that can be used as environmental indicators statewide. In addition to the regularly scheduled samples, a Watershed Reconnaissance study is devised

annually according to specific project needs. The purpose of the Watershed Reconnaissance study in water year 2002 was to assess week-long diurnal physical measurements and constituent concentrations at three network stations located in the Passaic River basin. This is discussed further in Ambient Stream Monitoring Network Reconnaissance Study.

### **Distribution of Selected Constituents in Filtered and Unfiltered Surface Water from Stations in the ASMN**

Physical characteristics and concentrations of total and filtered nutrients, filtered common ions, filtered organic carbon, and biochemical oxygen demand were determined in samples from 112 stations in the ASMN. Samples were collected at each station four times a year during the periods November to December, February to March, May to June, and August to September; however, two stations were not sampled during the August to September period as a result of drought conditions and construction. The analyzing laboratory used two different methods and reporting conventions for establishing the minimum concentration above which a quantitative measurement could be made. These reporting conventions were minimum reporting level (MRL) and laboratory reporting level (LRL). LRL was computed as twice the long-term method detection level (LT-MDL). Values reported by the analyzing laboratory as less than the MRL or LRL were included in each distribution but were reported as a value equal to one-half the MRL or the LT-MDL, respectively. Estimated values, which were determined to be greater than the LT-MDL but less than the LRL, were included. The estimated values are marked with an "E" in the water-quality tables. Refer to "Definition of Terms" in the "Introduction" for further explanation of these reporting conventions.

The record average ambient temperature for water year 2002 did not significantly affect median water temperatures when compared to those of previous water years. The median water temperatures for all the station types were within 3.25°C of each other (fig. 6). The remaining plots in figure 6 illustrate the relation between land use and water quality. Streams that drain urban areas seem to be negatively affected by wastewater discharges. In contrast, streams that drain background and undeveloped areas seemingly are not affected. The amount of dissolved and suspended organic matter in streams affect the concentrations of dissolved oxygen (DO), biochemical oxygen demand (BOD), and turbidity. Available DO is consumed during the biodegradation of organic matter; BOD is a measurement of this consumption. The lowest median DO concentration, 64.5 percent of saturation, the highest median BOD, 1.45 mg/L, and the highest median turbidity, 6.5 NTU, occurred at urban LUI stations. The highest median DO concentration, 95.5 percent of saturation, the lowest median BOD, 0.75 mg/L, and the lowest median turbidity, 1.1 NTU, occurred at background, undeveloped LUI, and background stations, respectively. Streams that are affected by wastewater discharges also are likely to have high levels of total dissolved solids (TDS); samples from urban LUI, WI, and agriculture LUI stations had the highest median

concentrations of TDS, 278 mg/L, 196 mg/L, and 157 mg/L, respectively. The minimum median TDS concentrations occurred at background stations with 30 mg/L, followed by undeveloped LUI stations with 51 mg/L. Stream concentrations of TDS also are affected by streamflow. Concentrations of TDS greater than 500 mg/L occurred only at statewide status stations during November 2001 and February 2002, the severest part of the drought. The high levels of TDS at those particular stations were likely the result of solute concentration from extremely low streamflow.

Nutrients in streams are generally from anthropogenic sources. Nutrients are likely the result of runoff that contains chemical fertilizer and animal waste, and of discharge of municipal sewage. Nutrient enrichment subsequently causes an increase in phytoplankton, free floating algae, in streams. The presence of chlorophyll a, contained in phytoplankton, is therefore an indicator of nutrient enrichment. As expected, median concentrations of ammonia, nitrite plus nitrate, phosphorus, and chlorophyll a are higher in samples from mixed LUI, urban LUI, agriculture LUI, and integrator station types (fig. 6). In contrast, median concentrations are lower in samples from background and undeveloped LUI station types. Dissolved organic carbon (DOC) is a heterogeneous mixture of many organic materials, mostly high molecular weight organic acids that result from the oxidation of organic matter. Organic matter can originate from anthropogenic or natural sources. Eutrophic urban streams have been found to have high levels of organic carbon caused by nutrient enrichment. The highest single value and median concentration of organic carbon occurred in samples from urban LUI stations. The highest single value was determined in a sample from a small urban stream that was stagnant until runoff from rainfall occurred the night prior to sampling. The water, both filtered and unfiltered, was reported as black in color. The lowest median concentration of DOC occurred in samples from background stations. Undeveloped LUI stations might be expected to have a low median concentration, but in fact, it is fairly high. Some undeveloped LUI stations were located on streams drain low relief cedar wetlands in the Coastal Plain physiographic province where the water has sufficient residence time to extract organic carbon compounds from decaying plant material.

### **Distribution, Detection Frequency, and Concentration of Selected Whole-Water Recoverable Trace Elements, Volatile Organic Compounds, and Filtered Pesticides in Samples from 46 Stations in the ASMN**

Samples for analysis of trace elements, volatile organic compounds (VOCs), and pesticides were collected during the period when the constituents were most likely to have been detected, during August and September, February and March, and May and June, respectively. For ease of discussion, only those constituents detected in one or more samples are shown in the figures or tables on pages 10 through 13. A detected constituent is one whose value is reported to be greater than or equal to the laboratory MRL or LRL.

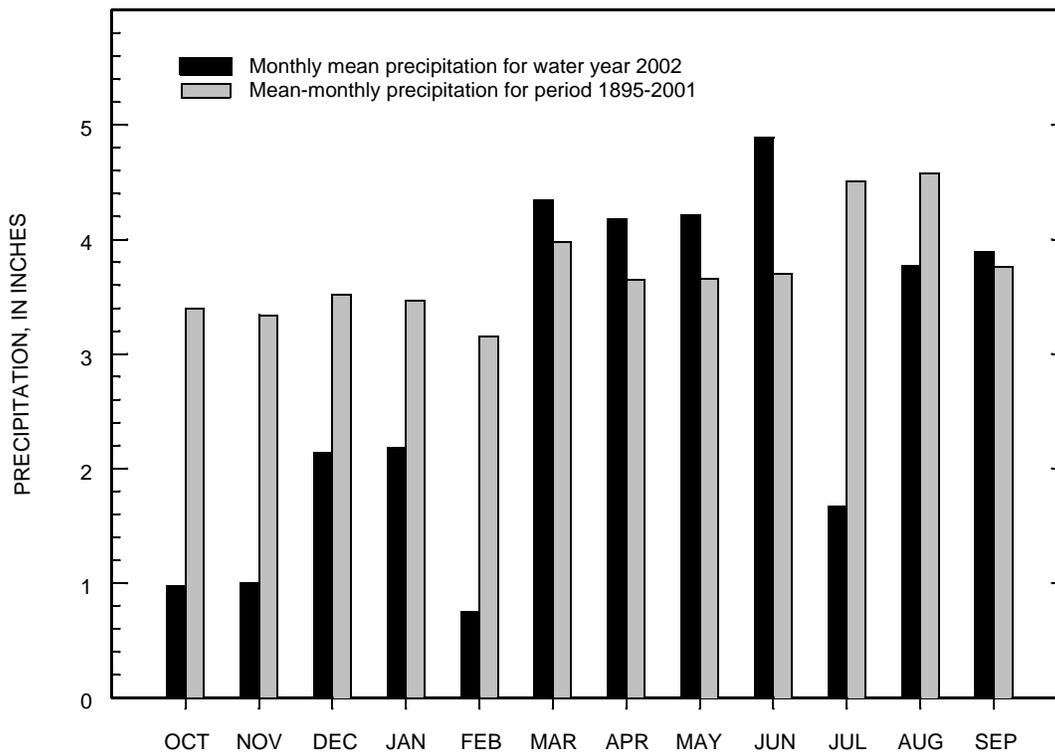
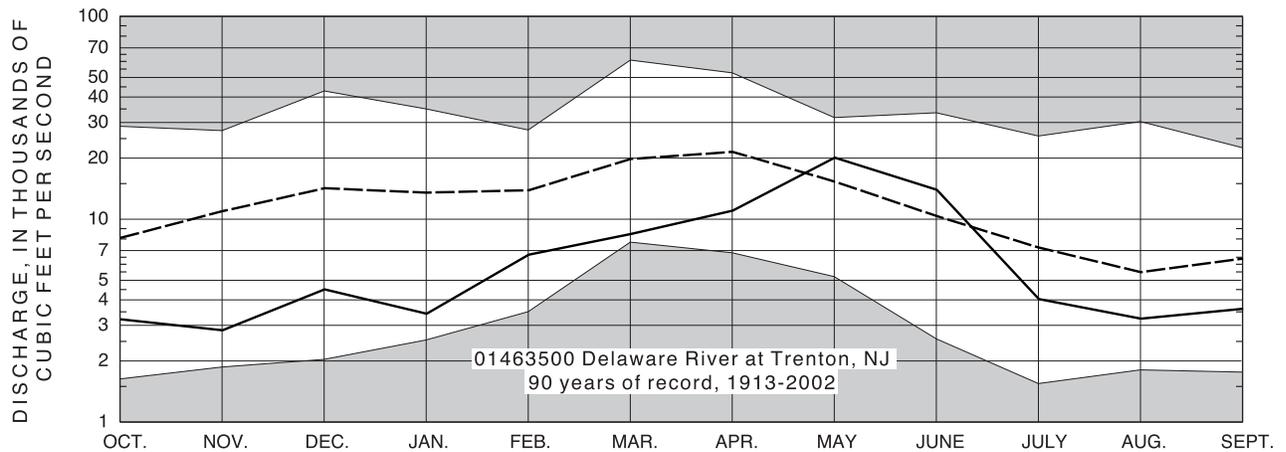
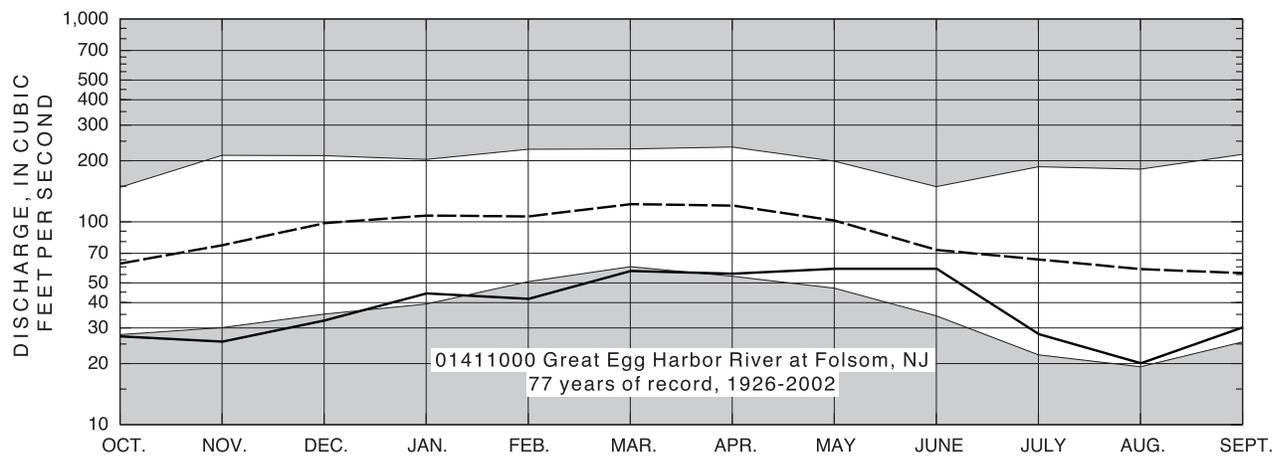
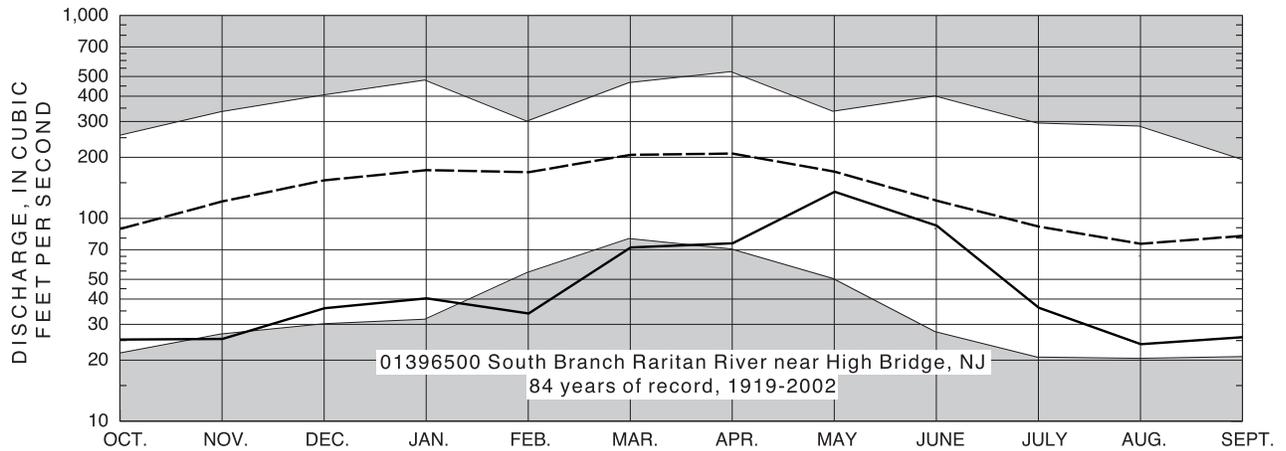


Figure 1. Monthly mean precipitation for water year 2002 and mean-monthly precipitation for 1895-2001. [Mean-monthly and monthly mean precipitation are spatially weighted averages of several dozen stations throughout the State]



EXPLANATION

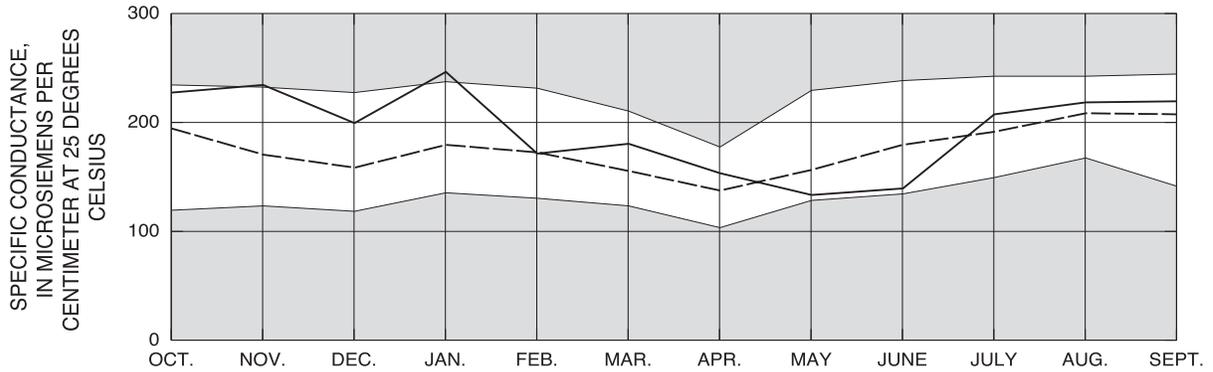
UNSHADED AREA--Indicates range between highest and lowest mean discharge recorded for the month, prior to 2002 water year

BROKEN LINE--Indicates normal discharge (median of the monthly means) for the standard reference period, 1971-2000

SOLID LINE--Indicates observed monthly mean discharge for the 2002 water year

Figure 2. Monthly mean discharge at index gaging stations, water year 2002.

**WATER RESOURCES DATA - NEW JERSEY, 2002**



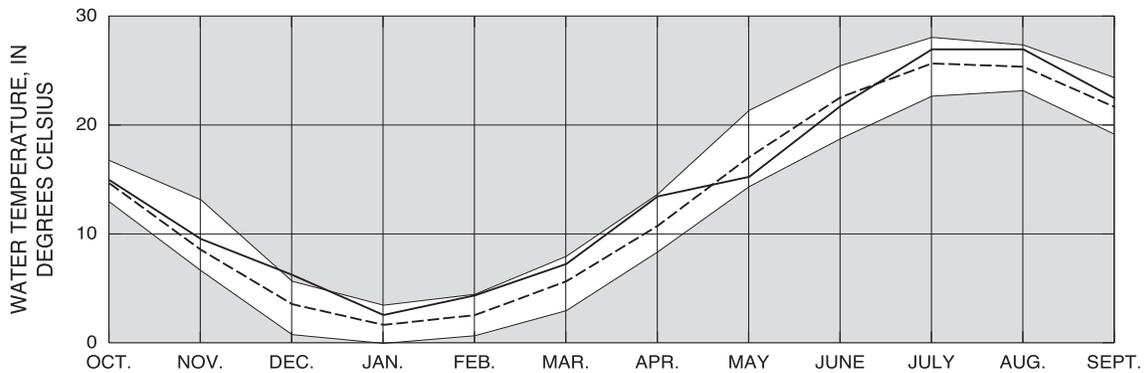
**EXPLANATION**

UNSHADED AREA--Indicates the range between the highest monthly mean values and the lowest monthly mean values, water years 1968-2001.

SOLID LINE--Indicates the monthly mean values for water year 2002.

BROKEN LINE--Indicates the mean-monthly values for water years 1968-2001.

Figure 3. Monthly mean specific conductance at Delaware River at Trenton, New Jersey, water year 2002.



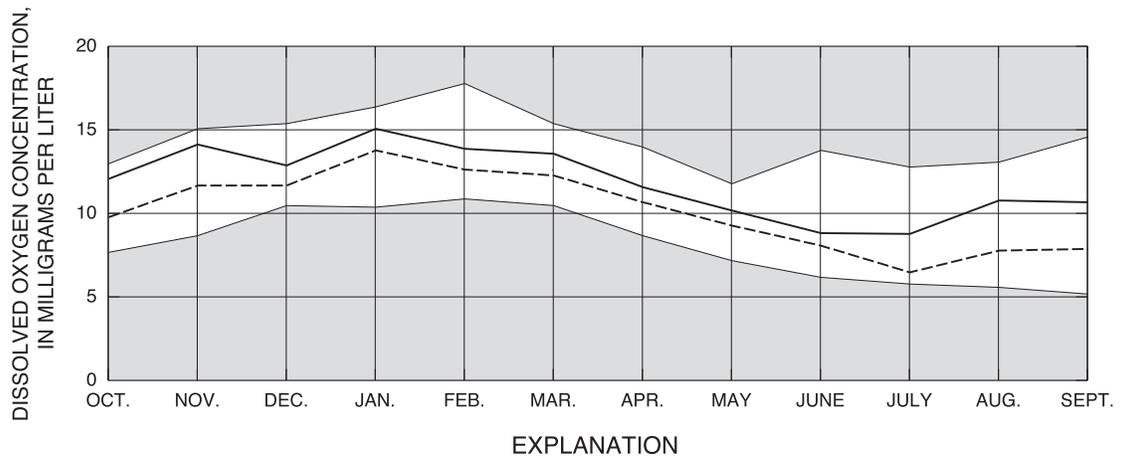
**EXPLANATION**

UNSHADED AREA--Indicates the range between the highest monthly mean values and the lowest monthly mean values, water years 1968-2001.

SOLID LINE--Indicates the monthly mean values for water year 2002.

BROKEN LINE--Indicates the mean-monthly values for water years 1968-2001.

Figure 4. Monthly mean water temperature at Delaware River at Trenton, New Jersey, water year 2002.



UNSHADED AREA--Indicates the range between the highest monthly median of daily maximum values and the lowest monthly median of daily minimum values, water years 1968-2001.

SOLID LINE--Indicates the monthly median of daily maximum values for water year 2002.

BROKEN LINE--Indicates the monthly median of daily minimum values for water year 2002.

Figure 5. Monthly medians of daily maximum and minimum dissolved oxygen concentrations at Delaware River at Trenton, New Jersey, water year 2002.

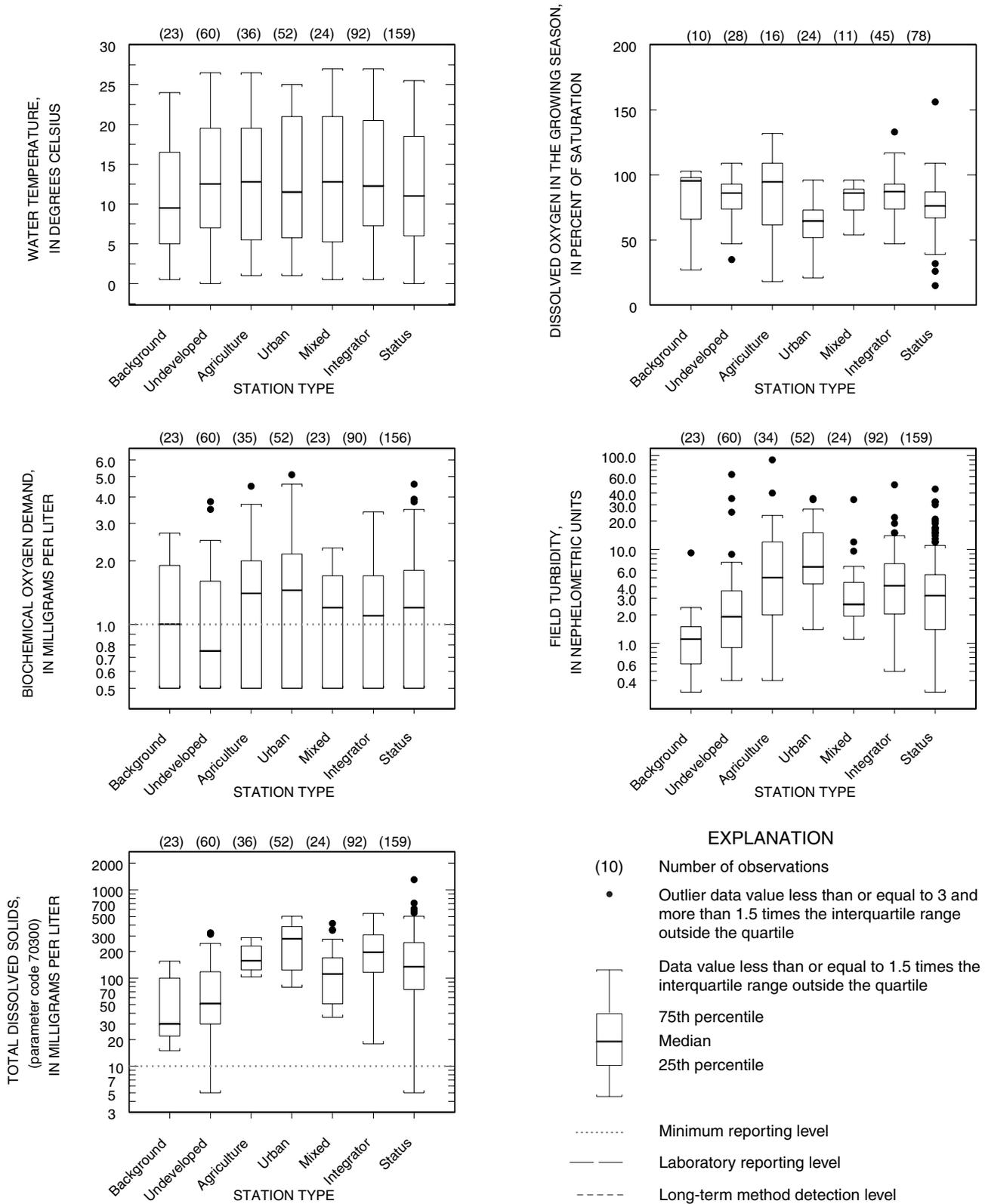


Figure 6. Distribution of physical characteristics of, and constituent concentrations in, samples from 112 stations in the Ambient Stream Monitoring Network, water year 2002. ["Less-than" values reported as equal to one-half the minimum reporting level or laboratory reporting level; excludes data from Delaware River main stem stations 01438500, 01443000, 01457500, 01461000, and 01463500]

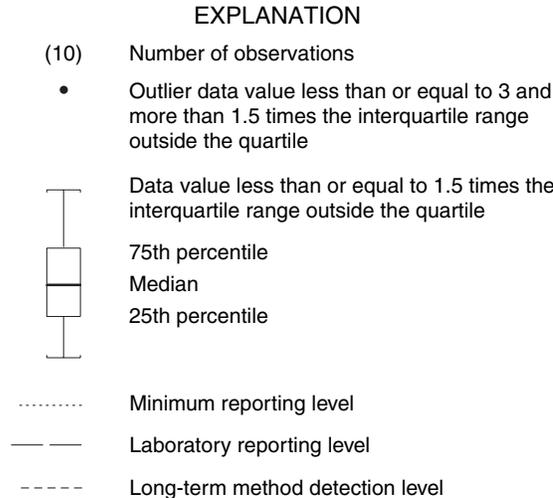
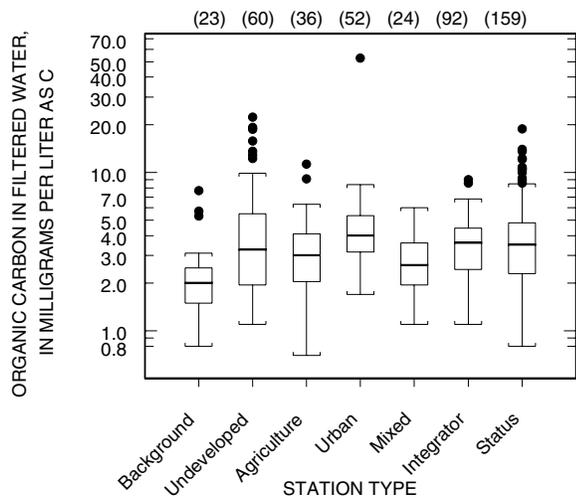
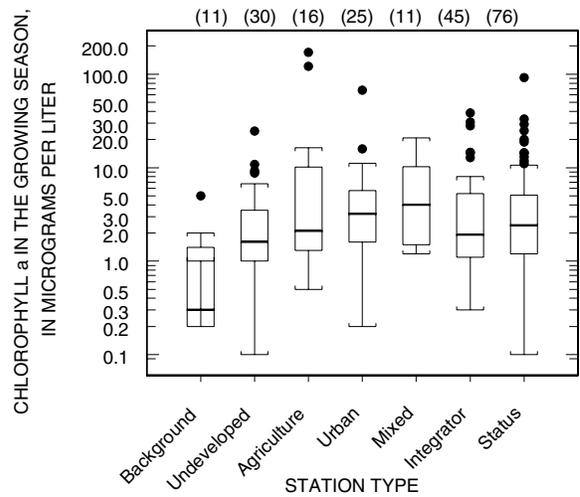
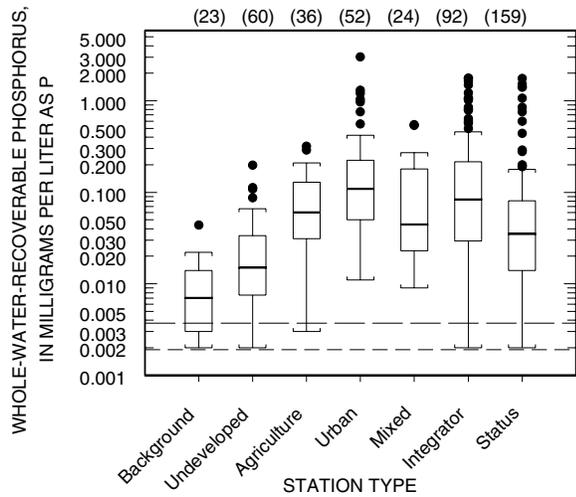
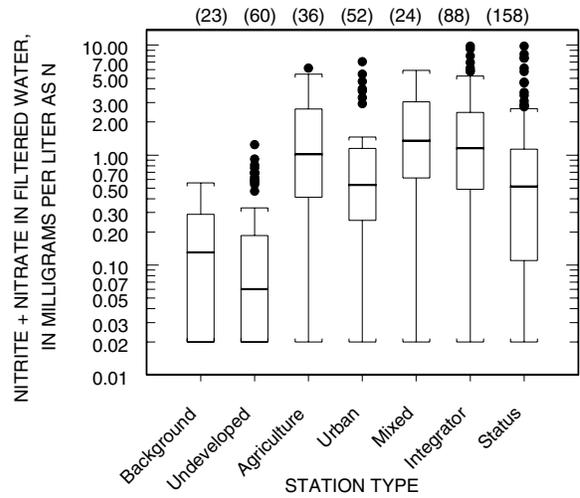
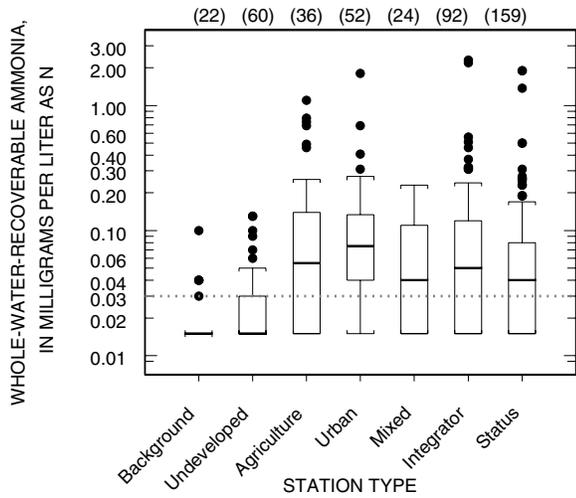


Figure 6. Distribution of physical characteristics of, and constituent concentrations in, samples from 112 stations in the Ambient Stream Monitoring Network, water year 2002--continued. ["Less-than" values reported as equal to one-half the minimum reporting level or laboratory detection level; excludes data from Delaware River main stem stations 01438500, 01443000, 01457500, 01461000, and 01463500]

**WATER RESOURCES DATA - NEW JERSEY, 2002**

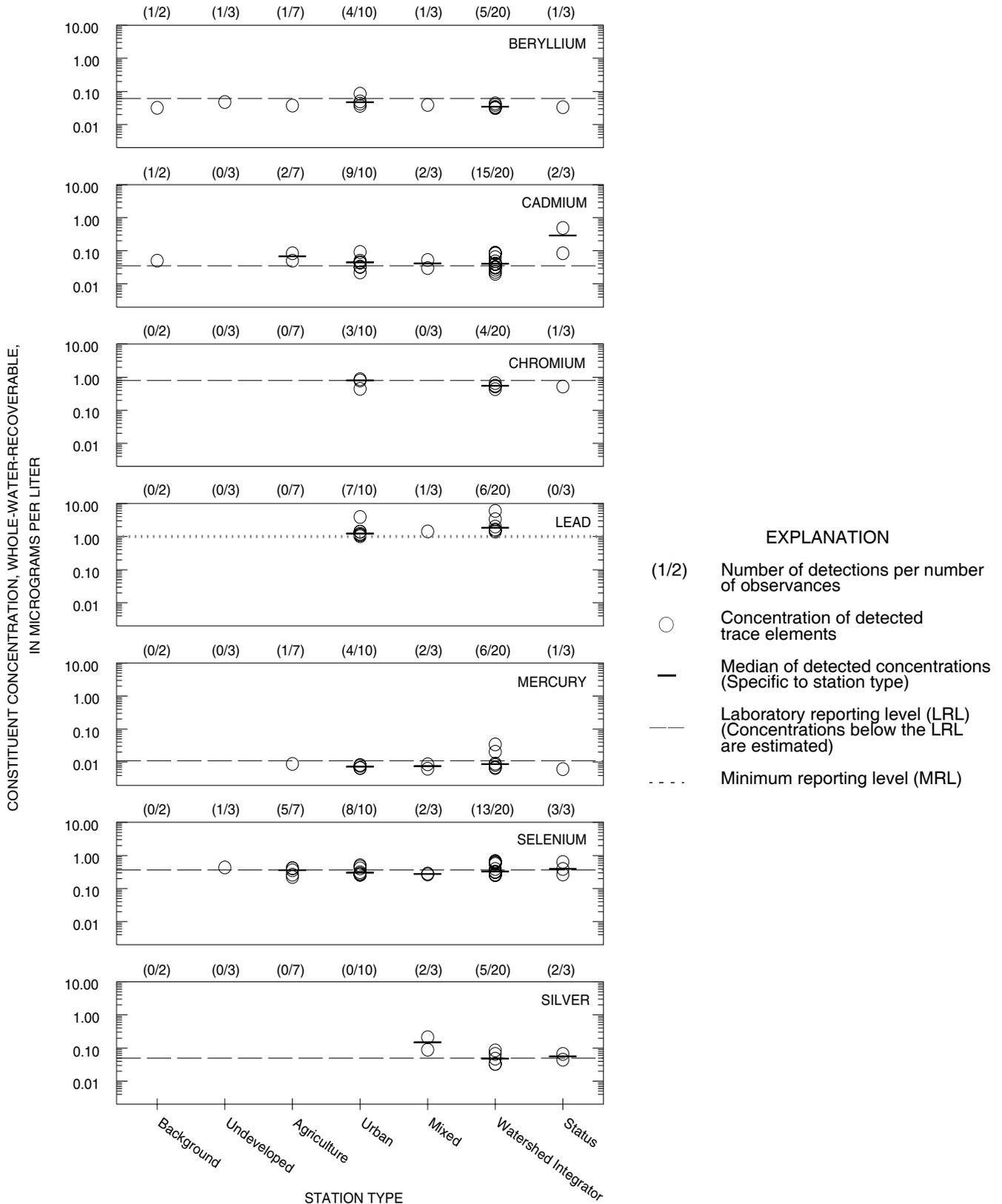


Figure 7. Concentration and detection frequency of whole-water-recoverable trace elements detected in samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [Two of the status stations are colocated at other station types; data were included in both distributions. Constituents whose values were reported by the laboratory as less than the MRL or LRL are considered to be not detected]

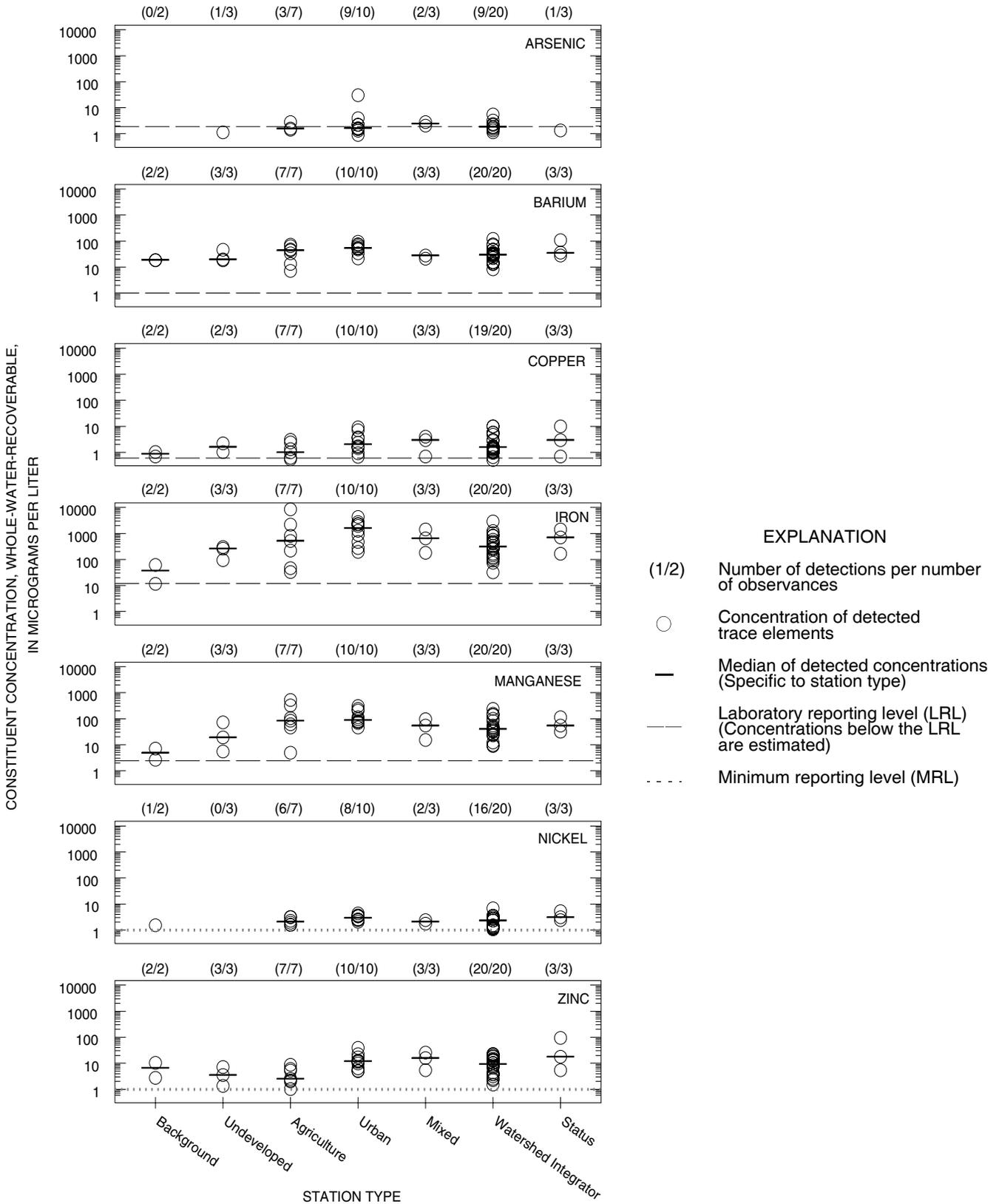
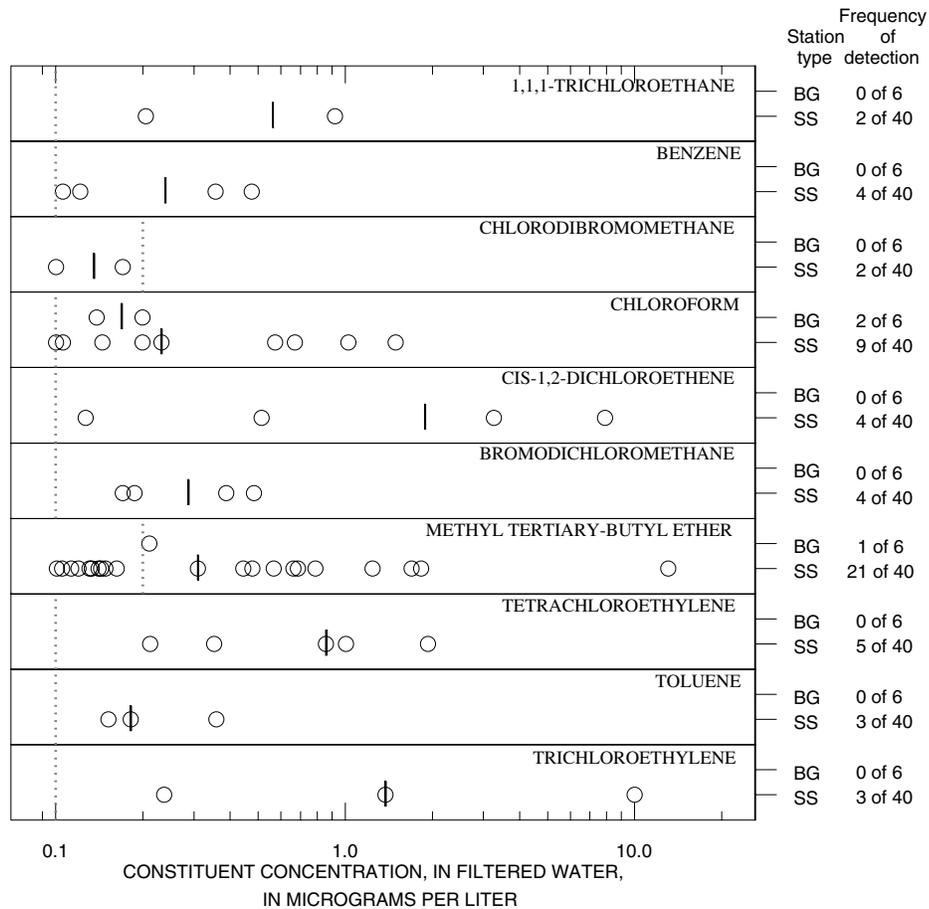


Figure 7. Concentration and detection frequency of whole-water-recoverable trace elements detected in samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002--continued. [Two of the status stations are collocated at other station types; data were included in both distributions. Constituents whose values were reported by the laboratory as less than the MRL or LRL are considered to be not detected]

**WATER RESOURCES DATA - NEW JERSEY, 2002**



**EXPLANATION**

- BG Background stations
- SS Statewide status stations
- Concentration of detected compounds
- | Median of detected concentrations (Specific to station type)
- ⋮ Minimum reporting level (MRL)

Figure 8. Concentration and detection frequency of volatile organic compounds detected in samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [Constituents whose values were reported by the laboratory as less than the MRL or LRL are considered to be not detected]

Table 1. Concentration of volatile organic compounds detected only once in samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [SS, statewide status]

CONSTITUENT	CONCENTRATION (micrograms per liter)	STATION TYPE
1,1-DICHLOROETHANE	0.6	SS
1,2-DICHLOROETHANE	0.2	SS
ORTHO DICHLOROBENZENE	0.2	SS
CHLOROBENZENE	1.5	SS
DIISOPROPYLETHER	0.5	SS
ETHYL ETHER	0.3	SS
ETHYLBENZENE	0.1	SS
META+PARA XYLENE	0.3	SS
ORTHO XYLENE	0.1	SS
VINYL CHLORIDE	3.0	SS

- EXPLANATION**
- BG Background stations
  - SS Statewide status stations
  - Concentration of detected compounds
  - | Median of detected concentrations (Specific to station type)
  - Laboratory reporting level (LRL) (Concentrations below the LRL are estimated)

Table 2. Detection frequency of selected pesticides in filtered samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [All values are estimated due to poor recovery or poor precision]

CONSTITUENT	STATEWIDE STATUS	BACKGROUND STATUS
ALPHA BHC	1 of 40	0 of 6
BENFLURALIN	2 of 40	0 of 6
CARBARYL	19 of 40	1 of 6
DEETHYLATRAZINE	31 of 40	3 of 6
METHYLAZINPHOS	3 of 40	0 of 6
TEBUTHIURON	3 of 40	0 of 6
TERBACIL	3 of 40	0 of 6
TRIFLURALIN	2 of 40	0 of 6

Table 3. Concentration of pesticides detected only once in filtered samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [SS, statewide status]

CONSTITUENT	CONCENTRATION (micrograms per liter)	STATION TYPE
LINURON	0.3	SS

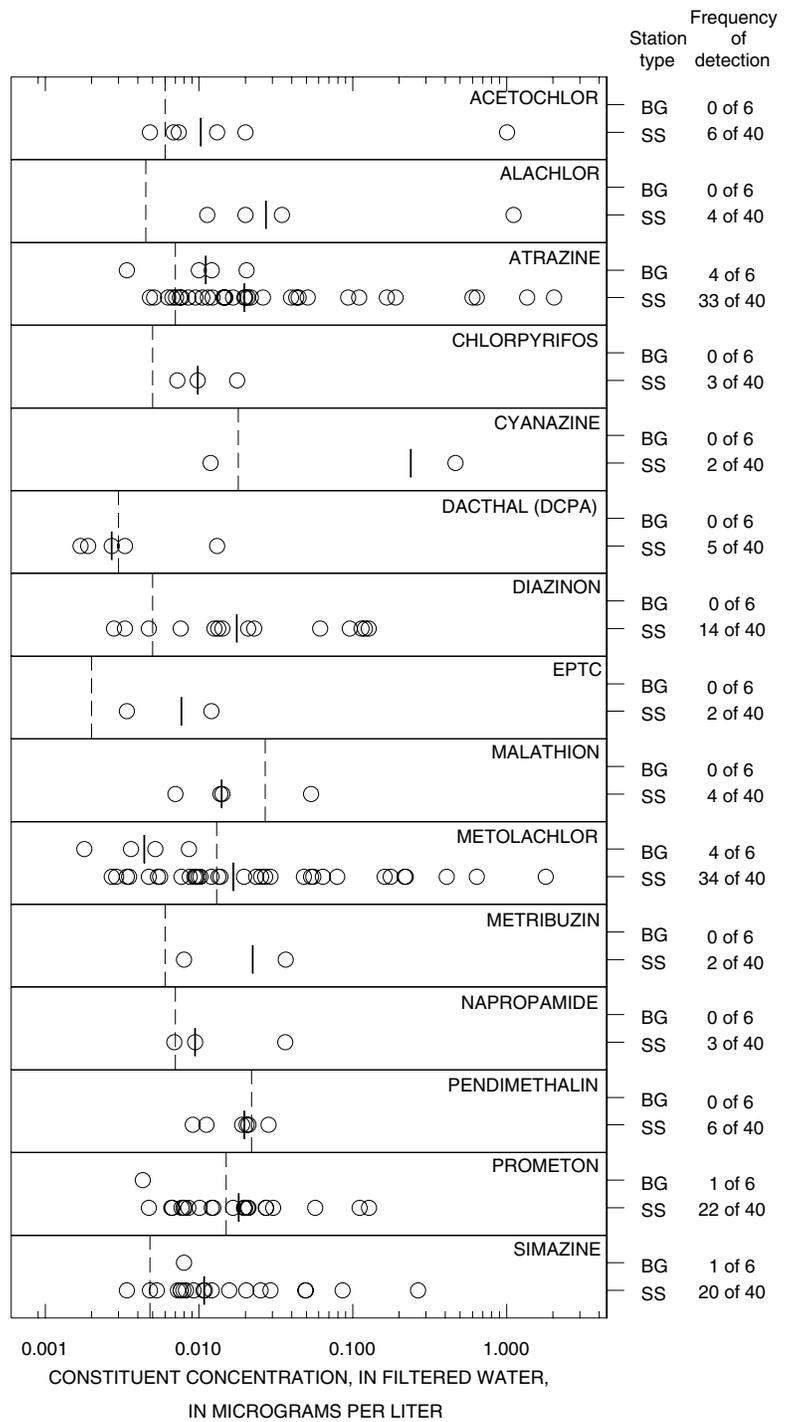


Figure 9. Concentration and detection frequency of pesticides detected in filtered samples from 46 stations in the Ambient Stream Monitoring Network, water year 2002. [Constituents whose values were reported by the laboratory as less than the MRL or LRL are considered to be not detected]

Values reported by the analyzing laboratory as “<” (less than the MRL or LRL) were considered to be not detected and were excluded from the plots. Values reported as “E” (estimated below the LRL) were included in the plots. Refer to “Definition of Terms” in the “Introduction” for more information about MRLs and LRLs.

Samples for the analysis of trace elements were collected at two background stations to develop a baseline with which to compare the water quality at other stations. Forty-four samples were collected from a random selection of long-term fixed station types. Every trace element in the USGS National Water Quality Laboratory schedule was detected in more than one sample and, therefore, was included in figure 7. Estimated values, concentrations below the LRL line in each plot, also were included. Barium, iron, manganese, and zinc were detected in 100 percent of the samples. Chromium and silver had the lowest percentages of detection, 16.7 and 18.7, respectively. In general, trace elements were detected more often in samples from mixed LUI and statewide status stations. They were detected less often and in smaller concentrations in samples from undeveloped LUI and background stations, which were located on reaches of streams that remain relatively unaffected by human activity.

Concentrations of VOCs and pesticides in samples from background stations were determined to develop a baseline and from SS stations to provide a general overview of the water quality statewide and of the aerial distribution of these compounds. Samples from 6 background and 40 SS stations were analyzed for 34 VOCs. Ten compounds were detected in more than one sample and are presented in figure 8. Ten compounds were detected only once and are presented in table 1. Refer to individual station records for tables that list all the compounds. The most frequently detected VOCs in 46 samples were Methyl tert-butyl ether (MTBE), in 48 percent of samples; chloroform, in 24 percent; and tetrachloroethylene, in 11 percent. Chloroform and MTBE were the only two compounds detected in samples from background stations. Chloroform is a by-product of the disinfection of drinking water and wastewater by chlorination; MTBE is a gasoline additive.

Filtered samples from 6 background and 40 SS stations were analyzed for 47 pesticides by use of laboratory schedule 2001. Only compounds detected in one or more samples are included in figure 9 and tables 2 and 3. Refer to “Laboratory Measurements” in the “Introduction” for the complete list of those pesticides and the LRL for each compound. Estimated values, concentrations to the left of the LRL line in each plot in figure 9, also are included. Pesticides, in low concentrations, were widely distributed throughout the State; twenty-four compounds were detected at one or more SS stations. Six compounds also were detected at background stations, indicating that atmospheric deposition is a possible source. Four of the detected compounds are insecticides—Carbaryl, Chlorpyrifos, Diazinon, and Malathion. The remaining compounds are herbicides. The most frequently detected pesticides in 46 samples were Metolachlor, in 83 percent of

samples; Atrazine, in 80 percent; Deethylatrazine (a degradation product of Atrazine), in 74 percent; and Prometon, in 50 percent. The six compounds detected at background stations are commonly used herbicides, with the exception of carbaryl, which is an insecticide.

### Ambient Stream Monitoring Network Reconnaissance Study

The water year 2002 reconnaissance study documented the occurrence of base-flow extremes of continuously monitored water temperature, dissolved oxygen (DO) concentration, percent of dissolved oxygen saturation, specific conductance, and pH at three network stations in the Passaic River basin. In situ multi-constituent sensors, or monitors, recorded the occurrence and magnitude of diurnal variations that could not be observed during normal station visits, which generally took place between the hours of 8 a.m. and 2 p.m. The monitors were deployed for five 1-week periods during the summer months. Graphs of hourly values are included in the individual station records for Pompton River at Pompton Plains (01388500), Passaic River at Little Falls (01389500), and Saddle River at Lodi (01391500) (figs. 19-23, 27-31, and 32-36, respectively).

The Reconnaissance stations were placed in the Passaic River basin, the most intensely used river basin in the State, to better characterize fluctuations of the characteristics and the relation of the characteristics to surface-water quality during a State-declared Drought Emergency with modified allowable passing flows in the basin (William Honachefsky, New Jersey Department of Environmental Protection, written commun., April 2003). Diurnal variation of DO during days of base flow and suppression of variation during days of higher flow were recorded at the three stations. About 1 inch of rain fell throughout the period June 10 to 14; subsequently, the monitors recorded relatively stable DO values (+/- 1 mg/L from the daily mean) during the period. Stable, low base-flow conditions were recorded during the first few days of two periods, June 24 to July 1 and July 16 to 23; subsequently, the monitors recorded wide variations (+/- 4 mg/L from the daily mean) during those times. Significant rainfall in the middle of the periods resulted in immediate suppression of diurnal fluctuation, which gradually resumed as flow returned to near base flow. The causes of diurnal DO fluctuation are photosynthesis and aerobic respiration. The process of photosynthesis is driven by sunlight and produces free oxygen, which causes an increase in DO levels during the day. The process of algal respiration consumes free oxygen and causes a decrease in DO levels during the night. High stream-flow, which carries an increased load of suspended material, increases turbidity that effectively blocks sunlight, and interrupts the photosynthetic process.

### Ground Water Quality

The USGS, in cooperation with the NJDEP, operates the Ambient Ground-Water-Quality Network (AGWQN), which was designed to monitor the quality of ground water at or near the water table throughout the State. Shallow ground water is generally the first

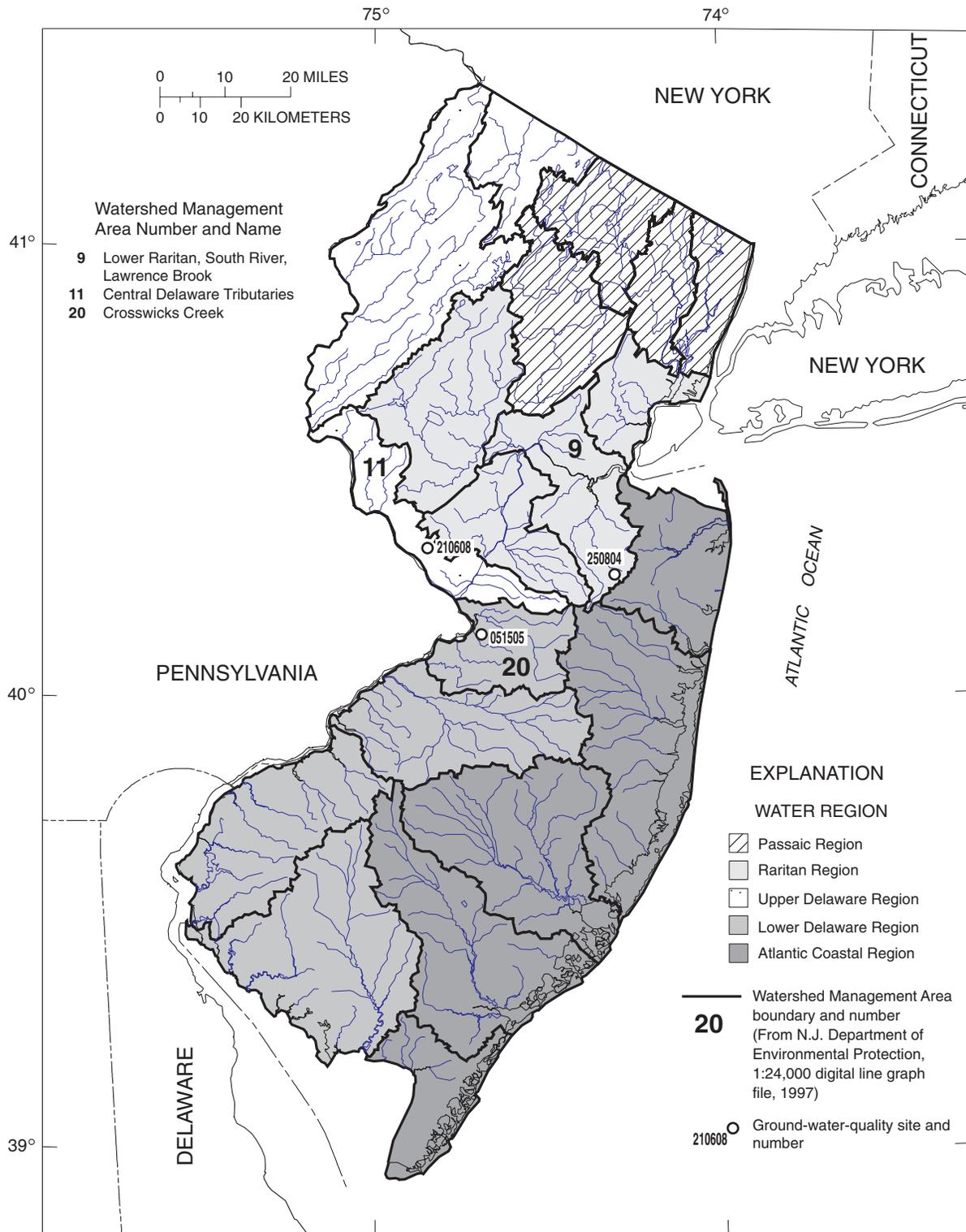


Figure 10. Location of sites in the Ambient Ground-Water-Quality Network, water year 2002.

Table 4. Hydrogeologic unit and land use at three wells sampled as part of U.S. Geological Survey-N.J. Department of Environmental Protection (cooperative) Ambient Ground-Water-Quality Network, water year 2002.

[WMA, Watershed Management Area; VOCs, volatile organic compounds; mg/L, milligrams per liter; NO<sub>2</sub>+NO<sub>3</sub>, nitrite plus nitrate; ft bls, feet below land surface; 211RDBK, Red Bank Sand; 211EGLS, Englishtown Formation; 231LCKG, Lockatong Formation; ---, data not available]

NJ-WRD well number	WMA number	Hydrogeologic unit aquifer code	Predominant land use <sup>1</sup>	Water type (dominant cation-anion)	Dissolved oxygen (mg/L)	Nitrogen			Number of pesticides detected <sup>2</sup>	Number of VOCs detected <sup>2</sup>	Number of trace elements detected <sup>2</sup>	Well depth (ft bls)
						NO <sub>2</sub> +NO <sub>3</sub> , dissolved (mg/L)	Total dissolved solids (mg/L)					
210608	11	231LCKG	Agricultural	Calcium-bicarbonate	0.4	1.02	307	None	None	9	14.0	
250804	9	211RDBK	Agricultural	Calcium-sulfate	1.3	E0.02	222	None	None	8	16.8	
51505	20	211EGLS	Urban	Calcium-sulfate	---	0.33	122	None	1	8	27.8	

<sup>1</sup>Land use based on New Jersey geographic information system (New Jersey Department of Environmental Protection, 1996).

<sup>2</sup>Includes compounds with estimated concentrations, defined as positive detections of a compound, but measured as less than the laboratory's reporting levels.

and most significantly affected part of the ground-water system, and the quality of this water is directly related to human activities at the land surface. The AGWQN is a long-term monitoring network with goals to assess the status of ground-water quality by examining the concentrations of various constituents that can be used as environmental indicators, assess water-quality trends by examining data collected on a 5-year cycle, determine the effects of land use on shallow ground-water quality, identify threats from nonpoint sources of contamination, and identify emerging or new environmental issues of concern to the public.

The network will consist of 150 shallow ground-water wells distributed throughout New Jersey within three land-use types. Sixty wells are, or will be located, in agricultural areas, 60 in urban/suburban areas, and 30 in undeveloped areas within New Jersey's five watershed management regions (WMRs)—the Passaic, the Raritan, the Upper Delaware, the Lower Delaware, and the Atlantic Coastal. These five WMRs are further divided into 20 watershed management areas (WMAs). Every year approximately 30 sites are sampled in one or several of the five WMRs. The cycle of sampling all 150 wells will be completed every 5 years. Water year 2002 was the fourth year of operation of the first 5-year cycle of the AGWQN.

Because of the difficulty of locating suitable sites north of the fall line, only three wells were installed and sampled during water year 2002 (fig. 10). The first 5-year cycle, however, will most likely be finished by the end of water year 2003. Because few samples were collected, statistical analyses are not presented in this volume. Selected location, construction, and analytical data for the three wells are summarized in table 4. Samples from the wells were analyzed for physical characteristics, major ions, nutrients, trace elements, organic constituents, and gross alpha and beta radioactivity. The records of chemical constituents are in the section, "Water-Quality at Miscellaneous Ground-Water Sites."

### SPECIAL NETWORKS AND PROGRAMS

The USGS/New Jersey Department of Environmental Protection (NJDEP) cooperative Ambient Stream Monitoring Network (ASMN) and Ambient Ground Water Quality Network (AGWQN) are designed to meet the expanding need for surface and ground-water-quality data in the State of New Jersey. The major objectives of the network are to (1) support the National Environmental Performance Partnership System agreement (a program set up to control long-term environmental planning) and the watershed-management process; (2) to work synergistically with the NJDEP Ambient Biomonitoring Network, and atmospheric, ground-water, and coastal water-quality networks; (3) determine statewide water-quality status and trends; (4) measure water-quality near the downstream end of each Watershed Management Area (WMA); (5) define background water quality in each of the four physiographic provinces of New Jersey; (6) measure nonpoint-source contributions from major landuse areas, atmospheric deposition, and ground-water; (7) facilitate response of state and local water-manage-

ment officials to emerging or watershed-specific water-quality issues.

The surface-water network consists of 112 stations located in 20 WMA's. These stations are segregated into five distinct types that together are used to define the surface-water-quality in the State. Background stations are located on reaches of streams that have remained relatively unaffected by human activity, to develop a baseline water-quality data base. Data from these stations are used in the development of water-quality standards and initiatives. Watershed Integrator stations are located at the furthest downstream point possible in each WMA to provide information on the combined water-quality effects within each WMA. Land Use Indicator stations are used to monitor the effects of the dominant land use in each WMA and provide data on nonpoint-source loading of contaminants to streams. Statewide Status stations are chosen randomly each year within the 20 WMA's to obtain a statistical basis that can be used to estimate water-quality indicators statewide. Five stations are located on the Delaware Main Stem—the border between New Jersey and Pennsylvania. Watershed Reconnaissance stations are also selected annually on the basis of specific project needs, determined by a committee of USGS and NJDEP personnel.

The surface-water network is sampled in four periods throughout the water year: November 1 to December 31, February 1 to March 31, May 1 to June 30, and August 1 to September 30. Samples for analysis for nutrients, major ions, biochemical-oxygen demand, and suspended solids are collected for the entire network each sampling period. Samples for the analysis of water-column volatile organic compounds during February and March, filtered organic pesticides during May and June, and whole-water-recoverable trace elements during August and September are collected at all Statewide Status and Background stations. Samples for the analyses of trace elements and polyaromatic hydrocarbons in streambed sediments are also collected in August and September at 19 Statewide Status stations and 2 Background stations. [In water year 2002, samples for the analysis of whole-water-recoverable trace elements were collected at 44 randomly selected long-term fixed station types and 2 Background stations. Samples for the analyses of trace elements and polyaromatic hydrocarbons in streambed sediments were collected at 20 of the 44 randomly selected long-term fixed station types and both the Background stations where whole-water-recoverable trace metals were collected.] Samples for the analyses of fecal coliform, *E. coli*, and enterococcus bacteria were collected synoptically in May, June, July, and August.

The Ambient Ground-Water-Quality Network (AGWQN) is designed to monitor the water quality of shallow wells. The quality of water from wells located at the water table is generally the first and most significantly affected part of the ground water system, and can be directly related to human activity at the land surface. The ground-water network will consist of 150 sites distributed throughout the State of New Jersey within three land-use types. Sixty wells are, or will be located,

in agricultural areas, 60 in urban/suburban areas, and 30 in undeveloped areas. These areas are located throughout New Jersey's five Watershed Management Regions (WMR), which are further divided into 20 watershed-management areas (WMA) (fig. 10). The Passaic Region encompasses WMAs 3-6; the Lower Delaware Region, WMAs 17-20; the Raritan Region, WMAs 7-10; the Upper Delaware Region, WMAs 1, 2, and 11; and, the Atlantic Coastal Region, WMAs 12-16. Approximately 30 wells in one or several of the five WMR are sampled each year. Thus, the entire network is sampled over a 5-year cycle.

Hydrologic Benchmark Network is a network of 50 sites in small drainage basins around the country whose purpose is to provide consistent data on the streamflow representative of undeveloped watersheds nationwide, and to provide analyses on a continuing basis to compare and contrast conditions observed in basins more obviously affected by human activities. At 10 of these sites, water-quality information is being gathered on major ions and nutrients, primarily to assess the affects of acid deposition on stream chemistry. Additional information on the Hydrologic Benchmark Program can be found at <http://water.usgs.gov/hbn/>.

National Stream-Quality Accounting Network (NASQAN) monitors the water quality of large rivers within the Nation's largest river basins. From 1995 through 1999, a network of approximately 40 stations were operated in the Mississippi, Columbia, Colorado, and Rio Grande. For the period 2000 through 2004, sampling was reduced to a few index stations on the Colorado and Columbia so that a network of 5 stations could be implemented on the Yukon River. Samples are collected with sufficient frequency that the flux of a wide range of constituents can be estimated. The objective of NASQAN is to characterize the water quality of these large rivers by measuring concentration and mass transport of a wide range of dissolved and suspended constituents, including nutrients, major ions, dissolved and sediment-bound heavy metals, common pesticides, and inorganic and organic forms of carbon. This information will be used (1) to describe the long-term trends and changes in concentration and transport of these constituents; (2) to test findings of the National Water-Quality Assessment Program (NAWQA); (3) to characterize processes unique to large-river systems such as storage and re-mobilization of sediments and associated contaminants; and (4) to refine existing estimates of off-continent transport of water, sediment, and chemicals for assessing human effects on the world's oceans and for determining global cycles of carbon, nutrients, and other chemicals. Additional information about the NASQAN Program can be found at <http://water.usgs.gov/nasqan/>

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) provides continuous measurement and assessment of the chemical constituents in precipitation throughout the United States. As the lead federal agency, the USGS works together with over 100 organizations to provide a long-term, spatial and temporal record of atmospheric deposition generated from a network of 225 precipitation

chemistry monitoring sites. This long-term, nationally consistent monitoring program, coupled with ecosystem research, provides critical information toward a national scorecard to evaluate the effectiveness of ongoing and future regulations intended to reduce atmospheric emissions and subsequent impacts to the Nation's land and water resources. Reports and other information on the NADP/NTN Program, as well as all data from the individual sites, can be found at <http://bqs.usgs.gov/acidrain/>.

The National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey is a long-term program with goals to describe the status and trends of water-quality conditions for a large, representative part of the Nation's ground- and surface-water resources; provide an improved understanding of the primary natural and human factors affecting these observed conditions and trends; and provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other agencies.

Assessment activities are being conducted in 59 study units (major watersheds and aquifer systems) that represent a wide range of environmental settings nationwide and that account for a large percentage of the Nation's water use. A wide array of chemical constituents will be measured in ground water, surface water, streambed sediments, and fish tissues. The coordinated application of comparative hydrologic studies at a wide range of spatial and temporal scales will provide information for decision making by water-resources managers and a foundation for aggregation and comparison of findings to address water-quality issues of regional and national interest.

NAWQA study units are divided into three groups that are studied intensively on a rotational basis. Two NAWQA studies are currently run out of the New Jersey District of the USGS. The Long Island-New Jersey Coastal Plain (LINJ) study unit conducted intensive sampling from 1996 through 1998 and is currently in a low-intensity phase. The LINJ study unit is slated to resume intensive sampling starting in 2006. The Delaware River Basin (DELR) study unit conducted intensive sampling from 1999 through 2001, and is currently in a low-intensity phase. The DELR is scheduled to resume intensive sampling in 2009.

Communication and coordination between USGS personnel and other local, State, and federal interests are critical components of the NAWQA Program. Each study unit has a local liaison committee consisting of representatives from key federal, State, and local water resources agencies, Indian nations, and universities in the study unit. Liaison committees typically meet semi-annually to discuss their information needs, monitoring plans and progress, desired information products, and opportunities to collaborate efforts among the agencies. Additional information about the NAWQA Program is available through the world wide web at <http://water.usgs.gov/nawqa/>

Long Island-New Jersey Coastal Plain (LINJ) NAWQA fixed stations published in this report (fig.13)

are: Raritan River at Queens Bridge, at Bound Brook, NJ (01403300) and Bound Brook at Middlesex, NJ (01403900). The location of ground-water sites that are sampled as part of the low-intensity-phase of the LINJ-NAWQA study are shown in figure 41. Ground-water data collected for the LINJ-NAWQA study are published in this report in the section titled "Water Quality at Miscellaneous Ground-Water Sites."

Delaware River Basin (DELR) NAWQA fixed stations published in this report (fig. 14) are: Delaware River at Trenton, NJ (01463500); Little Neshaminy Creek at Valley Rd. near Neshaminy, PA (01464907); French Creek near Phoenixville, PA (01472157); and Schuylkill River at Philadelphia, PA (01474500).

## EXPLANATION OF THE RECORDS

The water-quality records published in this report are for the 2002 water year that began October 1, 2001, and ended September 30, 2002. A calendar of the water year is provided on the inside of the front cover. The records contain surface-water and ground-water-quality data. The locations of the stations where the data were collected are shown in figures 12-14, and 40-41. The following sections of the introductory text are presented to provide users with a more detailed explanation of how the hydrologic data published in this report were collected, analyzed, computed, and arranged for presentation.

### Station Identification Numbers

Each data station in this report is assigned a unique identification number. This number is unique in that it applies specifically to a given station and to no other. The number usually is assigned when a station is first established and is retained for that station indefinitely. The systems used by the U.S. Geological Survey to assign identification numbers for surface-water stations and for ground-water well sites differ, but both are based on geographic location. Generally the "downstream order" system is used for regular surface-water stations and the "latitude-longitude" system is used for wells.

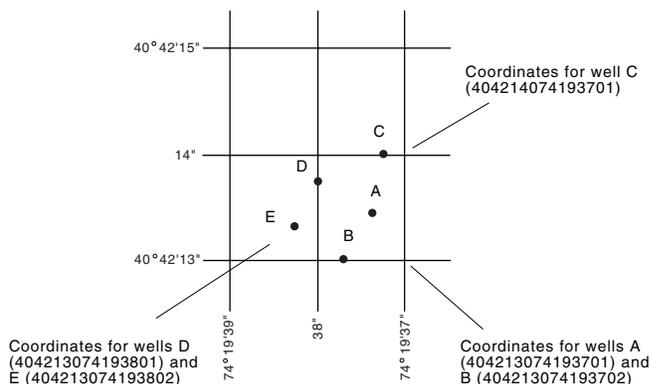
### Downstream Order System

Since October 1, 1950, the order of listing hydrologic-station records in Survey reports is in a downstream direction along the main stream. All stations on a tributary entering upstream from a mainstream station are listed before that station. A station on a tributary that enters between two mainstream stations is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary with respect to the stream to which it is immediately tributary is indicated by an indention in the "List of Stations" in the front of this report. Each indention represents one rank. This downstream order and system of indention shows which stations are on tributaries between any two stations and the rank of the tributary on which each station is situated.

The station-identification number is assigned according to downstream order. In assigning station numbers, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list made up of both types of stations. Gaps are left in the series of numbers to allow for new stations that may be established; hence, the numbers are not consecutive. The complete eight-digit number for each station, such as 01396500, which appears just to the left of the station name, includes the two-digit Part number "01" plus the 6-digit downstream-order number "396500". The Part number designates the major drainage basin; for example, Part "01" covers the North Atlantic slope basins. In some areas where all 8-digit numbers are used up, 10-digit station numbers are assigned between the 8-digit numbers.

### Latitude-Longitude System

The identification numbers for wells and miscellaneous surface-water sites are assigned according to the grid system of latitude and longitude (fig. 11). The number consists of 15 digits. The first six digits denote the degrees, minutes, and seconds of latitude, the next seven digits denote degrees, minutes, and seconds of longitude, and the last two digits (assigned sequentially) identify the wells or other sites within a 1-second grid. This site-identification number, once assigned, is a pure number and has no locational significance. In the rare instance where the initial determination of latitude and longitude are found to be in error, the station will retain its initial identification number; however, its true latitude and longitude will be listed in the LOCATION paragraph of the station description.



**Figure 11.--System for numbering wells and miscellaneous sites (latitude and longitude)**

### Water Quality Records

Records of surface-water quality ordinarily are obtained at or near stream-gaging stations because interpretation of records of surface-water quality nearly always requires corresponding discharge data. Records of surface-water quality in this report may involve a variety of types of data and measurement frequencies. Locations of stations for which records on the quality of surface water appear in this report are shown in figures 12-14.

### Classification of Records

Water-quality data for surface-water sites are grouped into one of three classifications. A continuing-record station is a site where data are collected on a regularly scheduled basis. Frequency may be one or more times daily, weekly, monthly, or quarterly. A partial-record station is a site where limited water-quality data are collected systematically over a period of years. Frequency of sampling is usually less than quarterly. A miscellaneous sampling site is a location other than a continuing or partial-record station where random samples are collected to give better areal coverage to define water-quality conditions in the river basin.

A careful distinction needs to be made between "continuing records", as used in this report, and "continuous recordings," which refers to a continuous graph or a series of discrete values logged at short intervals by electronic data loggers. Some records of water quality, such as temperature and specific conductance, may be obtained through continuous recordings; however, because of costs, most data are obtained only monthly or less frequently.

### Arrangement of Records

Water-quality records from continuing-record and continuous-recording stations are listed in downstream order immediately after the "Introduction." Water-quality records from miscellaneous surface-water and ground-water sites are listed immediately after the continuing-record stations.

### On-site Measurements and Sample Collection

Water-quality data must represent the in-situ quality of the water. To assure this, certain measurements, such as water temperature, pH, and dissolved oxygen, must be made on-site when the samples are collected. In addition, specific procedures must be used in collecting, treating, and shipping the samples to the laboratory. Procedures for on site measurements and for collecting, treating, and shipping samples are given in publications on "Techniques of Water-Resources Investigations," Book 1, Chap. D2; Book 3, Chap. C2; Book 5, Chap. A1, A3, and A4; Book 9, Chap. A1-A9. These references are listed under "PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS" section of this report. These methods are consistent with ASTM standards and generally follow ISO standards.

In streams, concentrations of various constituents may vary within the cross section depending on variables such as flow rate, the sources of the constituents, and mixing. Generally, constituents in solid phases are more variable in the cross section than are dissolved constituents. In many cases, samples must integrate several parts of the stream cross section to be representative, especially if loads will be calculated. One sample may be representative of the cross section when the distribution of constituents is homogeneous. All samples are obtained from multiple verticals.

Chemical-quality data published in this report are

considered to be the most representative values available for the stations listed. In some instances, apparent inconsistencies may exist in the data. For example, the orthophosphate-phosphorus concentration may exceed total phosphorus concentration. However, the difference in the inconsistent values normally is smaller than the precision of the analytical techniques. Inconsistencies between pH and carbonate and bicarbonate concentrations are commonly caused by intake or loss of carbon dioxide by the sample before it can be analyzed.

For chemical-quality stations equipped with continuous water-quality monitors, the records consist of daily maximum, minimum, and mean values for each constituent measured and are based upon hourly recordings beginning at 0100 hours and ending at 2400 hours for the day of record. More detailed records (hourly values) may be obtained from the U.S. Geological Survey, New Jersey District Office whose address is given on the back of the title page of this report.

Continuous-record water-quality data for periods for which the difference between the sensor's response and a known value did not exceed recalibration criteria were considered to be reliable and were not adjusted. Differences between sensor responses documented during cleaning or verification of sensor calibration that exceeded the criteria listed below (recalibration criteria) indicated the need for sensor recalibration and adjustment of the recorded data for the period between inspections.

Water Temperature	±0.2 °C
Specific Conductance	greater of ±5 uS/cm or 3%
pH	±0.3 units
Dissolved Oxygen	greater of ±0.3 mg/L or 5%
Turbidity	greater of ±2 NTU or 5%

Continuous-record water-quality data for periods for which the differences between the sensor's response and a known value exceeded the criteria listed below (deletion criteria) were considered to be unreliable and were not published.

Water Temperature	±1.5 °C
Specific Conductance	±25 %
pH	±1.5 units
Dissolved Oxygen	greater of ±1.5 mg/L or 25%
Turbidity	±25 %

### Water Temperature

Water temperatures are measured at most of the water-quality stations. In addition, water temperatures are taken at time of discharge measurements for water-discharge stations. Large streams have a small diurnal temperature change; shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. Some streams may be affected by waste-heat discharges.

At stations where recording instruments are used, maximum, minimum and mean temperatures for each

day are published. Water temperatures measured at the time of water-discharge measurements are on file in the New Jersey District Office.

**Sediment**

Suspended-sediment concentrations are determined from samples collected by using depth-integrating samplers. Samples usually are obtained at several verticals in the cross section, or a single sample may be obtained at a fixed point and a coefficient applied to determine the mean concentration in the cross sections.

At other stations, suspended-sediment samples were collected periodically at many verticals in the stream cross section. Although data collected periodically may represent conditions only at the time of observations, such data are useful in establishing seasonal relations between quality and streamflow and in predicting long-term sediment-discharge characteristics of the stream.

In addition to the records of suspended-sediment discharge, records of the periodic measurements of the particle-size distribution of the suspended sediment and bed material are included for some stations.

**Laboratory Measurements**

Samples for biochemical-oxygen demand, fecal coliform, E. coli, enterococcus bacteria, hexavalent chromium, total suspended solids in surface water, kjeldahl nitrogen in bottom material, and total phosphorus in bottom material are analyzed at the New Jersey Department of Health and Senior Services, Public Health and Environmental Laboratories, Environmental and Chemical Laboratory Services. Chlorophyll A samples are analyzed by the New Jersey Department of Environmental Protection, Bureau of Freshwater and Biological Monitoring Laboratory. Samples for nutrients are analyzed at the New Jersey Department of Health or at the U.S. Geological Survey National Water-Quality Laboratory (NWQL) in Denver, Colorado. Sediment samples--parameter codes, 80154, 80157, and 80164--are analyzed in the U.S. Geological Survey Laboratories in Iowa City, Iowa. Replicate samples for the ASMN were analyzed by the U.S. Environmental Protection Agency, Region II, Division of Environmental Science and Assessment. All other samples are analyzed in the U.S. Geological Survey laboratory in Denver, Colorado. Methods used in analyzing sediment samples and computing sediment records are given in TWRI, Book 5, Chap. C1. Methods used by the U.S. Geological Survey laboratory are given in TWRI, Book 1, Chap. D2; Book 3, Chap. C2; Book 5, Chap. A1, A3, A4, and A5. These methods are consistent with ASTM standards and generally follow ISO standards.

**Analyses of pesticides in surface-water and ground-water samples (schedule 2001)**

Selected water samples from ASMN, AGWQN, and NAWQA study sites were analyzed for pesticides by use of NWQL schedule 2001. This table lists the

pesticides on the schedule, the unit of measure (micrograms per liter, ug/L), the U.S. Geological Survey National Water Information System parameter code, and the reporting level. **Only pesticides measured at or above the minimum reporting level for one or more samples are listed in the water-quality tables.**

SCHEDULE DESCRIPTION.--Pesticides in filtered water extracted on C-18 Solid Phase Extraction (SPE) cartridge and analyzed by Gas Chromatography/Mass Spectrometry (GC/MS).

SAMPLE REQUIREMENTS.--1 liter of water filtered through 0.7-micron glass-fiber depth filter, chilled at 4°C (packed in ice).

CONTAINER REQUIREMENTS.--1 liter baked amber glass bottle (GCC) from NWQL.

PCODE.--The USGS/EPA parameter code.

COMMON NAME.--Common or trade name(s) for constituent

LRL.--Laboratory reporting level

PCode	Common Name	LRL (ug/L)
82660	2,6-Diethylaniline	0.006
49260	Acetochlor	0.006
46342	Alachlor	0.0045
34253	alpha-HCH	0.0046
39632	Atrazine	0.007
82686	Azinphos-methyl	0.05
82673	Benfluralin	0.010
04028	Butylate	0.002
82680	Carbaryl	0.041
82674	Carbofuran	0.020
38933	Chlorpyrifos	0.005
82687	cis-Permethrin	0.006
04041	Cyanazine	0.018
82682	Dacthal	0.0030
04040	Deethylatrazine	0.006
39572	Diazinon	0.005
39381	Dieldrin	0.0048
82677	Disulfoton	0.021
82668	EPTC	0.0020
82663	Ethalfuralin	0.009
82672	Ethoprophos	0.005
04095	Fonofos	0.0027
39341	Lindane	0.0040
82666	Linuron	0.035
39532	Malathion	0.027
39415	Metolachlor	0.013
82630	Metribuzin	0.006
82671	Molinate	0.0016
82684	Napropamide	0.007
34653	p,p'-DDE	0.0025
39542	Parathion	0.010

PCode	Common Name	LRL (ug/L)
82667	Parathion-methyl	0.006
82669	Pebulate	0.0041
82683	Pendimethalin	0.022
82664	Phorate	0.011
04037	Prometon	0.015
04024	Propachlor	0.010
82679	Propanil	0.011
82685	Propargite	0.023
82676	Propyzamide	0.0041
04035	Simazine	0.005
82670	Tebuthiuron	0.016
82665	Terbacil	0.034
82675	Terbufos	0.017
82681	Thiobencarb	0.0048
82678	Tri-allate	0.0023
82661	Trifluralin	0.009

### **Analyses of volatile organic compounds in surface-water and ground-water samples (schedule 2020/2021)**

Selected samples from NAWQA study sites were analyzed for volatile organic compounds (VOCs) by use of NWQL schedules 2020/2021. The NWQL created this schedule to provide a method for accurate determination of VOCs in water in the nanogram per liter range. The method described in USGS Open-File Report 97-829 (Connor and others) is similar to USEPA method 524-2 (Mund, 1995) and the method described by Rose and Schroeder (1995). Minor improvements to instrument operating conditions include the following: additional compounds, quantitation ions that are different from those recommended in USEPA Method 524.2 because of interferences from the additional compounds, and a data reporting strategy for measuring detected compounds extrapolated at less than the lowest calibration standard or measured at less than the reporting limit. The laboratory reporting limit (LRL) is introduced as a statistically defined reporting limit designed to limit false positives and false negatives to less than 1 percent.

This table lists the volatile organic compounds on the schedule, the unit of measure (micrograms per liter (ug/L), the U.S. Geological Survey National Water Information System parameter code, the Union of Pure and Applied Chemistry (IUPAC) compound name, and the National Water Quality Laboratory compound name. Positive detections measured at less than LRL but greater than or equal to the long-term method-detection limit are reported as estimated concentrations (E) to alert the data user to decreased confidence in accurate quantitation. Values for analytes in the 2020/2021 schedules are preceded by an "E" in the following situations:

1. When the calculated concentration is less than the lowest calibration standard. The analyte meets all identification criteria to be positively

identified, but the amount detected is below where it can be reliably quantified.

2. If a sample is diluted for any reason. The method reporting level is multiplied by the dilution factor to obtain the adjusted method reporting level. Values below the lowest calibration standard, multiplied by the dilution factor are qualified with an "E". For example, a value of 0.19 in a 1:2 dilution is reported as E0.1.
3. If the set spike has recoveries out of the specified range (60-140%).
4. If the analyte is also detected in the set blank. If the value in the sample is less than five times the blank value and greater than the blank value plus the long term method detection limit, the value is preceded by an "E" to indicate that the analyte is positively identified but not positively quantified because the analyte was also detected in the blank.

### **Only VOCs measured at or above the minimum reporting level for one or more samples are listed in the water-quality tables.**

**SCHEDULE DESCRIPTION.**--The sample water is actively purged with helium to extract the volatile organic compounds. The volatile compounds are trapped onto a sorbent trap, thermally desorbed, separated by a megabore gas chromatographic capillary column, and finally determined by a full scan quadrupole mass spectrometer. Compound identification is confirmed by the gas chromatographic retention time and by the resultant mass spectrum, typically identified by three unique ions.

**SAMPLE REQUIREMENTS.**--Water collected in vials placed in stainless steel VOC sampler. Hydrochloric acid is used for preservation. Chilled at 4°C (packed in ice).

**CONTAINER REQUIREMENTS.**--40 milliliter baked amber septum glass vial, from OCALA Quality Water Service Unit.

**PCODE.**--The EPA/USGS parameter code

**COMPOUND NAME.**--IUPAC nomenclature.

**LRL.**--Laboratory reporting level.

PCode	Compound Name	LRL (ug/L)
77041	Carbon disulfide	0.075
34506	1,1,1-Trichloroethane	0.032
34516	1,1,2,2-Tetrachloroethane	0.09
34511	1,1,2-Trichloroethane	0.064
34496	1,1-Dichloroethane	0.035



PCode	Compound Name
49406	2, 6-Dimethylnaphthalene
49948	2-Ethyl-naphthalene
49399	9h-Fluorene
49466	Fluoranthene
49400	Isophorone
49435	2-methylantracene
49398	1-Methyl-9h-fluorene
49390	1-Methylindeno(1,2,3-c,d)pyrene
49410	1-Methylphenanthrene
49388	1-Methylpyrene
49402	Naphthalene
49409	Phenanthrene
49393	Phenanthridine
49387	Pyrene
49405	2, 3, 6-Trimethylnaphthalene

### **Methylene blue active substances**

MBAS determinations made from January 1, 1970 through August 29, 1993, at the National Water Quality Laboratory in Denver (Analyzing Agency Code 80020) are positively biased. These data can be corrected by using the following equation, if concentrations of dissolved nitrate plus nitrite, as nitrogen, and dissolved chloride, determined concurrently with the MBAS data, are applied:

$$\text{MBASCOR} = \text{M} - 0.0088\text{N} - 0.00019\text{C}$$

where:

MBASCOR = corrected MBAS concentration, in mg/L;  
M = reported MBAS concentration, in mg/L;  
N = dissolved nitrate plus nitrite, as nitrogen, concentration, in mg/L; and  
C = dissolved chloride concentration, in mg/L.

The detection limit of the new method is 0.02 mg/L, whereas the detection limit for the old method was 0.01 mg/L. A detection limit of 0.02 mg/L should be used with corrected MBAS data from January 1, 1970 through August 29, 1993.

### **Analysis of acid neutralizing capacity (ANC)**

Prior to October 1, 1996, ANC was called ALKALINITY, LAB.

### **Analysis of inorganic carbon in bottom material**

Prior to October 1996, the analysis of total inorganic carbon in bottom material by the National Water Quality Laboratory (NWQL) was subject to a systematic positive bias of 3 percent. That is, results calculated before this date were found to be about 3 percent higher than results calculated correctly with a new computer system. The average agreement between analysis results for duplicate samples (a measure of the NWQL's precision for this analysis) is 98 percent. The 3-percent bias, therefore, approximates the preci-

sion of the analytical method. The overall effect on historical data from New Jersey is minor. Ninety-three percent of the reported concentrations for this analysis were less than 1.7 grams per kilogram; values of this magnitude are unaffected because the difference is obscured by rounding prior to publication of the analysis results. The magnitude of the error is such that the 3 percent difference, effective October 1, 1996, is indiscernible in the relatively small data set for any station.

### **Data Presentation**

Precision varies for different analytical methods used to determine the same constituent. The presence of trailing zeros after the decimal in values printed in this report does not necessarily indicate that the method used for the determination is as precise as the level implied by the rightmost zero.

The column headings for water-quality constituents include 5-digit EPA Storet parameter codes. The codes are included to permit accurate cross reference to data from other data bases using the same code system.

For continuing-record stations, information pertinent to the history of station operation is provided in descriptive headings preceding the tabular data. These descriptive headings give details regarding location, drainage area, period of record, type of data available, instrumentation, general remarks, cooperation, and extremes for parameters currently measured daily. Tables of chemical, physical, biological, radiochemical data, obtained at a frequency less than daily are presented first. Tables of "daily values" of specific conductance, pH, water temperature, and dissolved oxygen, then follow in sequence.

### **Station manuscript**

The following information, as appropriate, is provided with each continuous-record station. Comments that follow clarify information presented under the various headings of the station description.

**LOCATION.**--Information on locations is obtained from the most accurate maps available. The location of the station with respect to the cultural and physical features in the vicinity and with respect to the reference place.

**DRAINAGE AREA.**--Drainage areas are measured using the most accurate maps available. Because the type of maps available varies from one drainage basin to another, the accuracy of drainage areas likewise varies. Drainage areas are updated as better maps become available.

**PERIOD OF RECORD.**--This indicates the periods for which there are published water-quality records for the station. The periods are shown separately for records of parameters measured daily or continuously and those measured less than daily. For those measured daily or continuously, periods of record are given for the parameters individually.

**INSTRUMENTATION.**--Information on instrumentation is given only if a water-quality monitor, temperature recorder, sediment pumping sampler, or other sampling device is in operation at a station.

**REMARKS.**--Remarks provide added information pertinent to the collection, analysis, or computation of the records.

**COOPERATION.**--Records provided by a cooperating organization or obtained for the U.S. Geological Survey by a cooperating organization are identified here.

**EXTREMES.**--Maximums and minimums are given only for parameters measured daily or more frequently. None are given for parameters measured weekly or less frequently, because the true maximums or minimums may not have been sampled. Extremes, when given, are provided for both the period of record and for the current water year.

**REVISIONS.**--If errors in published water-quality records are discovered after publication, appropriate updates are made in the U.S. Geological Survey's distributed data system, NWIS, and subsequently to its web-based National data system, NWISWeb [<http://water.usgs.gov/nwis/nwis>]. Because the usual volume of updates makes it impractical to document individual changes in the State data-report series or elsewhere, potential users of U.S. Geological Survey water-quality data are encouraged to obtain all required data from NWIS or NWISWeb to ensure the most recent updates. Updates to NWISWeb are currently made on an annual basis.

The surface-water-quality records for partial-record stations and miscellaneous sampling sites which are not at a surface-water daily record station are published in separate tables following the continuous record data. No descriptive statements are given for these records. Each station is published with its own station number and name in the regular downstream-order sequence.

**Remark codes**

The following remark codes may appear with the water-quality data in this section:

**PRINTED**

**OUTPUT    REMARK**

- E            Value is estimated.
- >            Actual value is known to be greater than the value shown.
- <            Actual value is known to be less than the value shown.

- M            Presence of material verified, but not quantified.
- N            Presumptive evidence of presence of material.
- U            Material specifically analyzed for, but not detected.
- A            Value is an average.
- V            Analyte was detected in both the environmental sample and the associated blanks.
- S            Most probable value.

**Quality-control data**

Data generated from quality-control (QC) samples are a requisite for evaluating the quality of the sampling and processing techniques as well as data from the actual samples themselves. Without QC data, environmental sample data cannot be adequately interpreted because the errors associated with the sample data are unknown. The various types of QC samples collected by this District are described in the following section. Procedures have been established for the storage of water-quality-control data within the USGS. These procedures allow for storage of all derived QC data and are identified so that they can be related to corresponding environmental samples.

**BLANK SAMPLES.**--Blank samples are collected and analyzed to ensure that environmental samples have not been contaminated by the overall data-collection process. The blank solution used to develop specific types of blank samples is a solution that is free of the analytes of interest. Any measured value signal in a blank sample for an analyte (a specific component measured in a chemical analysis) that was absent in the blank solution is believed to be due to contamination. There are many types of blank samples possible, each designed to segregate a different part of the overall data-collection process. The types of blank samples collected in this District are:

Source solution blank - a blank solution that is transferred to a sample bottle in an area of the office laboratory with an atmosphere that is relatively clean and protected with respect to target analytes.

Ambient blank - a blank solution that is put in the same type of bottle used for an environmental sample, kept with the set of sample bottles before sample collection, and opened at the site and exposed to the ambient conditions.

Field blank - a blank solution that is subjected to all aspects of sample collection, field processing preservation, transportation, and

laboratory handling as an environmental sample.

Trip blank - a blank solution that is put in the same type of bottle used for an environmental sample and kept with the set of sample bottles before and after sample collection.

Equipment blank - a blank solution that is processed through all equipment used for collecting and processing an environmental sample (similar to a field blank but normally done in the more controlled conditions of the office).

Sampler blank - a blank solution that is poured or pumped through the same field sampler used for collecting an environmental sample.

Pump blank - a blank solution that is processed through the same pump-and-tubing system used for an environmental sample.

Standpipe blank - a blank solution that is poured from the containment vessel (standpipe) before the pump is inserted to obtain the pump blank.

Filter blank - a blank solution that is filtered in the same manner and through the same filter apparatus used for an environmental sample.

Splitter blank - a blank solution that is mixed and separated using a field splitter in the same manner and through the same apparatus used for an environmental sample.

Preservation blank - a blank solution that is treated with the sampler preservatives used for an environmental sample.

Cannister blank - a blank solution that is taken directly from a stainless steel containment vessel just before the VOC sampler is submerged to obtain a field blank sample.

**REFERENCE SAMPLES.**--Reference material is a solution or material prepared by a laboratory whose composition is certified for one or more properties so that it can be used to assess a measurement method. Samples of reference material are submitted for analysis to ensure that an analytical method is accurate for the known properties of the reference material. Generally, the selected reference material properties are similar to the environmental sample properties.

**REPLICATE SAMPLES.**--Replicate samples are a set of environmental samples collected in a manner such that the samples are thought to be essentially identical in composition. Replicate is the general case

for which a duplicate is the special case consisting of two samples. Replicate samples are collected and analyzed to establish the amount of variability in the data contributed by some part of the collection and analytical process. There are many types of replicate samples possible, each of which may yield slightly different results in a dynamic hydrologic setting, such as a flowing stream. The types of replicate samples collected in this District are:

Concurrent sample - a type of replicate sample in which the samples are collected simultaneously with two or more samplers or by using one sampler and alternating collection of samples into two or more compositing containers.

Sequential sample - a type of replicate sample in which the samples are collected one after the other, typically over a short time.

Split sample - a type of replicate sample in which a sample is split into subsamples contemporaneous in time and space.

**SPIKE SAMPLES.**--Spike samples are samples to which known quantities of a solution with one or more well-established analyte concentrations have been added. These samples are analyzed to determine the extent of matrix interference or degradation on the analyte concentration during sample processing and analysis.

Concurrent sample - a type of spike sample that is collected at the same time with the same sampling and compositing devices then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

Split sample - a type of spike sample in which a sample is split into subsamples contemporaneous in time and space then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

### **Dissolved Trace-Element Concentrations**

Note.--Traditionally, dissolved trace-element concentrations have been reported at the microgram per liter ( $\mu\text{g/L}$ ) level. Recent evidence, mostly from large rivers, indicates that actual dissolved-phase concentrations for a number of trace elements are within the range of 10's and 100's of nanograms per liter ( $\text{ng/L}$ ). Data above the  $\text{mg/L}$  level should be viewed with caution. Such data may actually represent elevated environmental concentrations from natural or human causes; however, these data could reflect contamination introduced during sampling, processing, or analysis. To confidently produce dissolved trace-element data with insignificant