

## INTRODUCTION

The United States 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 data is also available on the world wide web at <http://nj.usgs.gov/>.

This report series includes records of stage, discharge, and water quality in streams; stage and contents, and water quality in lakes and reservoirs; and water levels and water quality in ground-water wells. This volume contains records of water discharge at 103 gaging stations, tide summaries at 28 tidal gaging stations, stage and contents at 34 lakes and reservoirs, and diversions from 50 surface-water sources. Also included are stage and discharge for 116 crest-stage partial-record stations and stage-only at 33 tidal crest-stage gages, and discharge for 155 low-flow partial-record stations. Locations of these sites are shown in figures 8-11. Additional discharge measurements were made at 222 miscellaneous sites that are not part of the systematic data-collection program. In previous years, gaging stations, reservoirs, and diversions located in New York were also published in this volume. The data for these stations is available on the world wide web at <http://ny.usgs.gov/>. 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. Beginning in 1975, surface-water, water-quality, and ground-water data were combined in one volume. 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. Beginning with the 1998 water year, the format has changed to include surface-water discharge records in Volume 1, ground-water level records in Volume 2, and surface-water and ground-water quality records in Volume 3.

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-02-1." 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, compact disc, microfiche, or electronic format from the U.S. Department of Commerce, National Technical Information Service, Springfield, VA 22161, (703) 605-6100, <http://www.ntis.gov/>.

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

The U.S. Geological Survey New Jersey Water Science Center, maintains a World Wide Web site which has water-resource related information for New Jersey and information on New Jersey Water Science Center activities. Links to other USGS and Federal web sites are also available. We invite you to visit us at: <http://nj.usgs.gov/>.

## 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--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, Lisa P. Jackson, (Acting) Commissioner

New Jersey Department of Transportation, Kris Kolluri, (Acting) Commissioner

New Jersey Water Supply Authority, Henry Patterson, III, Executive Director

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

Lake Hopatcong Commission, Arthur R. Ondish, Chairman

North Jersey District Water Supply Commission, Michael E. Restaino, Executive Director

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

Pinelands Commission, John C. Stokes, Executive Director

County of Bergen, Paul Juliano, Director of Public Works

County of Essex, Sanjeev Varghese, County Engineer

County of Hunterdon, George B. Melick, Freeholder Director

County of Gloucester, Charles E. Romick, Director of Planning

County of Mercer, Phillip S. Miller, Executive Director, Mercer County Improvement Authority

County of Morris, Glen Schweizer, Executive Director, Morris County Municipal Utilities Authority

County of Somerset, Michael J. Amorosa, Director of Public Works

County of Union, Frank E. Dann, Jr., Director of Department of Engineering and Public Works

City of New Brunswick, Shawn Maloney, Director, Water Utility Department

City of Perth Amboy, Joseph Vas, Mayor

Brick Township Municipal Utilities Authority, Kevin F. Donald, Executive Director

Princeton Sewer Operating Committee, Donald W. Mayer-Brown, Manager

Funding assistance was provided by the U.S. Army Corps of Engineers, for the collection of records at 4 surface-water stations, by the Fort Dix Directorate of Public Works for collection of records at 1 surface-water station, and by the U.S. Army Armament Research and Development Center for the collection of records at 3 surface-water stations. In addition, several stations were operated fully or partially with funds appropriated directly to the USGS. Funding also was supplied by the following Federal Energy Regulatory Commission licensees: GPU Generation Corporation, Passaic Valley Water Commission, and Great Falls Hydroelectric Company. Assistance was provided by the National Weather Service and the National Ocean Service.

The following organizations aided in collecting records:

New Jersey Department of Environmental Protection; Municipalities of Jersey City, Newark, New Brunswick, and Spotswood; Elizabethtown Water Company; Ewing-Lawrence Sewerage Authority; United Water New Jersey; New Jersey-American Water Company; Rockaway Valley Regional Sewerage Authority; and GPU Generation Corporation.

Organizations that supplied data are acknowledged in station descriptions.

## SUMMARY OF HYDROLOGIC CONDITIONS

### Streamflow

Three gaging stations, located in north, south, and central New Jersey, on the South Branch Raritan River, Great Egg Harbor River, and the Delaware River, respectively, are considered index stations for statewide streamflow conditions. Monthly mean discharges at the three index gages were above or close to average from October through April and then generally below average from May through September, during water year 2005 (fig. 1). Annual mean discharge at each of these index gaging stations was above the annual mean for the period of record for the third consecutive year (fig. 2).

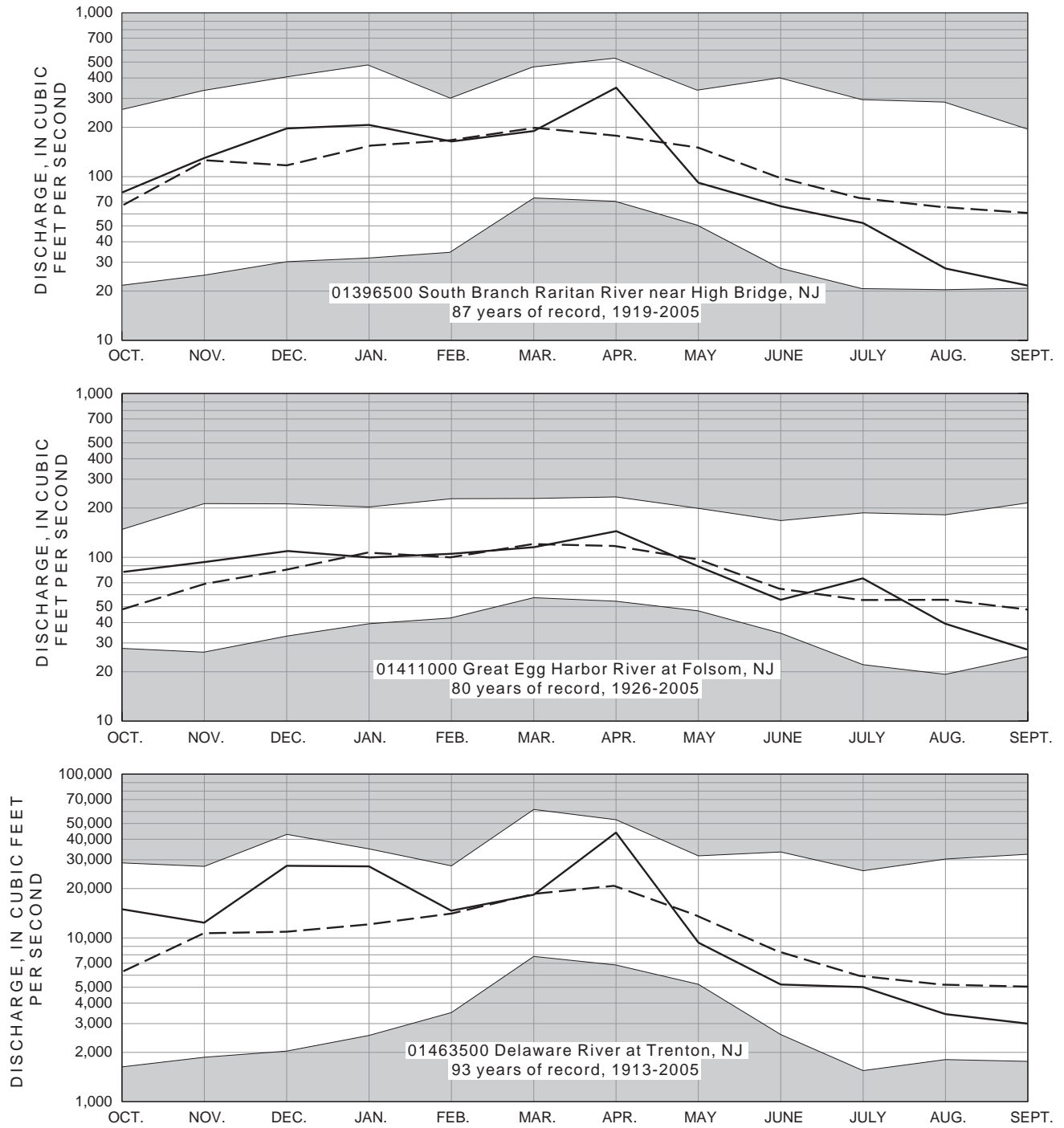
Streamflow at the index station in northern New Jersey (South Branch Raritan River near High Bridge) averaged 131 ft<sup>3</sup>/s for the water year, which is 107 percent of the 1919-2005 average. Peak flow for the water year was 3,920 ft<sup>3</sup>/s on April 3; the recurrence interval is greater than 10 years. The lowest daily mean flow was 18 ft<sup>3</sup>/s, recorded September 11-13, and 23-25, which is lower than the 99-percent flow duration.

Streamflow at the index station in southern New Jersey (Great Egg Harbor River at Folsom) averaged 85.9 ft<sup>3</sup>/s, which is 101 percent of the 1926-2005 average. Peak flow for the water year was 346 ft<sup>3</sup>/s on April 5; the recurrence interval is from 2 to 5 years. The lowest daily mean flow was 24 ft<sup>3</sup>/s, recorded on September 24-30, which is less than the 98-percent flow duration.

The observed annual mean discharge for the Delaware River at Trenton was 15,470 ft<sup>3</sup>/s, which is 131 percent of the 1913-2005 average. Peak flow for the water year was 242,000 ft<sup>3</sup>/s on April 4; the recurrence interval is greater than 100 years. The lowest daily mean flow was 2,520 ft<sup>3</sup>/s, recorded on September 20, which is about the 95-percent flow exceedance. The Delaware River is substantially regulated by reservoirs and diversions.

Eleven floods and flash floods occurred during the 2005 water year due to heavy rainfall, as documented by the National Oceanic and Atmospheric Administration's National Weather Service (<http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>). Table 1 lists the dates of the events and the affected counties. The most widespread event this year occurred at the end of March through the beginning of April. Many surface water gages throughout the state had peak-of-year discharges during this period.

The greatest flood since 1955 occurred on the main stem of the Delaware River on April 2-3, 2005 due to the spring rain event. A rainstorm that passed through the region on March 28-29, 2004, saturated soils and caused rivers to rise. A second rainstorm occurred the following week on April 2-3, 2004, for a total of 3 to 6 inches of rain in a



**EXPLANATION**

UNSHADED AREA--Indicates range between highest and lowest mean discharge recorded for the month, prior to 2005 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 2005 water year

**Figure 1.** Monthly mean discharge at index gaging stations.

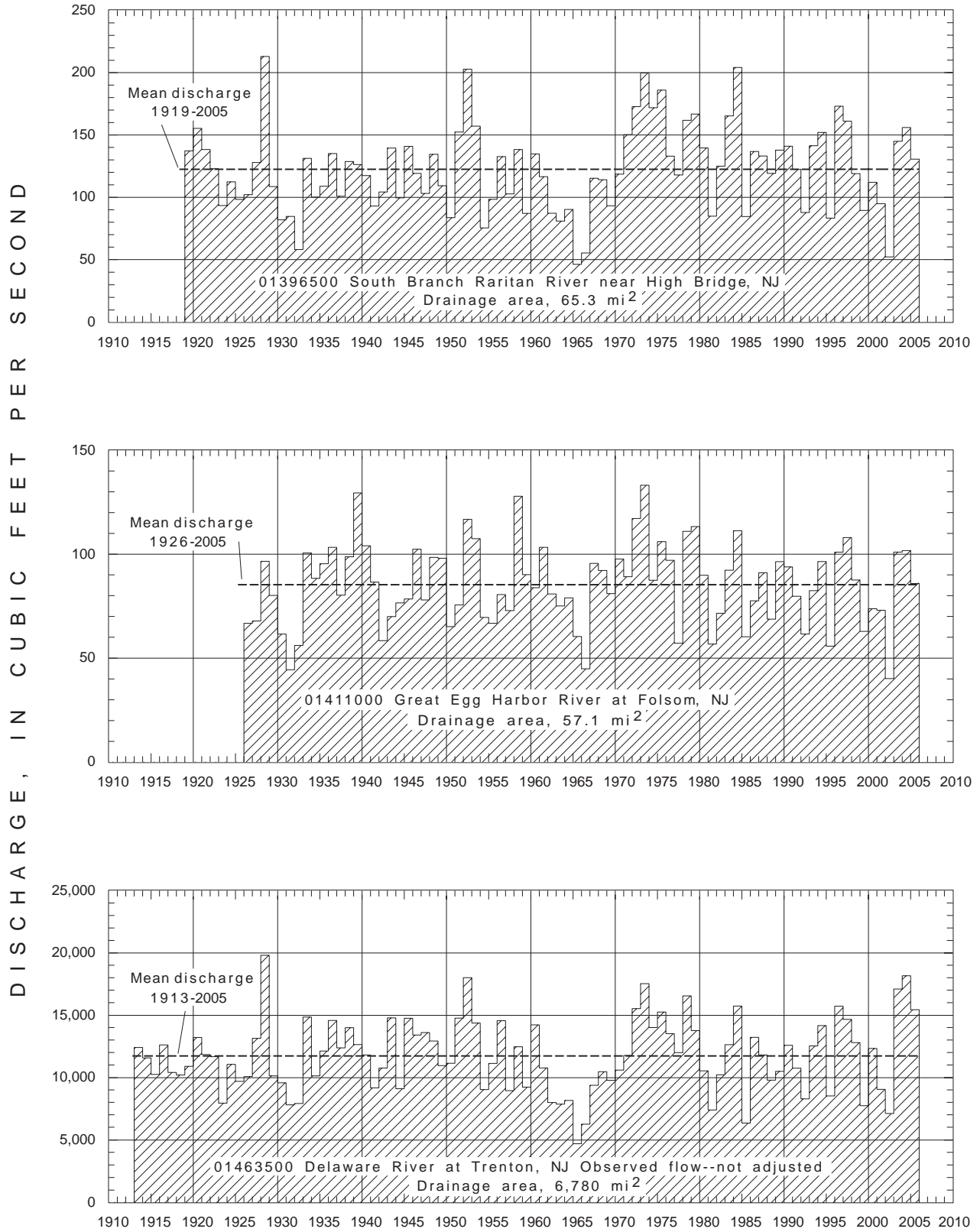


Figure 2. Annual mean discharge at index gaging stations.

seven-day period. In addition to the rainfall, a substantial snowpack with a water equivalency of up to 6 inches was present throughout the Catskill and Pocono Mountains from eleven winter storms that occurred January through March. The snow melted from the warmer temperatures and heavy rains, and exacerbated the record flows. Peak discharges were the third highest for the period of record, and had recurrence intervals greater than 100 years. Flooding on the main stem of the Delaware River had occurred just seven months earlier, on September 19, 2004. Peak discharges from the September event had recurrence intervals ranging from 40 to 70 years.

**Table 1.** Floods and flash floods in New Jersey in water year 2005, by date and county.

Date	Location by County
11/28/2004	Bergen, Somerset
12/01/2004	Hunterdon, Somerset
01/14/2005	Sussex, Mercer, Somerset
02/15/2005	Hunterdon, Somerset
03/28/2005	Bergen, Camden, Essex, Mercer, Morris, Passaic, Somerset, Union
04/02/2005	Bergen, Burlington, Camden, Essex, Gloucester, Hudson, Hunterdon, Mercer, Morris, Passaic, Salem, Somerset, Sussex, Union, Warren
07/06/2005	Bergen, Passaic
07/18/2005	Bergen, Middlesex, Ocean
08/08/2005	Burlington, Camden
08/14/2005	Bergen, Sussex
09/14/2005	Essex, Middlesex, Morris, Somerset, Union

For the remainder of the water year, a general decreasing trend in streamflow was evident throughout the state. The months of June through September were all in the top 10 for warmth, and August and September were ranked as the 3rd and 5th driest, respectively. The State of New Jersey issued a drought watch on September 13, 2005. A drought watch indicates that the NJDEP is closely monitoring drought indicators including precipitation, streamflow, reservoir contents, groundwater levels, and water demands. Under a drought watch, the public was asked to voluntarily cut back on water use.

Annual mean discharges for water year 2005 at 45 selected gaging stations that had 40 years or more of continuous record and mean annual discharge for the period of record at each gaging station are shown in table 2. The differences are listed as percent difference, and ranged from -24.6 to 79.1 percent. The majority of the sites had discharges near or above the period of record mean. For 16 of the 46 sites, the difference between the current and the period of record annual means was within  $\pm 5$  percent. Of the remaining 29 sites, 21 had discharges greater than the period of record mean. During both the 2004 and 2003 water years, discharges at 45 of 46 gages were above the historical mean. In contrast, during the 2002 and 2001 water years, 46 and 40 gages out of 46, respectively, had discharges below the historical mean. Several gaging stations that monitor heavily regulated rivers were not included in this comparison because of large artificial deficits related to regulation. The criterion of assessing gaging stations with 40 years or more of record was used in order to encompass at least one of the approximately 30-year drought cycles that New Jersey has experienced.

## Reservoir Contents

The combined usable contents of 13 major water-supply reservoirs in New Jersey ranged from 48.1 to 99.3 percent of the 80.4 billion gallon capacity for the entire water year. The combined contents at the end of each month exceeded the 1961-1990 monthly averages from October to May then dropped steadily from June until September. Precipitation was considerably above normal in the months prior to the 2005 water year, and approximately normal for the first half of the water year in northern New Jersey, which maintained the higher reservoir levels. The second half of the water year had below normal precipitation, with corresponding lower reservoir contents. Combined usable contents of the 13 major water-supply reservoirs was 76.7 billion gallons at the end of September 2004, which is 145 percent of the 30-year mean (normal) contents for September, and 95.4 percent of capacity. Combined usable

**Table 2.** Annual mean discharges for water year 2005 and mean annual discharge for the period of record at selected continuous gaging stations with 40 years or more of records  
[ft<sup>3</sup>/s, cubic feet per second; mi<sup>2</sup>, square miles]

Station number	Station name	Drainage area (mi <sup>2</sup> )	Number of years of record	Annual mean discharge for 2005 water year (ft <sup>3</sup> /s)	Mean annual discharge for period of record (ft <sup>3</sup> /s)	Percent difference
01377000	Hackensack River at Rivervale, NJ	58.0	64	101	87.0	16.1
01377500	Pascack Brook at Westwood, NJ	29.6	71	50.3	54.0	-6.9
01379000	Passaic River near Millington, NJ	55.4	84	84.2	90.9	-7.4
01379500	Passaic River near Chatham, NJ	100	77	160	172	-7.0
01380500	Rockaway River above reservoir, at Boonton, NJ	116	68	244	230	6.1
01381500	Whippany River at Morristown, NJ	29.4	84	53.9	54.5	-1.1
01382500	Pequannock River at Macopin Intake Dam, NJ	63.7	82	85.6	47.8	79.1
01383500	Wanaque River at Awosting, NJ	27.1	86	61.4	54.4	12.9
01384500	Ringwood Creek near Wanaque, NJ	19.1	64	38.4	33.4	15.0
01387500	Ramapo River near Mahwah, NJ	120	86	237	229	3.5
01388000	Ramapo River at Pompton Lakes, NJ	160	84	319	287	11.1
01388500	Pompton River at Pompton Plains, NJ	355	66	652	494	32.0
01389500	Passaic River at Little Falls, NJ	762	107	1,211	1,136	6.6
01390500	Saddle River at Ridgewood, NJ	21.6	48	31.6	33.8	-6.5
01391500	Saddle River at Lodi, NJ	54.6	83	107	100	7.0
01393450	Elizabeth River at Ursino Lake, at Elizabeth, NJ	16.9	84	20.6	25.9	-20.5
01394500	Rahway River near Springfield, NJ	25.5	68	31.0	30.7	1.0
01395000	Rahway River at Rahway, NJ	40.9	83	48.0	49.4	-2.8
01396500	South Branch Raritan River near High Bridge, NJ	65.3	87	131	123	6.5
01397000	South Branch Raritan River at Stanton, NJ	147	89	295	248	19.0
01398000	Neshanic River at Reaville, NJ	25.7	75	37.1	38.0	-2.4
01398500	North Branch Raritan River near Far Hills, NJ	26.2	82	48.7	48.0	1.5
01399500	Lamington (Black) River near Pottersville, NJ	32.8	84	55.7	55.6	0.2
01400000	North Branch Raritan River near Raritan, NJ	190	82	329	311	5.8
01400500	Raritan River at Manville, NJ	490	88	873	779	12.1
01401000	Stony Brook at Princeton, NJ	44.5	52	66.3	67.0	-1.0
01402000	Millstone River at Blackwells Mills, NJ	258	84	405	384	5.5
01403060	Raritan River below Calco Dam, at Bound Brook, NJ	785	67	1,184	1,195	-0.9
01405400	Manalapan Brook at Spotswood, NJ	40.7	48	70.8	61.8	14.6
01408000	Manasquan River at Squankum, NJ	44.0	74	67.7	73.4	-7.8
01408500	Toms River near Toms River, NJ	123	77	207	210	-1.4
01409400	Mullica River near Batsto, NJ	46.7	48	106	105	1.0
01409500	Batsto River at Batsto, NJ	67.8	77	114	120	-5.0
01410000	Oswego River at Harrisville, NJ	72.5	75	64.4	85.4	-24.6
01411000	Great Egg Harbor River at Folsom, NJ	57.1	80	85.9	85.3	0.7
01411500	Maurice River at Norma, NJ	112	73	162	163	-0.6
01440000	Flat Brook near Flatbrookville, NJ	64.0	82	128	111	15.3
01443500	Paulins Kill at Blairstown, NJ	126	83	247	199	24.1
01445500	Pequest River at Pequest, NJ	106	84	202	158	27.8
01457000	Musconetcong River near Bloomsbury, NJ	141	88	286	240	19.2
01463500	Delaware River at Trenton, NJ	6,780	93	15,470	11,770	31.4
01464000	Assunpink Creek at Trenton, NJ	90.6	82	136	134	1.5
01464500	Crosswicks Creek at Extonville, NJ	81.5	64	126	134	-6.0
01466500	McDonalds Branch in Byrne State Forest, NJ	2.35	51	2.16	2.13	1.4
01467000	North Branch Rancocas Creek at Pemberton, NJ	118	84	191	170	12.4

contents climbed steadily from September 2004 to a maximum for the water year of 79.5 billion gallons by the end of March 2005; this is 114 percent of normal contents for the end of March and 99.3 percent of capacity. Reservoir levels remained high for April, then declined steadily during the summer because of a combination of below normal precipitation, evaporation, and increased demand for water supplies. By September 30, 2005, combined usable contents totaled 38.7 billion gallons, which is 73.3 percent of the 30-year mean (normal) contents for the end of September and 48.1 percent of capacity (fig. 3). The term "usable contents" is used here as a measure of the total volume of water that can be removed from a reservoir without pumping and does not account for the volume of water below the bottom of the lowest outlet pipe (sometimes referred to as dead storage).

## Precipitation and Temperature

Monthly spatially weighted average-precipitation values using data from several dozen stations throughout New Jersey, along with the statewide long-term monthly means (1895-2005), can be accessed at [http://climate.rutgers.edu/stateclim\\_v1/data/njhistprecip.html](http://climate.rutgers.edu/stateclim_v1/data/njhistprecip.html). For water year 2005, the spatially weighted values for 7 of 12 months were above the long-term mean (November through January, March, April, June and July were above their respective means, as shown in Figure 4). Water year 2005 is the 25th driest for the period of record. The statewide spatially weighted average-precipitation total was 39.38 inches, which is 5.36 inches less than the long-term mean-annual precipitation from 1895 to 2005. The average annual precipitation for New Jersey is approximately 45 inches. Rankings of monthly precipitation in New Jersey for water year 2005 as compared to water years 1896-2005 are listed in table 3.

**Table 3.** Ranking of monthly precipitation values in New Jersey for water 2005 in relation to the period of record, water years 1896-2005.

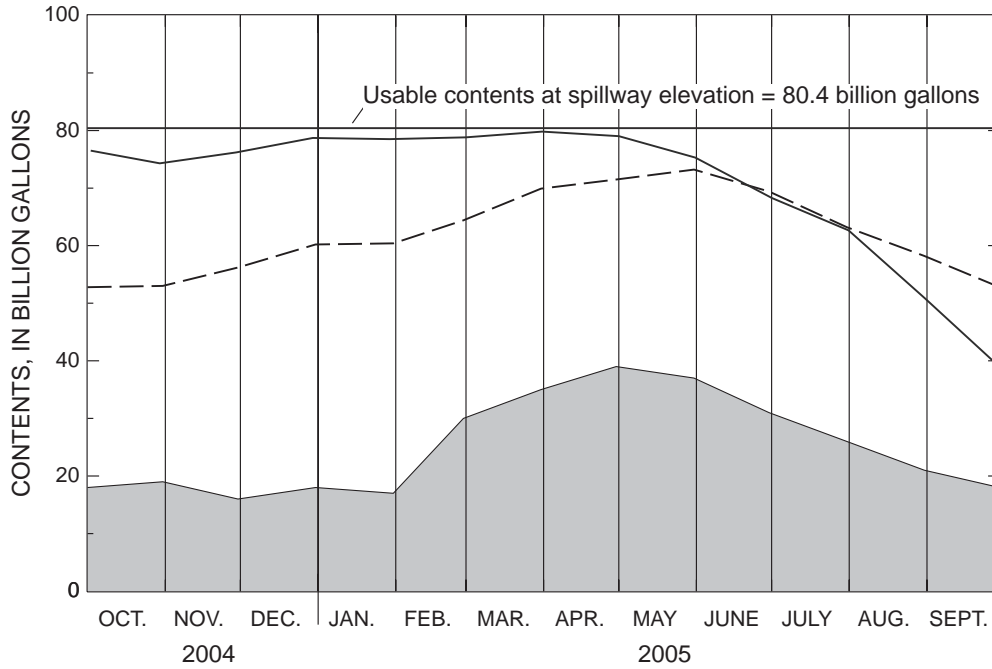
Monthly precipitation are spatially weighted averages from many stations throughout the State.

Month of water year	Total Precipitation, in inches	Ranking
Oct. 2004	2.35	35th driest
Nov. 2004	4.74	26th wettest
Dec. 2004	3.32	55th wettest
Jan. 2005	4.30	27th wettest
Feb. 2005	2.50	38th driest
Mar. 2005	4.37	41st wettest
Apr. 2005	4.10	35th wettest
May 2005	2.75	39th driest
June 2005	3.66	54th wettest
July 2005	4.57	51st wettest
Aug. 2005	1.41	3rd driest
Sept. 2005	1.31	5th driest

Three National Weather Service (NWS) precipitation stations in Newark, Trenton, and Atlantic City have been selected as index sites for precipitation. Water year 2005 precipitation totals were below normal at the Newark and Atlantic City index sites and slightly above normal at the Trenton index site. The Newark station recorded 32.21 inches, which is 14.04 inches below normal or 69.6 percent of the 30-year reference-period (1971-2000) mean. The Atlantic City station recorded 38.21 inches, which is 2.99 inches below normal or 94.1 percent of the 30-year mean. The Trenton station recorded 42.91 inches, which is 1.52 inches above normal or 104 percent of the 30-year mean. Monthly precipitation at the three NWS stations, along with the 30-year mean, is shown in figure 5.

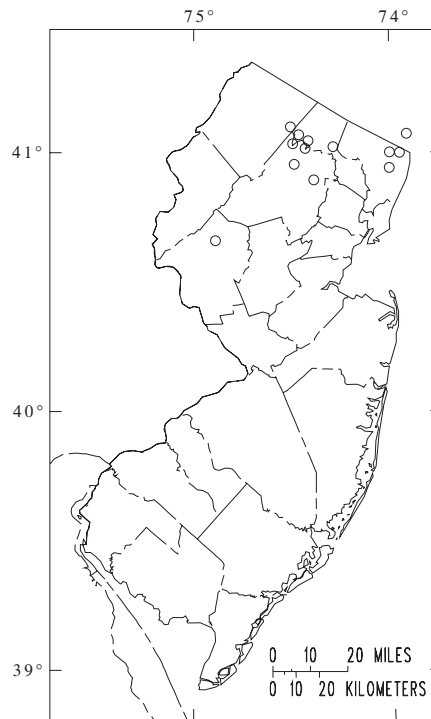
Eight of the 12 monthly mean temperatures in the 2005 water year (determined from spatially weighted average temperatures recorded throughout New Jersey) were above the long-term mean monthly average (1895- 2005) (fig. 6). The October monthly mean was 0.4 degrees Celsius below the long-term average temperature. Monthly mean temperatures were 1.4 and 1.0 degrees Celsius above average for November and December. January averaged 0.1





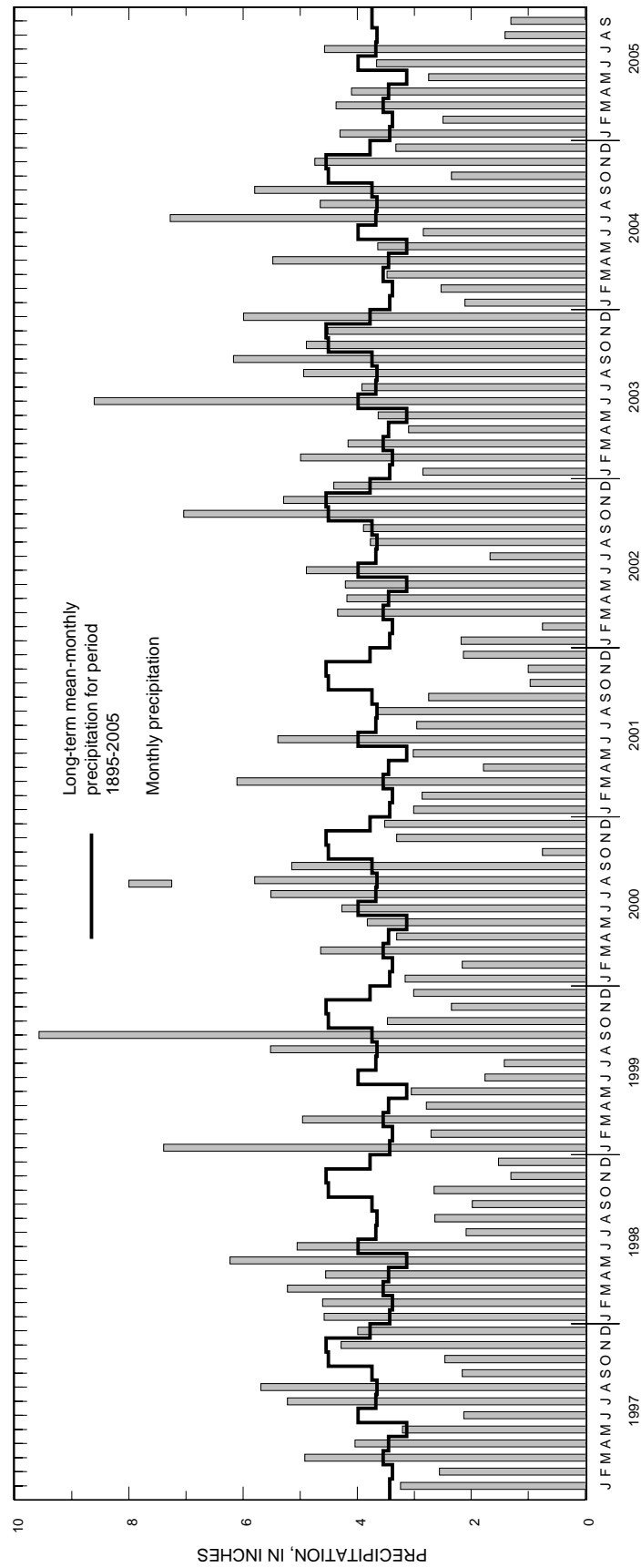
EXPLANATION

- Shaded area indicates lowest monthly usable contents for reference period
- Mean usable contents, 1961-90
- Month-end usable contents, 2005 water year

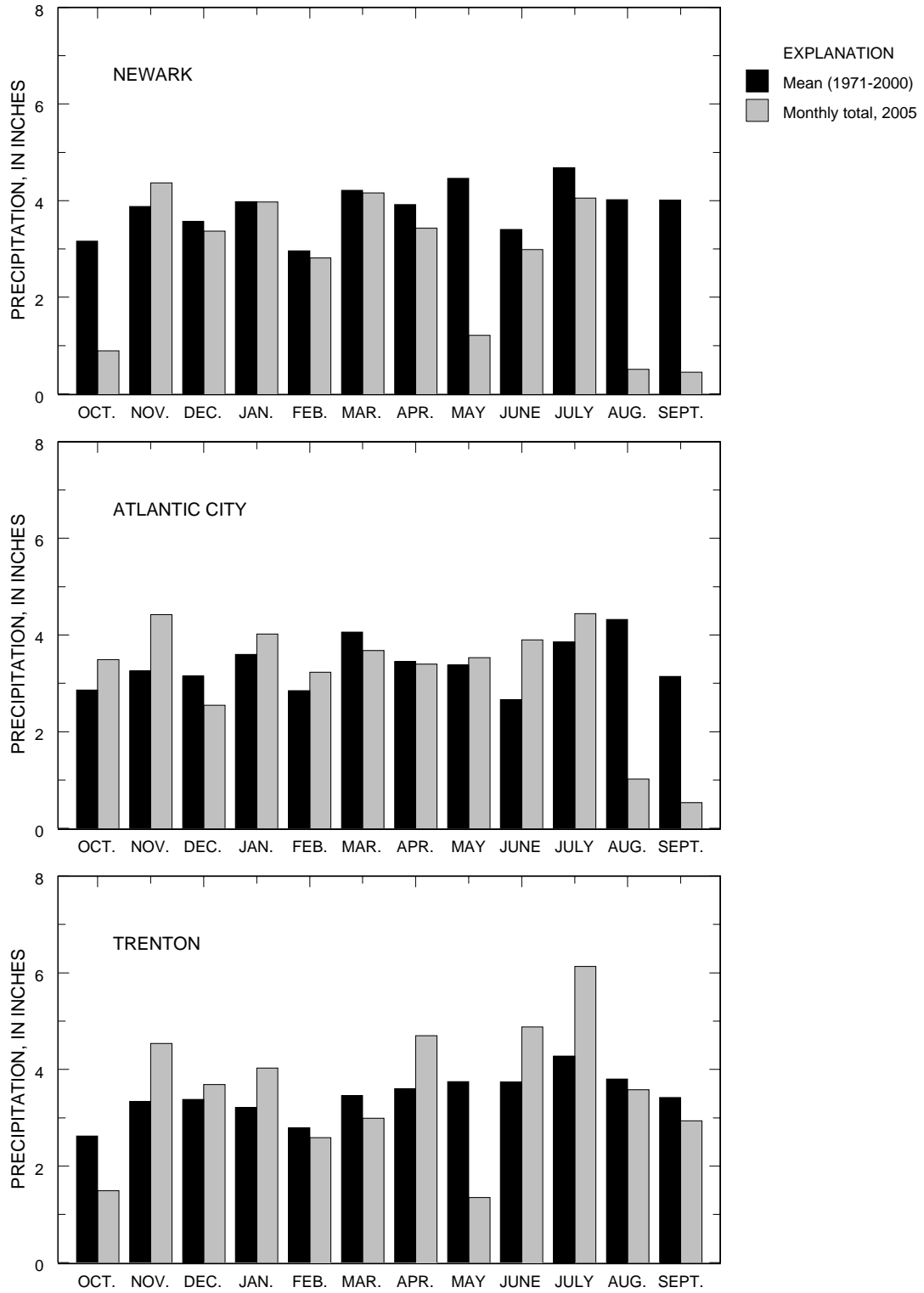


Map showing locations of reservoirs

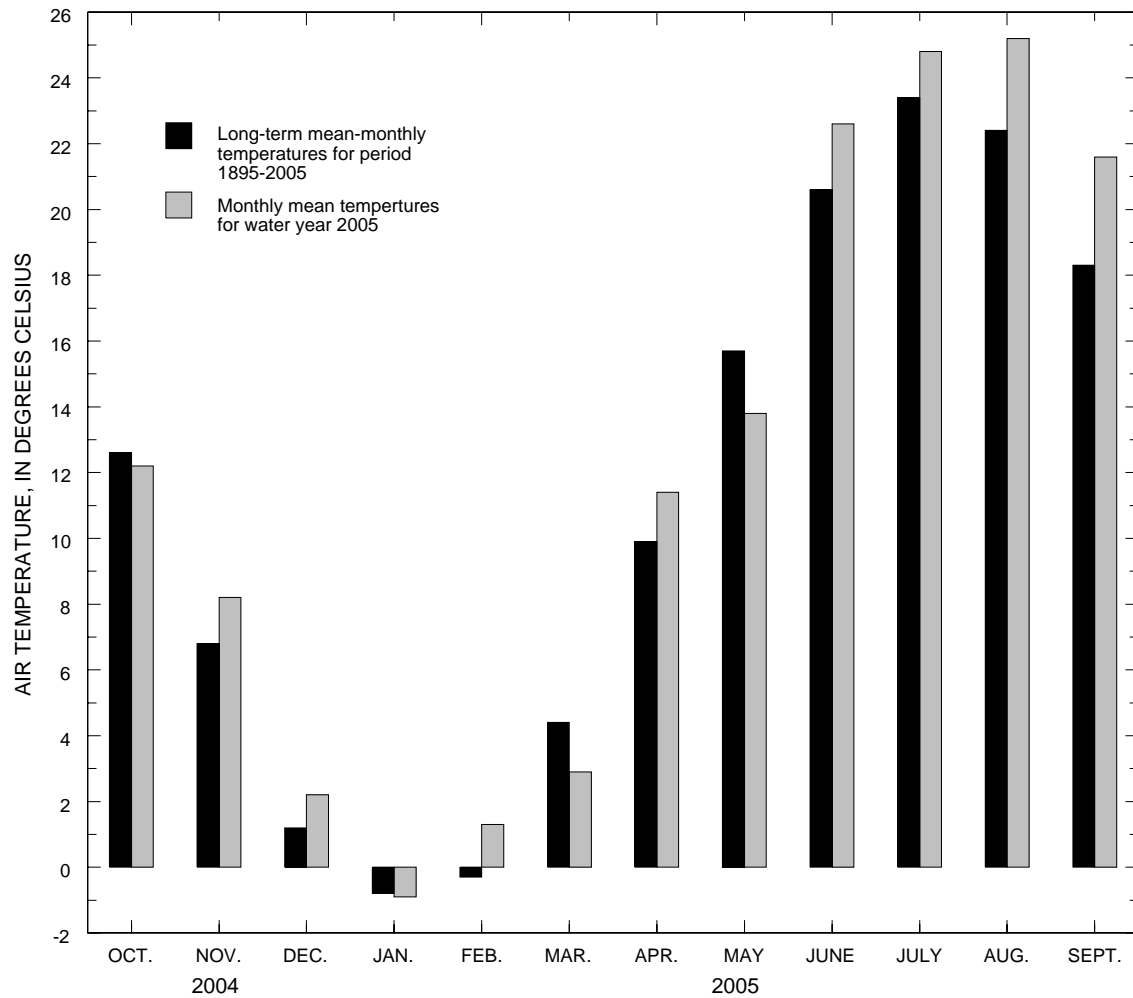
**Figure 3.** Combined usable contents of 13 major water-supply reservoirs.



**Figure 4.** Monthly precipitation for water years 1997-2005 in New Jersey and long-term mean-monthly precipitation for period 1895-2005. (Long-term mean-monthly and monthly precipitation are spatially weighted averages for several dozen stations throughout the State.)



**Figure 5.** Monthly precipitation at three National Weather Service stations.



**Figure 6.** Water year 2005 monthly mean air temperatures and long-term mean-monthly air temperatures for New Jersey.

degrees Celsius below average. The low temperatures of January caused streams to ice over at times. This ice cover led to ice jams and flooding on a number of streams. The monthly mean for February was 1.6 degrees Celsius above average. The monthly mean for March was 1.5 degrees Celsius below average. April was 1.5 degrees Celsius above average; May was 1.9 degrees Celsius below average; and June through September was up to 3.3 degrees Celsius above average. Monthly mean temperatures for the 2005 water year are listed in table 4 and are compared by rank to the historical monthly means (water years 1896-2005). August was the warmest August on record, with September being the second warmest on record. Temperature data can be accessed at <http://climate.rutgers.edu/stateclim-v1/data/njhisttemp.html>.

**Table 4.** Ranking of monthly temperatures in New Jersey for water 2005 in relation to the period of record, water years 1896-2005.

Monthly temperatures are spatially weighted averages from many stations throughout the State.

Month of water year	Monthly mean temperature, in degrees Celsius	Rank of month
Oct. 2004	12.2	47th coolest
Nov. 2004	8.2	18th warmest
Dec. 2004	2.2	43rd warmest
Jan. 2005	-0.9	54th coolest
Feb. 2005	1.3	29th warmest
Mar. 2005	2.9	28th coolest
Apr. 2005	11.4	20th warmest
May 2005	13.8	5th coolest
June 2005	22.6	3rd warmest
July 2005	24.8	8th warmest
Aug. 2005	25.2	The warmest
Sept. 2005	21.6	2nd warmest

## DOWNSTREAM ORDER AND STATION NUMBER

Since October 1, 1950, hydrologic-station records in USGS reports have been listed in order of downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary entering between two main-stream stations is listed between those stations. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary on which a station is located with respect to the stream to which it is immediately tributary is indicated by an indentation in that list of stations in the front of this report. Each indentation represents one rank. This downstream order and system of indentation indicates which stations are on tributaries between any two stations and the rank of the tributary on which each station is located.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These station numbers are in the same downstream order used in this report. In assigning a station number, 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 composed of both types of stations. Gaps are consecutive. The complete 8-digit (or 10-digit) number for each station such as 09004100, which appears just to the left of the station name, includes a 2-digit part number "09" plus the 6-digit (or 8-digit) downstream order number "004100." In areas of high station density, an additional two digits may be added to the station identification number to yield a 10-digit number. The stations are numbered in downstream order as described above between stations of consecutive 8-digit numbers.

## NUMBERING SYSTEM FOR WELLS AND MISCELLANEOUS SITES

The USGS well and miscellaneous site-numbering system is based on the grid system of latitude and longitude. The system provides the geographic location of the well or miscellaneous site and a unique number for each site. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude, and the next 7 digits denote degrees, minutes, and seconds of longitude; the last 2 digits are a sequential number for wells within a 1-second grid. In the event that the latitude-longitude coordinates for a well and miscellaneous site are the same, a sequential number such as “01,” “02,” and so forth, would be assigned as one would for wells (see fig. 7). The 8-digit, downstream order station numbers are not assigned to wells and miscellaneous sites where only random water-quality samples or discharge measurements are taken.

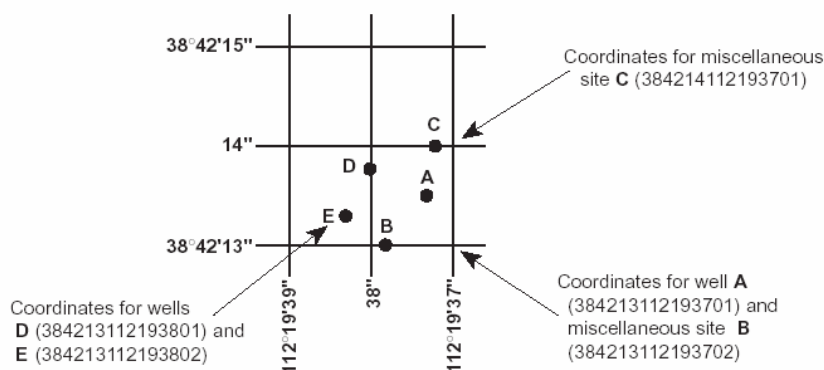


Figure 7. System for numbering wells and miscellaneous sites (latitude and longitude).

## SPECIAL NETWORKS AND PROGRAMS

**Hydrologic Benchmark Network** is a network of 61 sites in small drainage basins in 39 States that was established in 1963 to provide consistent streamflow data representative of undeveloped watersheds nationwide, and from which data could be analyzed on a continuing basis for use in comparison and contrast with conditions observed in basins more obviously affected by human activities. At selected sites, water-quality information is being gathered on major ions and nutrients, primarily to assess the effects of acid deposition on stream chemistry. Additional information on the Hydrologic Benchmark Program may be accessed from <http://ny.cf.er.usgs.gov/hbn/>.

**National Stream-Quality Accounting Network (NASQAN)** is a network of sites used to monitor the water quality of large rivers within the Nation's largest river basins. From 1995 through 1999, a network of approximately 40 stations was operated in the Mississippi, Columbia, Colorado, and Rio Grande River basins. For the period 2000 through 2004, sampling was reduced to a few index stations on the Colorado and Columbia Rivers so that a network of five 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 (NAWQA) Program; (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 may be accessed from <http://water.usgs.gov/nasqan/>.

**The National Atmospheric Deposition Program/National Trends Network (NADP/NTN)** is a network of monitoring sites that 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 this network of 250 precipitation-chemistry monitoring sites. The USGS supports 74 of these 250 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 data from the individual sites, may be accessed from <http://bqs.usgs.gov/acidrain/>.

**The USGS National Water-Quality Assessment (NAWQA) Program** 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; to provide an improved understanding of the primary natural and human factors affecting these observed conditions and trends; and to provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other agencies.

Assessment activities are being conducted in 42 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 is 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 water-resources managers to use in making decisions and a foundation for aggregation and comparison of findings to address water-quality issues of regional and national interest.

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 semiannually to discuss their information needs, monitoring plans and progress, desired information products, and opportunities for collaboration among the agencies. Additional information about the NAWQA Program may be accessed from <http://water.usgs.gov/nawqa/>.

**The USGS National Streamflow Information Program (NSIP)** is a long-term program with goals to provide framework streamflow data across the Nation. Included in the program are creation of a permanent Federally funded streamflow network, research on the nature of streamflow, regional assessments of streamflow data and databases, and upgrades in the streamflow information delivery systems. Additional information about NSIP may be accessed from <http://water.usgs.gov/nsip/>.

## EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS

### Data Collection and Computation

The base data collected at gaging stations (fig. 8-11) consist of records of stage and measurements of discharge of streams or canals, and stage, surface area, and volume of lakes or reservoirs. In addition, observations of factors affecting the stage-discharge relation or the stage-capacity relation, weather records, and other information are used to supplement base data in determining the daily flow or volume of water in storage. Records of stage are obtained from a water-stage recorder that is either downloaded electronically in the field to a laptop computer or similar device or is transmitted using telemetry such as GOES satellite, land-line or cellular-phone modems, or by radio transmission. Measurements of discharge are made with a current meter or acoustic Doppler current profiler, using the general methods adopted by the USGS. These methods are described in standard textbooks, USGS Water-Supply Paper 2175, and the Techniques of Water-Resources Investigations of the United States Geological Survey (TWRIs), Book 3, Chapters A1 through A19 and Book 8, Chapters A2 and B2, which may be accessed from <http://water.usgs.gov/pubs/twri/>. The methods are consistent with the American Society for Testing and Materials (ASTM) standards and generally follow the standards of the International Organization for Standards (ISO).

For stream-gaging stations, discharge-rating tables for any stage are prepared from stage-discharge curves. If extensions to the rating curves are necessary to express discharge greater than measured, the extensions are made on the basis of indirect measurements of peak discharge (such as slope-area or contracted-opening measurements, or computation of flow over dams and weirs), step-backwater techniques, velocity-area studies, and logarithmic plotting. The daily mean discharge is computed from gage heights and rating tables, then the monthly and yearly mean discharges are computed from the daily values. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features of the stream channel, the daily mean discharge is computed by the shifting-control method in which correction factors that are based on individual discharge measurements and notes by engineers and observers are used when applying the gage heights to the rating tables. If the stage-discharge relation for a station is temporarily changed by the presence of aquatic growth or debris on the controlling section, the daily mean discharge is computed by the shifting-control method.

The stage-discharge relation at some stream-gaging stations is affected by backwater from reservoirs, tributary streams, or other sources. Such an occurrence necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in computing discharge. The slope or fall is obtained by means of an auxiliary gage at some distance from the base gage.

An index velocity is measured using ultrasonic or acoustic instruments at some stream-gaging stations, and this index velocity is used to calculate an average velocity for the flow in the stream. This average velocity along with a stage-area relation is then used to calculate average discharge.

At some stations, the stage-discharge relation is affected by changing stage. At these stations, the rate of change in stage is used as a factor in computing discharge.

At some stream-gaging stations in the northern United States, the stage-discharge relation is affected by ice in the winter; therefore, computation of the discharge in the usual manner is impossible. Discharge for periods of ice effect is computed on the basis of gage-height record and occasional winter-discharge measurements. Consideration is given to the available information on temperature and precipitation, notes by gage observers and hydrologists, and comparable records of discharge from other stations in the same or nearby basins.

For a lake or reservoir station, capacity tables giving the volume or contents for any stage are prepared from stage-area relation curves defined by surveys. The application of the stage to the capacity table gives the contents, from which the daily, monthly, or yearly changes are computed.

If the stage-capacity curve is subject to changes because of deposition of sediment in the reservoir, periodic resurveys of the reservoir are necessary to define new stage-capacity curves. During the period between reservoir surveys, the computed contents may be increasingly in error due to the gradual accumulation of sediment.

For some stream-gaging stations, periods of time occur when no gage-height record is obtained or the recorded gage height is faulty and cannot be used to compute daily discharge or contents. Such a situation can happen when the recorder stops or otherwise fails to operate properly, the intakes are plugged, the float is frozen in the well, or for various other reasons. For such periods, the daily discharges are estimated on the basis of recorded range in stage, prior and subsequent records, discharge measurements, weather records, and comparison with records from other stations in the same or nearby basins. Likewise, lake or reservoir volumes may be estimated on the basis of operator's log, prior and subsequent records, inflow-outflow studies, and other information.

## **Data Presentation**

The records published for each continuous-record surface-water discharge station (stream-gaging station) consist of five parts: (1) the station manuscript or description; (2) the data table of daily mean values of discharge for the current water year with summary data; (3) a tabular statistical summary of monthly mean flow data for a designated period, by water year; (4) a summary statistics table that includes statistical data of annual, daily, and instantaneous



flows as well as data pertaining to annual runoff, 7-day low-flow minimums, and flow duration; and (5) a hydrograph of discharge.

## Station Manuscript

The manuscript provides, under various headings, descriptive information, such as station location; period of record; historical extremes outside the period of record; record accuracy; and other remarks pertinent to station operation and regulation. The following information, as appropriate, is provided with each continuous record of discharge or lake content. Comments follow that clarify information presented under the various headings of the station description.

**LOCATION.**—Location information is obtained from the most accurate maps available. The location of the gaging station with respect to the cultural and physical features in the vicinity and with respect to the reference place mentioned in the station name is given. River mileages, given for only a few stations, were determined by methods given in “River Mileage Measurement,” Bulletin 14, Revision of October 1968, prepared by the Water Resources Council or were provided by the U.S. Army Corps of Engineers.

**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 term indicates the time period for which records have been published for the station or for an equivalent station. An equivalent station is one that was in operation at a time that the present station was not and whose location was such that its flow reasonably can be considered equivalent to flow at the present station.

**REVISED RECORDS.**—If a critical error in published records is discovered, a revision is included in the first report published following discovery of the error.

**GAGE.**—The type of gage in current use, the datum of the current gage referred to a standard datum, and a condensed history of the types, locations, and datums of previous gages are given under this heading.

**REMARKS.**—All periods of estimated daily discharge either will be identified by date in this paragraph of the station description for water-discharge stations or flagged in the daily discharge table. (See section titled Identifying Estimated Daily Discharge.) Information is presented relative to the accuracy of the records, to special methods of computation, and to conditions that affect natural flow at the station. In addition, information may be presented pertaining to average discharge data for the period of record; to extremes data for the period of record and the current year; and, possibly, to other pertinent items. For reservoir stations, information is given on the dam forming the reservoir, the capacity, the outlet works and spillway, and the purpose and use of the reservoir.

**COOPERATION.**—Records provided by a cooperating organization or obtained for the USGS by a cooperating organization are identified here.

**EXTREMES OUTSIDE PERIOD OF RECORD.**—Information here documents major floods or unusually low flows that occurred outside the stated period of record. The information may or may not have been obtained by the USGS.

**REVISIONS.**—Records are revised if errors in published records are discovered. Appropriate updates are made in the USGS distributed data system, NWIS, and subsequently to its Web-based national data system, NWISWeb (<http://water.usgs.gov/nwis/nwis>). Users are encouraged to obtain all required data from NWIS or NWISWeb to ensure that they have the most recent data updates. Updates to NWISWeb are made on an annual basis.

Although rare, occasionally the records of a discontinued gaging station may need revision. Because no current or, possibly, future station manuscript would be published for these stations to document the revision in a REVISED RECORDS entry, users of data for these stations who obtained the record from previously published data reports may

wish to contact the USGS Water Science Center (address given on the back of the title page of this report) to determine if the published records were revised after the station was discontinued. If, however, the data for a discontinued station were obtained by computer retrieval, the data would be current. Any published revision of data is always accompanied by revision of the corresponding data in computer storage.

Manuscript information for lake or reservoir stations differs from that for stream stations in the nature of the REMARKS and in the inclusion of a stage-capacity table when daily volumes are given.

## Peak Discharge Greater than Base Discharge

Tables of peak discharge above base discharge are included for some stations where secondary instantaneous peak discharge data are used in flood-frequency studies of highway and bridge design, flood-control structures, and other flood-related projects. The base discharge value is selected so an average of three peaks a year will be reported. This base discharge value has a recurrence interval of approximately 1.1 years or a 91-percent chance of exceedance in any 1 year.

## Data Table of Daily Mean Values

The daily table of discharge records for stream-gaging stations gives mean discharge for each day of the water year. In the monthly summary for the table, the line headed TOTAL gives the sum of the daily figures for each month; the line headed MEAN gives the arithmetic average flow in cubic feet per second for the month; and the lines headed MAX and MIN give the maximum and minimum daily mean discharges, respectively, for each month. Discharge for the month is expressed in cubic feet per second per square mile (line headed CFSM); or in inches (line headed IN); or in acre-feet (line headed AC-FT). Values for cubic feet per second per square mile and runoff in inches or in acre-feet may be omitted if extensive regulation or diversion is in effect or if the drainage area includes large noncontributing areas. At some stations, monthly and (or) yearly observed discharges are adjusted for reservoir storage or diversion, or diversion data or reservoir volumes are given. These values are identified by a symbol and a corresponding footnote.

## Statistics of Monthly Mean Data

A tabular summary of the mean (line headed MEAN), maximum (MAX), and minimum (MIN) of monthly mean flows for each month for a designated period is provided below the mean values table. The water years of the first occurrence of the maximum and minimum monthly flows are provided immediately below those values. The designated period will be expressed as FOR WATER YEARS \_\_-\_\_, BY WATER YEAR (WY), and will list the first and last water years of the range of years selected from the PERIOD OF RECORD paragraph in the station manuscript. The designated period will consist of all of the station record within the specified water years, including complete months of record for partial water years, and may coincide with the period of record for the station. The water years for which the statistics are computed are consecutive, unless a break in the station record is indicated in the manuscript.

## Summary Statistics

A table titled SUMMARY STATISTICS follows the statistics of monthly mean data tabulation. This table consists of four columns with the first column containing the line headings of the statistics being reported. The table provides a statistical summary of yearly, daily, and instantaneous flows, not only for the current water year but also for the previous calendar year and for a designated period, as appropriate. The designated period selected, WATER YEARS \_\_-\_\_, will consist of all of the station records within the specified water years, including complete months of record for partial water years, and may coincide with the period of record for the station. The water years for which the statistics are computed are consecutive, unless a break in the station record is indicated in the manuscript. All of the calculations for the statistical characteristics designated ANNUAL (see line headings below), except for the

ANNUAL 7-DAY MINIMUM statistic, are calculated for the designated period using complete water years. The other statistical characteristics may be calculated using partial water years.

The date or water year, as appropriate, of the first occurrence of each statistic reporting extreme values of discharge is provided adjacent to the statistic. Repeated occurrences may be noted in the REMARKS paragraph of the manuscript or in footnotes. Because the designated period may not be the same as the station period of record published in the manuscript, occasionally the dates of occurrence listed for the daily and instantaneous extremes in the designated-period column may not be within the selected water years listed in the heading. When the dates of occurrence do not fall within the selected water years listed in the heading, it will be noted in the REMARKS paragraph or in footnotes. Selected streamflow duration-curve statistics and runoff data also are given. Runoff data may be omitted if extensive regulation or diversion of flow is in effect in the drainage basin.

The following summary statistics data are provided with each continuous record of discharge. Comments that follow clarify information presented under the various line headings of the SUMMARY STATISTICS table.

ANNUAL TOTAL.—The sum of the daily mean values of discharge for the year.

ANNUAL MEAN.—The arithmetic mean for the individual daily mean discharges for the year noted or for the designated period.

HIGHEST ANNUAL MEAN.—The maximum annual mean discharge occurring for the designated period.

LOWEST ANNUAL MEAN.—The minimum annual mean discharge occurring for the designated period.

HIGHEST DAILY MEAN.—The maximum daily mean discharge for the year or for the designated period.

LOWEST DAILY MEAN.—The minimum daily mean discharge for the year or for the designated period.

ANNUAL 7-DAY MINIMUM.—The lowest mean discharge for 7 consecutive days for a calendar year or a water year. Note that most low-flow frequency analyses of annual 7-day minimum flows use a climatic year (April 1-March 31). The date shown in the summary statistics table is the initial date of the 7-day period. This value should not be confused with the 7-day 10-year low-flow statistic.

MAXIMUM PEAK FLOW.—The maximum instantaneous peak discharge occurring for the water year or designated period. Occasionally the maximum flow for a year may occur at midnight at the beginning or end of the year, on a recession from or rise toward a higher peak in the adjoining year. In this case, the maximum peak flow is given in the table and the maximum flow may be reported in a footnote or in the REMARKS paragraph in the manuscript.

MAXIMUM PEAK STAGE.—The maximum instantaneous peak stage occurring for the water year or designated period. Occasionally the maximum stage for a year may occur at midnight at the beginning or end of the year, on a recession from or rise toward a higher peak in the adjoining year. In this case, the maximum peak stage is given in the table and the maximum stage may be reported in the REMARKS paragraph in the manuscript or in a footnote. If the dates of occurrence of the maximum peak stage and maximum peak flow are different, the REMARKS paragraph in the manuscript or a footnote may be used to provide further information.

INSTANTANEOUS LOW FLOW.—The minimum instantaneous discharge occurring for the water year or for the designated period.

ANNUAL RUNOFF.—Indicates the total quantity of water in runoff for a drainage area for the year. Data reports may use any of the following units of measurement in presenting annual runoff data:

Acre-foot (AC-FT) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Cubic feet per square mile (CFSM) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming the runoff is distributed uniformly in time and area.

Inches (INCHES) indicate the depth to which the drainage area would be covered if all of the runoff for a given time period were uniformly distributed on it.

10 PERCENT EXCEEDS.—The discharge that has been exceeded 10 percent of the time for the designated period.

50 PERCENT EXCEEDS.—The discharge that has been exceeded 50 percent of the time for the designated period.

90 PERCENT EXCEEDS.—The discharge that has been exceeded 90 percent of the time for the designated period.

Data collected at partial-record stations follow the information for continuous-record sites. Data for partial-record discharge stations are presented in two tables. The first table lists annual maximum stage and discharge at crest-stage stations, and the second table lists discharge measurements at low-flow partial-record stations. The tables of partial-record stations are followed by a listing of discharge measurements made at sites other than continuous-record or partial-record stations. These measurements are often made in times of drought or flood to give better areal coverage to those events. Those measurements and others collected for a special reason are called measurements at miscellaneous sites.

## Identifying Estimated Daily Discharge

Estimated daily-discharge values published in the water-discharge tables of annual State data reports are identified. This identification is shown either by flagging individual daily values with the letter “e” and noting in a table footnote, “e—Estimated,” or by listing the dates of the estimated record in the REMARKS paragraph of the station description.

## Accuracy of Field Data and Computed Results

The accuracy of streamflow data depends primarily on (1) the stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements, and (2) the accuracy of observations of stage, measurements of discharge, and interpretations of records.

The degree of accuracy of the records is stated in the REMARKS in the station description. “Excellent” indicates that about 95 percent of the daily discharges are within 5 percent of the true value; “good” within 10 percent; and “fair,” within 15 percent. “Poor” indicates that daily discharges have less than “fair” accuracy. Different accuracies may be attributed to different parts of a given record.

Values of daily mean discharge in this report are shown to the nearest hundredth of a cubic foot per second for discharges of less than 1 ft<sup>3</sup>/s; to the nearest tenths between 1.0 and 10 ft<sup>3</sup>/s; to whole numbers between 10 and 1,000 ft<sup>3</sup>/s; and to three significant figures above 1,000 ft<sup>3</sup>/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharge values listed for partial-record stations.

Discharge at many stations, as indicated by the monthly mean, may not reflect natural runoff due to the effects of diversion, consumption, regulation by storage, increase or decrease in evaporation due to artificial causes, or to other factors. For such stations, values of cubic feet per second per square mile and of runoff in inches are not published unless satisfactory adjustments can be made for diversions, for changes in contents of reservoirs, or for other changes incident to use and control. Evaporation from a reservoir is not included in the adjustments for changes in reservoir contents, unless it is so stated. Even at those stations where adjustments are made, large errors in computed runoff may occur if adjustments or losses are large in comparison with the observed discharge.

## Other Data Records Available

Information of a more detailed nature than that published for most of the stream-gaging stations such as discharge measurements, gage-height records, and rating tables is available from the USGS Water Science Center. Also, most stream-gaging station records are available in computer-usable form and many statistical analyses have been made.

Information on the availability of unpublished data or statistical analyses may be obtained from the USGS Water Science Center (see address that is shown on the back of the title page of this report).

## EXPLANATION OF PRECIPITATION RECORDS

### Data Collection and Computation

Rainfall data generally are collected using electronic data loggers that measure the rainfall in 0.01-inch increments every 15 minutes using either a tipping-bucket rain gage or a collection well gage. Twenty-four hour rainfall totals are tabulated and presented. A 24-hour period extends from just past midnight of the previous day to midnight of the current day. Snowfall-affected data can result during cold weather when snow fills the rain-gage funnel and then melts as temperatures rise. Snowfall-affected data are subject to errors. Missing values are indicated by this symbol “---” in the table.

### Data Presentation

Precipitation records collected at surface-water gaging stations are identified with the same station number and name as the stream-gaging station. Where a surface-water daily-record station is not available, the precipitation record is published with its own name and latitude-longitude identification number.

Information pertinent to the history of a precipitation station is provided in descriptive headings preceding the tabular data. These descriptive headings give details regarding location, period of record, and general remarks.

The following information is provided with each precipitation station. Comments that follow clarify information presented under the various headings of the station description.

**LOCATION.**—See Data Presentation in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

**PERIOD OF RECORD.**—See Data Presentation in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

**INSTRUMENTATION.**—Information on the type of rainfall collection system is given.

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

## Water Temperature

Water temperatures are measured at most of the water-quality stations. In addition, water temperatures are taken at the time of discharge measurements for water-discharge stations. For stations where water temperatures are taken manually once or twice daily, the water temperatures are taken at about the same time each day. 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, either mean temperatures or maximum and minimum temperatures for each day are published. Water temperatures measured at the time of water-discharge measurements are on file in the USGS Water Science Center.

## ACCESS TO USGS WATER DATA

The USGS provides near real-time stage and discharge data for many of the gaging stations equipped with the necessary telemetry and historic daily-mean and peak-flow discharge data for most current or discontinued gaging stations through the World Wide Web (WWW). These data may be accessed from <http://water.usgs.gov>.

Water-quality data and ground-water data also are available through the WWW. In addition, data can be provided in various machine-readable formats on various media. Information about the availability of specific types of data or products, and user charges, can be obtained locally from each USGS Water Science Center (See address that is shown on the back of the title page of this report.)

## DEFINITION OF TERMS

Specialized technical terms related to streamflow, water-quality, and other hydrologic data, as used in this report, are defined below. Terms such as algae, water level, and precipitation are used in their common everyday meanings, definitions of which are given in standard dictionaries. Not all terms defined in this alphabetical list apply to every State. See also table for converting English units to International System (SI) Units. Other glossaries that also define water-related terms are accessible from <http://water.usgs.gov/glossaries.html>.

**Acre-foot (AC-FT, acre-ft)** is a unit of volume, commonly used to measure quantities of water used or stored, equivalent to the volume of water required to cover 1 acre to a depth of 1 foot and equivalent to 43,560 cubic feet, 325,851 gallons, or 1,233 cubic meters. (See also “Annual runoff”)

**Adjusted discharge** is discharge data that have been mathematically adjusted (for example, to remove the effects of a daily tide cycle or reservoir storage).

**Annual runoff** is the total quantity of water that is discharged (“runs off”) from a drainage basin in a year. Data reports may present annual runoff data as volumes in acre-feet, as discharges per unit of drainage area in cubic feet per second per square mile, or as depths of water on the drainage basin in inches.

**Annual 7-day minimum** is the lowest mean value for any 7-consecutive-day period in a year. Annual 7-day minimum values are reported herein for the calendar year and the water year (October 1 through September 30). Most low-flow frequency analyses use a climatic year (April 1-March 31), which tends to prevent the low-flow period from being artificially split between adjacent years. The date shown in the summary statistics table is the initial date of the 7-day period. (This value should not be confused with the 7-day, 10-year low-flow statistic.)

**Bankfull stage**, as used in this report, is the stage at which a stream first overflows its natural banks formed by floods with 1- to 3-year recurrence intervals.

**Base discharge** (for peak discharge) is a discharge value, determined for selected stations, above which peak discharge data are published. The base discharge at each station is selected so that an average of about three peak flows per year will be published. (See also “Peak flow”)

**Base flow** is sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by ground-water discharge.

**Bedload discharge** (tons per day) is the rate of sediment moving as bedload, reported as dry weight, that passes through a cross section in a given time. NOTE: Bedload discharge values in this report may include a component of the suspended-sediment discharge. A correction may be necessary when computing the total sediment discharge by summing the bedload discharge and the suspended-sediment discharge. (See also “Bedload,” “Dry weight,” “Sediment,” and “Suspended-sediment discharge”)

**Canadian Geodetic Vertical Datum 1928** is a geodetic datum derived from a general adjustment of Canada’s first order level network in 1928.

**Cfs-day** (See “Cubic foot per second-day”)

**Channel bars**, as used in this report, are the lowest prominent geomorphic features higher than the channel bed.

**Contents** is the volume of water in a reservoir or lake. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

**Continuous-record station** is a site where data are collected with sufficient frequency to define daily mean values and variations within a day.

**Control** designates a feature in the channel that physically affects the water-surface elevation and thereby determines the stage-discharge relation at the gage. This feature may be a constriction of the channel, a bedrock outcrop, a gravel bar, an artificial structure, or a uniform cross section over a long reach of the channel.

**Control structure**, as used in this report, is a structure on a stream or canal that is used to regulate the flow or stage of the stream or to prevent the intrusion of saltwater.

**Cubic foot per second** (CFS,  $\text{ft}^3/\text{s}$ ) is the rate of discharge representing a volume of 1 cubic foot passing a given point in 1 second. It is equivalent to approximately 7.48 gallons per second or approximately 449 gallons per minute, or 0.02832 cubic meters per second. The term “second-foot” sometimes is used synonymously with “cubic foot per second” but is now obsolete.

**Cubic foot per second-day** (CFS-DAY, Cfs-day,  $[(\text{ft}^3/\text{s})/\text{d}]$ ) is the volume of water represented by a flow of 1 cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, 1.98347 acre-feet, 646,317 gallons, or 2,446.6 cubic meters. The daily mean discharges reported in the daily value data tables numerically are equal to the daily volumes in cfs-days, and the totals also represent volumes in cfs-days.

**Cubic foot per second per square mile** [CFSM,  $(\text{ft}^3/\text{s})/\text{mi}^2$ ] is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming the runoff is distributed uniformly in time and area. (See also “Annual runoff”)

**Daily record station** is a site where data are collected with sufficient frequency to develop a record of one or more data values per day. The frequency of data collection can range from continuous recording to data collection on a daily or near-daily basis.

**Data collection platform** (DCP) is an electronic instrument that collects, processes, and stores data from various sensors, and transmits the data by satellite data relay, line-of-sight radio, and/or landline telemetry.

**Data logger** is a microprocessor-based data acquisition system designed specifically to acquire, process, and store data. Data usually are downloaded from onsite data loggers for entry into office data systems.

**Datum** is a surface or point relative to which measurements of height and/or horizontal position are reported. A vertical datum is a horizontal surface used as the zero point for measurements of gage height, stage, or elevation; a horizontal datum is a reference for positions given in terms of latitude-longitude, State Plane coordinates, or Universal

Transverse Mercator (UTM) coordinates. (See also “Gage datum,” “Land-surface datum,” “National Geodetic Vertical Datum of 1929,” and “North American Vertical Datum of 1988”)

**Diel** is of or pertaining to a 24-hour period of time; a regular daily cycle.

**Discharge**, or **flow**, is the rate that matter passes through a cross section of a stream channel or other water body per unit of time. The term commonly refers to the volume of water (including, unless otherwise stated, any sediment or other constituents suspended or dissolved in the water) that passes a cross section in a stream channel, canal, pipeline, and so forth, within a given period of time (cubic feet per second). Discharge also can apply to the rate at which constituents, such as suspended sediment, bedload, and dissolved or suspended chemicals, pass through a cross section, in which cases the quantity is expressed as the mass of constituent that passes the cross section in a given period of time (tons per day).

**Drainage area** of a stream at a specific location is that area upstream from the location, measured in a horizontal plane, that has a common outlet at the site for its surface runoff from precipitation that normally drains by gravity into a stream. Drainage areas given herein include all closed basins, or noncontributing areas, within the area unless otherwise specified.

**Drainage basin** is a part of the Earth’s surface that contains a drainage system with a common outlet for its surface runoff. (See “Drainage area”)

**Embeddedness** is the degree to which gravel-sized and larger particles are surrounded or enclosed by finer-sized particles. (See also “Substrate embeddedness class”)

**Flow-duration percentiles** are values on a scale of 100 that indicate the percentage of time for which a flow is exceeded. For example, the 90th percentile of river flow is the streamflow exceeded 90 percent of the time in the period of interest.

**Gage datum** is a horizontal surface used as a zero point for measurement of stage or gage height. This surface usually is located slightly below the lowest point of the stream bottom such that the gage height is usually slightly greater than the maximum depth of water. Because the gage datum is not an actual physical object, the datum is usually defined by specifying the elevations of permanent reference marks such as bridge abutments and survey monuments, and the gage is set to agree with the reference marks. Gage datum is a local datum that is maintained independently of any national geodetic datum. However, if the elevation of the gage datum relative to the national datum (North American Vertical Datum of 1988 or National Geodetic Vertical Datum of 1929) has been determined, then the gage readings can be converted to elevations above the national datum by adding the elevation of the gage datum to the gage reading.

**Gage height** (G.H.) is the water-surface elevation, in feet above the gage datum. If the water surface is below the gage datum, the gage height is negative. Gage height often is used interchangeably with the more general term “stage,” although gage height is more appropriate when used in reference to a reading on a gage.

**Gage values** are values that are recorded, transmitted, and/or computed from a gaging station. Gage values typically are collected at 5-, 15-, or 30-minute intervals.

**Gaging station** is a site on a stream, canal, lake, or reservoir where systematic observations of stage, discharge, or other hydrologic data are obtained.

**Geomorphic channel units**, as used in this report, are fluvial geomorphic descriptors of channel shape and stream velocity. Pools, riffles, and runs are types of geomorphic channel units considered for National Water-Quality Assessment (NAWQA) Program habitat sampling.



**High tide** is the maximum height reached by each rising tide. The high-high and low-high tides are the higher and lower of the two high tides, respectively, of each tidal day. See NOAA Web site: <http://www.csc.noaa.gov/text/glossary.html> (see “High water”)

**Horizontal datum** (See “Datum”)

**Hydrologic index stations** referred to in this report are continuous-record gaging stations that have been selected as representative of streamflow patterns for their respective regions. Station locations are shown on index maps.

**Hydrologic unit** is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as defined by the former Office of Water Data Coordination and delineated on the State Hydrologic Unit Maps by the USGS. Each hydrologic unit is identified by an 8-digit number.

**Inch** (IN., in.), in reference to streamflow, as used in this report, refers to the depth to which the drainage area would be covered with water if all of the runoff for a given time period were distributed uniformly on it. (See also “Annual runoff”)

**Instantaneous discharge** is the discharge at a particular instant of time. (See also “Discharge”)

**International Boundary Commission Survey Datum** refers to a geodetic datum established at numerous monuments along the United States-Canada boundary by the International Boundary Commission.

**Island**, as used in this report, is a mid-channel bar that has permanent woody vegetation, is flooded once a year, on average, and remains stable except during large flood events.

**Land-surface datum** (lsd) is a datum plane that is approximately at land surface at each ground-water observation well.

**Low tide** is the minimum height reached by each falling tide. The high-low and low-low tides are the higher and lower of the two low tides, respectively, of each tidal day. See NOAA Website: <http://www.csc.noaa.gov/text/glossary.html> (see “Low water”)

**Mean discharge** (MEAN) is the arithmetic mean of individual daily mean discharges during a specific period. (See also “Discharge”)

**Mean high or low tide** is the average of all high or low tides, respectively, over a specific period.

**Mean sea level** is a local tidal datum. It is the arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; for example, monthly mean sea level and yearly mean sea level. In order that they may be recovered when needed, such datums are referenced to fixed points known as benchmarks. (See also “Datum”)

**Measuring point** (MP) is an arbitrary permanent reference point from which the distance to water surface in a well is measured to obtain water level.

**Megahertz** is a unit of frequency. One megahertz equals one million cycles per second.

**Method of Cubatures** is a method of computing discharge in tidal estuaries based on the conservation of mass equation.

**Miscellaneous site**, miscellaneous station, or miscellaneous sampling site is a site where streamflow, sediment, and/or water-quality data or water-quality or sediment samples are collected once, or more often on a random or discontinuous basis to provide better areal coverage for defining hydrologic and water-quality conditions over a broad area in a river basin.

**National Geodetic Vertical Datum of 1929** (NGVD 29) is a fixed reference adopted as a standard geodetic datum for elevations determined by leveling. It formerly was called “Sea Level Datum of 1929” or “mean sea level.”

Although the datum was derived from the mean sea level at 26 tide stations, it does not necessarily represent local mean sea level at any particular place. *See NOAA Web site: <http://www.ngs.noaa.gov/faq.shtml#WhatVD29VD88>* (See “North American Vertical Datum of 1988”)

**North American Datum of 1927** (NAD 27) is the horizontal control datum for the United States that was defined by a location and azimuth on the Clarke spheroid of 1866.

**North American Datum of 1983** (NAD 83) is the horizontal control datum for the United States, Canada, Mexico, and Central America that is based on the adjustment of 250,000 points including 600 satellite Doppler stations that constrain the system to a geocentric origin. NAD 83 has been officially adopted as the legal horizontal datum for the United States by the Federal government.

**North American Vertical Datum of 1988** (NAVD 88) is a fixed reference adopted as the official civilian vertical datum for elevations determined by Federal surveying and mapping activities in the United States. This datum was established in 1991 by minimum-constraint adjustment of the Canadian, Mexican, and United States first-order terrestrial leveling networks.

**Parameter code** is a 5-digit number used in the USGS computerized data system, National Water Information System (NWIS), to uniquely identify a specific constituent or property.

**Partial-record station** is a site where discrete measurements of one or more hydrologic parameters are obtained over a period of time without continuous data being recorded or computed. A common example is a crest-stage gage partial-record station at which only peak stages and flows are recorded.

**Peak flow (peak stage)** is an instantaneous local maximum value in the continuous time series of streamflows or stages, preceded by a period of increasing values and followed by a period of decreasing values. Several peak values ordinarily occur in a year. The maximum peak value in a year is called the annual peak; peaks lower than the annual peak are called secondary peaks. Occasionally, the annual peak may not be the maximum value for the year; in such cases, the maximum value occurs at midnight at the beginning or end of the year, on the recession from or rise toward a higher peak in the adjoining year. If values are recorded at a discrete series of times, the peak recorded value may be taken as an approximation of the true peak, which may occur between the recording instants. If the values are recorded with finite precision, a sequence of equal recorded values may occur at the peak; in this case, the first value is taken as the peak.

**Periodic-record station** is a site where stage, discharge, sediment, chemical, physical, or other hydrologic measurements are made one or more times during a year but at a frequency insufficient to develop a daily record.

**Pool**, as used in this report, is a small part of a stream reach with little velocity, commonly with water deeper than surrounding areas.

**Reach**, as used in this report, is a length of stream that is chosen to represent a uniform set of physical, chemical, and biological conditions within a segment. It is the principal sampling unit for collecting physical, chemical, and biological data.

**Recurrence interval**, also referred to as return period, is the average time, usually expressed in years, between occurrences of hydrologic events of a specified type (such as exceedances of a specified high flow or nonexceedance of a specified low flow). The terms “return period” and “recurrence interval” do not imply regular cyclic occurrence. The actual times between occurrences vary randomly, with most of the times being less than the average and a few being substantially greater than the average. For example, the 100-year flood is the flow rate that is exceeded by the annual maximum peak flow at intervals whose average length is 100 years (that is, once in 100 years, on average); almost two-thirds of all exceedances of the 100-year flood occur less than 100 years after the previous exceedance, half occur less than 70 years after the previous exceedance, and about one-eighth occur more than 200 years after

the previous exceedance. Similarly, the 7-day, 10-year low flow ( $7Q_{10}$ ) is the flow rate below which the annual minimum 7-day-mean flow dips at intervals whose average length is 10 years (that is, once in 10 years, on average); almost two-thirds of the nonexceedances of the  $7Q_{10}$  occur less than 10 years after the previous nonexceedance, half occur less than 7 years after, and about one-eighth occur more than 20 years after the previous nonexceedance. The recurrence interval for annual events is the reciprocal of the annual probability of occurrence. Thus, the 100-year flood has a 1-percent chance of being exceeded by the maximum peak flow in any year, and there is a 10-percent chance in any year that the annual minimum 7-day-mean flow will be less than the  $7Q_{10}$ .

**Return period** (See “Recurrence interval”)

**Riffle**, as used in this report, is a shallow part of the stream where water flows swiftly over completely or partially submerged obstructions to produce surface agitation.

**River mileage** is the curvilinear distance, in miles, measured upstream from the mouth along the meandering path of a stream channel in accordance with Bulletin No. 14 (October 1968) of the Water Resources Council and typically is used to denote location along a river.

**Run**, as used in this report, is a relatively shallow part of a stream with moderate velocity and little or no surface turbulence.

**Runoff** is the quantity of water that is discharged (“runs off”) from a drainage basin during a given time period. Runoff data may be presented as volumes in acre-feet, as mean discharges per unit of drainage area in cubic feet per second per square mile, or as depths of water on the drainage basin in inches. (See also “Annual runoff”)

**Sea level**, as used in this report, refers to one of the two commonly used national vertical datums (NGVD 1929 or NAVD 1988). See separate entries for definitions of these datums.

**Seven-day, 10-year low flow ( $7Q_{10}$ )** is the discharge below which the annual 7-day minimum flow falls in 1 year out of 10 on the long-term average. The recurrence interval of the  $7Q_{10}$  is 10 years; the chance that the annual 7-day minimum flow will be less than the  $7Q_{10}$  is 10 percent in any given year. (See also “Annual 7-day minimum” and “Recurrence interval”)

**Shelves**, as used in this report, are streambank features extending nearly horizontally from the flood plain to the lower limit of persistent woody vegetation.

**Stage** (See “Gage height”)

**Stage-discharge relation** is the relation between the water-surface elevation, termed stage (gage height), and the volume of water flowing in a channel per unit time.

**Streamflow** is the discharge that occurs in a natural channel. Although the term “discharge” can be applied to the flow of a canal, the word “streamflow” uniquely describes the discharge in a surface stream course. The term “streamflow” is more general than “runoff” as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

**Surface area of a lake** is that area (acres) encompassed by the boundary of the lake as shown on USGS topographic maps, or other available maps or photographs. Because surface area changes with lake stage, surface areas listed in this report represent those determined for the stage at the time the maps or photographs were obtained.

**Thalweg** is the line formed by connecting points of minimum streambed elevation (deepest part of the channel).

**Thermograph** is an instrument that continuously records variations of temperature on a chart. The more general term “temperature recorder” is used in the table descriptions and refers to any instrument that records temperature whether on a chart, a tape, or any other medium.

**Transect**, as used in this report, is a line across a stream perpendicular to the flow and along which measurements are taken, so that morphological and flow characteristics along the line are described from bank to bank. Unlike a cross section, no attempt is made to determine known elevation points along the line.

**Vertical datum** (See “Datum”)

**Water year** in USGS reports dealing with surface-water supply is the 12-month period October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 2002, is called the “2002 water year.”

**Watershed** (See “Drainage basin”)

**WDR** is used as an abbreviation for “Water-Data Report” in the REVISED RECORDS paragraph to refer to State annual hydrologic-data reports. (WRD was used as an abbreviation for “Water-Resources Data” in reports published prior to 1976.)

**Weighted average** is used in this report to indicate discharge-weighted average. It is computed by multiplying the discharge for a sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the sum of the discharges. A discharge-weighted average approximates the composition of water that would be found in a reservoir containing all the water passing a given location during the water year after thorough mixing in the reservoir.

**WSP** is used as an acronym for “Water-Supply Paper” in reference to previously published reports.

## CURRENT WATER RESOURCES PROJECTS IN NEW JERSEY

The U.S. Geological Survey is currently involved in a number of hydrologic investigations in the State of New Jersey. The following is a list of these investigations. Results are published at the conclusion of short-term projects or periodically in the case of long-term projects. Hydrologic data from these projects are entered into the NWIS data base.

An application to integrate GIS and database processing steps for conducting public supply susceptibility assessments  
Delaware River Basin National Water Quality Assessment

Determination of the hydrologic and ecological effects of ground-water diversions from the Kirkwood-Cohansey  
aquifer system in the Pinelands Area

Determining Impacts on Special Protection Waters in the Delaware Water Gap National Recreation Area  
EPA Technical Assistance Program

Evaluation of the changes in hydrology and ground- and surface-water quality in an urban wetland as part of a  
wetlands restoration effort

Flood Characteristics of New Jersey Streams

Flow Characteristics and Basis for Development of Ecological Goals for New Jersey Streams

Geohydrology of the Naval Air Warfare Center, West Trenton, New Jersey

Ground-Water Data Collection Network

Ground-Water Levels and Chloride Concentrations in Major Aquifers of the Coastal Plain

Ground-Water Supply Availability in Southern Ocean County

Head of Tide Sampling Program for the New Jersey Harbor Toxic Contaminant Assessment Reduction Program  
 Hydrogeologic Investigation to Ensure Sustainable Water Supply for Cape May County  
 Hydrologic data for Neldon's Brook and Indian Brook in the Swartswood Lake Basin  
 Identification of sources of arsenic to the Wallkill River Watershed  
 Investigation of Hydrogeology and Volatile Organic Compound Contamination in Fair Lawn, New Jersey  
 Investigation of Hydrogeology and Volatile Organic Compound Contamination in the Pohatcong Valley, New Jersey  
 Investigation of Potential Threats to Water Supply from the Potomac-Raritan-Magothy Aquifer in Salem and Western Gloucester Counties, New Jersey  
 Lower Delaware Non-Point Source  
 Low Flow Characteristics of New Jersey Streams  
 Modeling and Experimental Investigation of Hydrocarbon Transport and Biodegradation in the Unsaturated Zone  
 Movement of Chromium in the Ground Water of Pennsauken Township, Camden County  
 New Jersey Drought Monitoring System  
 New Jersey-Long Island National Water Quality Assessment  
 New Jersey Tide Telemetry System  
 Occurrence and Distribution of Trace Level Organics in Waste Water and Streams  
 Pascack Brook Flood Warning System  
 Passaic Flood Warning System  
 Passaic River Basin Flow Model  
 Program to Maintain and Update Ground-Water Models to Evaluate Continued Water-Supply Development  
 Quality of Water Data Collection Network  
 Quantification of Radium Mass Loading and Radioactivity in the Shallow Aquifer from the Water-Softening-Treatment Backwash Waste Stream that is Discharged to Septic Systems  
 Radionuclides in Public Water Supply Systems  
 Rahway Flood Warning System  
 Refinement of a Data Model for Watershed Water Transfer Analysis, Phase 2  
 Small Watershed Flood Data Collection  
 Somerset County Flood-Information System  
 Surface Water Data Collection Network  
 Validation of Membrane Diffusion Sampler for soluble inorganic and all organic (volatile/nonvolatile) contaminants in ground water  
 Water Budget Analysis of Confined Aquifers for Water-Supply Planning and Regulation  
 Water Budgets and Ground-Water Availability in the Delaware River Basin  
 Water-Quality Characteristics of Upper-Delaware Watershed

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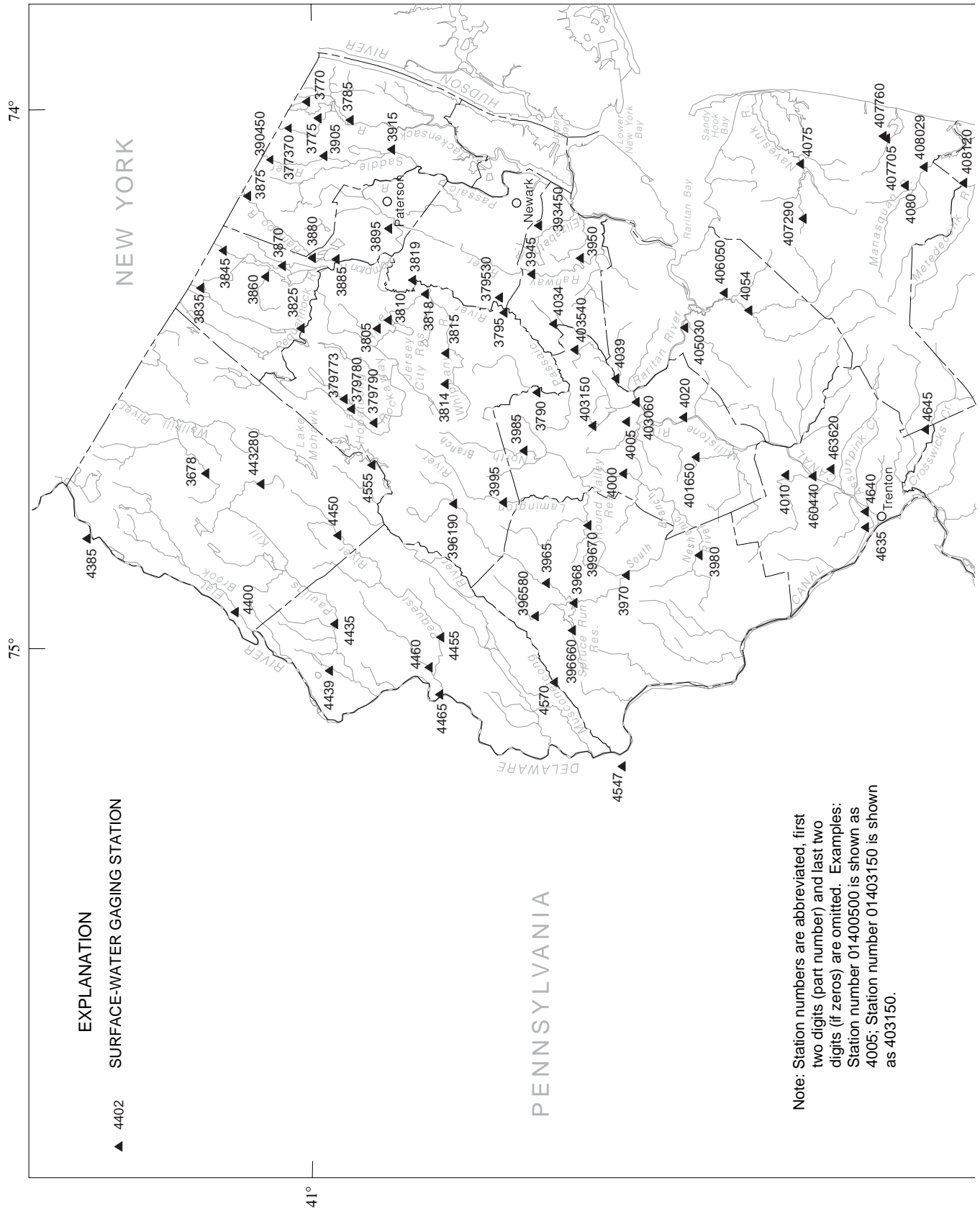
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**WATER RESOURCES DATA-NEW JERSEY, 2005**



**EXPLANATION**

▲ 4402 SURFACE-WATER GAGING STATION

Note: Station numbers are abbreviated, first two digits (part number) and last two digits (if zeros) are omitted. Examples: Station number 01400500 is shown as 4005; Station number 01403150 is shown as 403150.

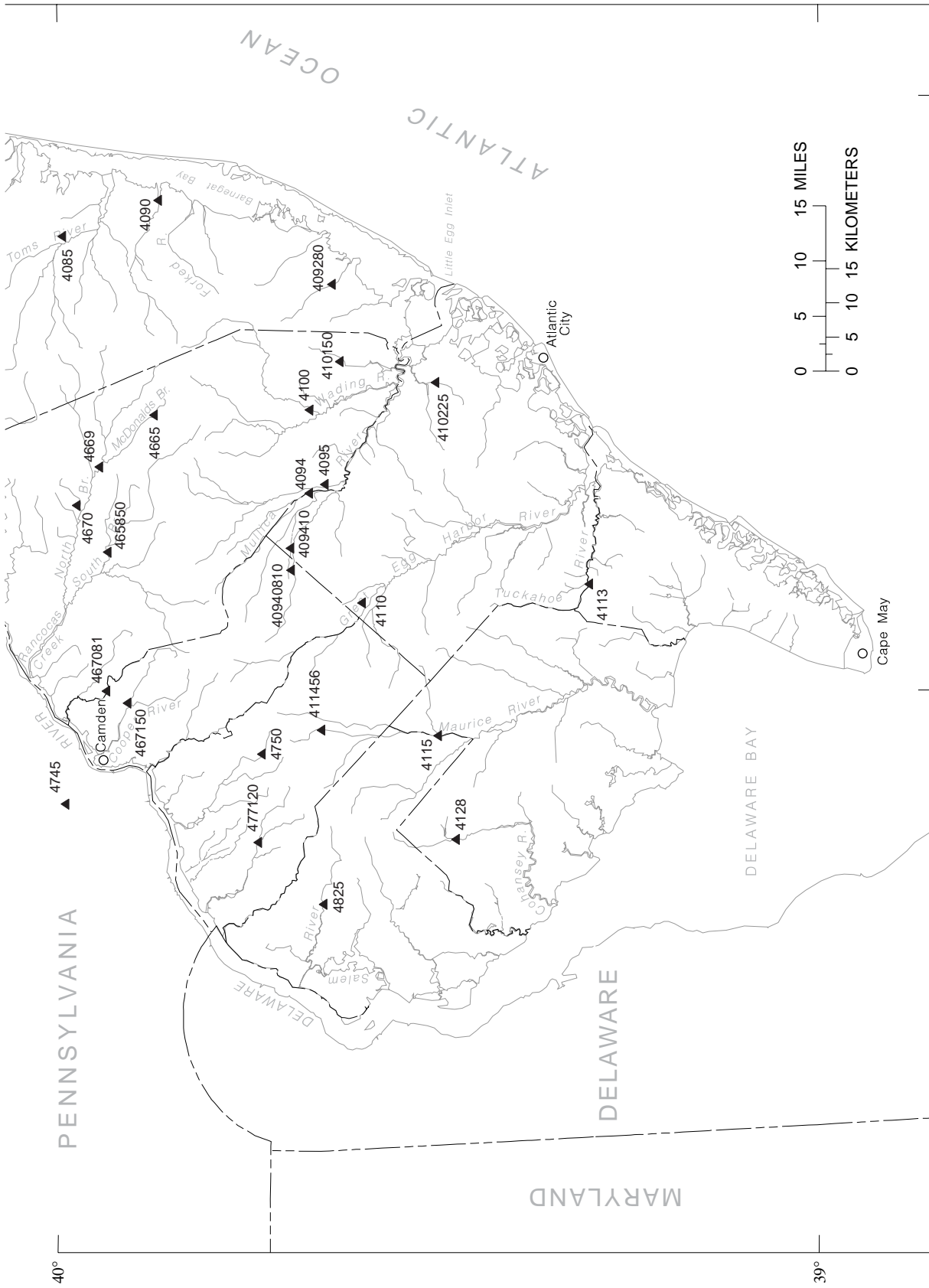
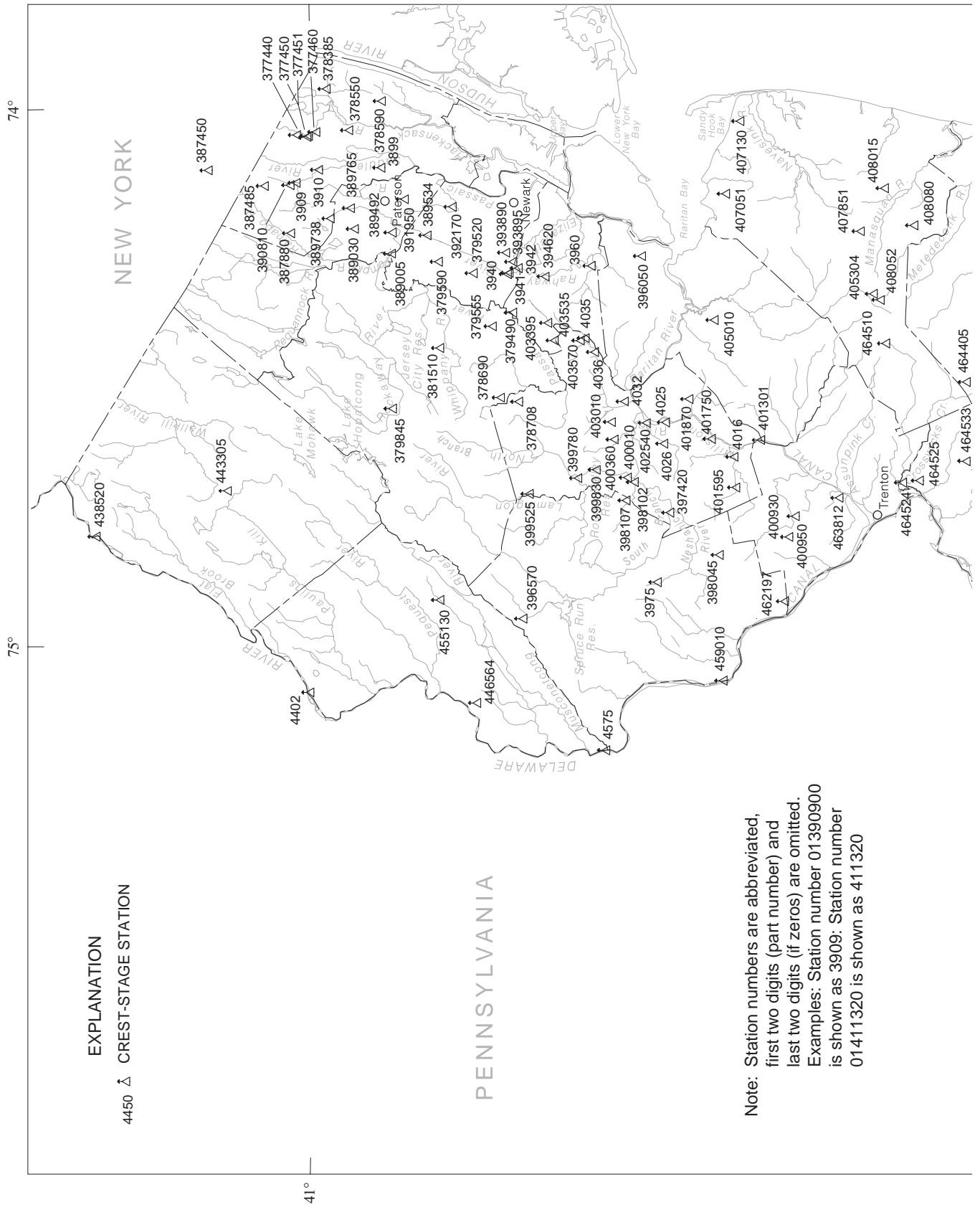


Figure 8. Map showing locations of surface-water gaging stations.

WATER RESOURCES DATA-NEW JERSEY, 2005



EXPLANATION

4450 ▲ CREST-STAGE STATION

Note: Station numbers are abbreviated, first two digits (part number) and last two digits (if zeros) are omitted. Examples: Station number 01390900 is shown as 3909; Station number 01411320 is shown as 411320

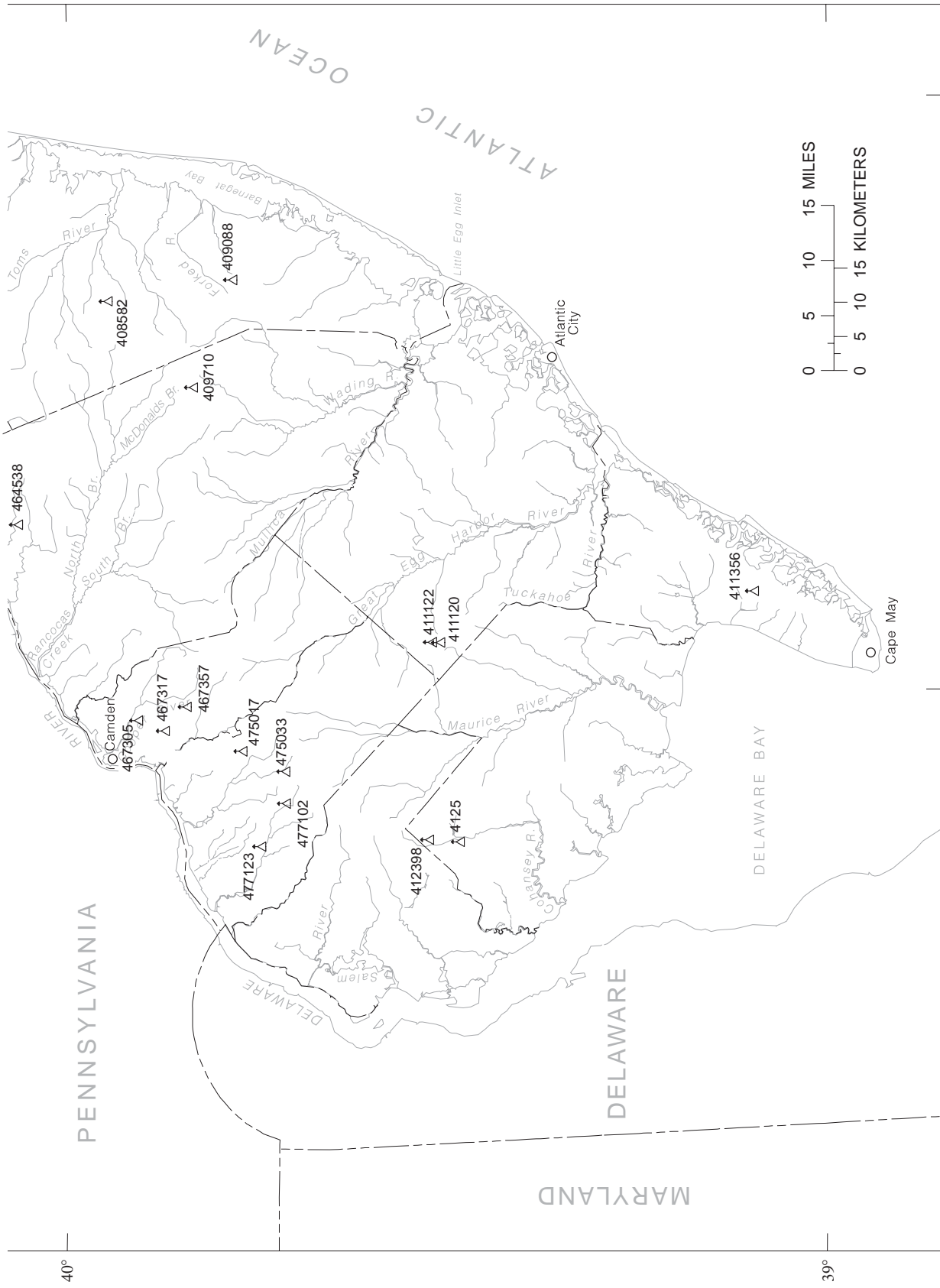
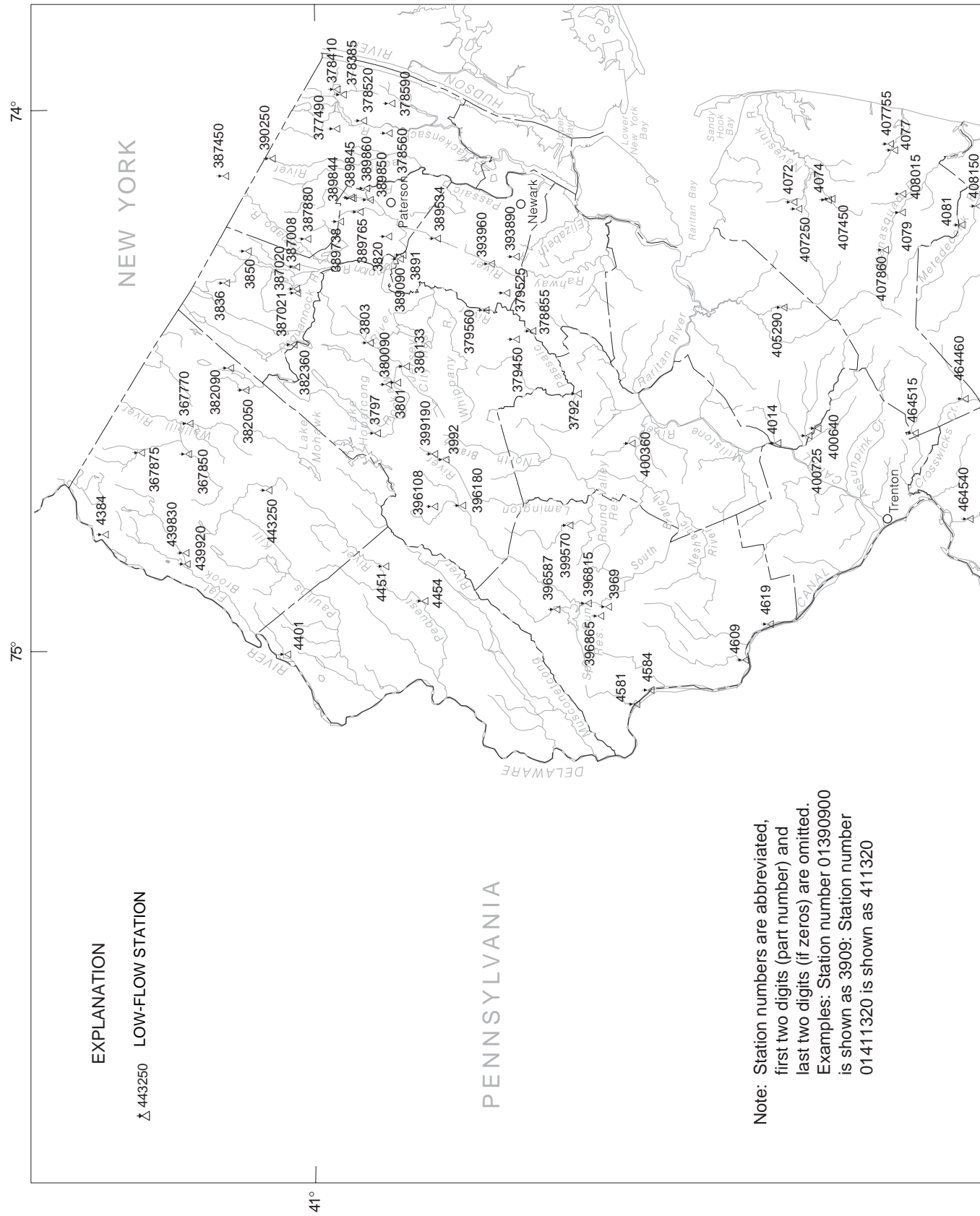


Figure 9. Map showing locations of crest-stage partial-record stations.



EXPLANATION

△ 443250 LOW-FLOW STATION

Note: Station numbers are abbreviated, first two digits (part number) and last two digits (if zeros) are omitted.  
 Examples: Station number 01390900 is shown as 3909; Station number 01411320 is shown as 411320



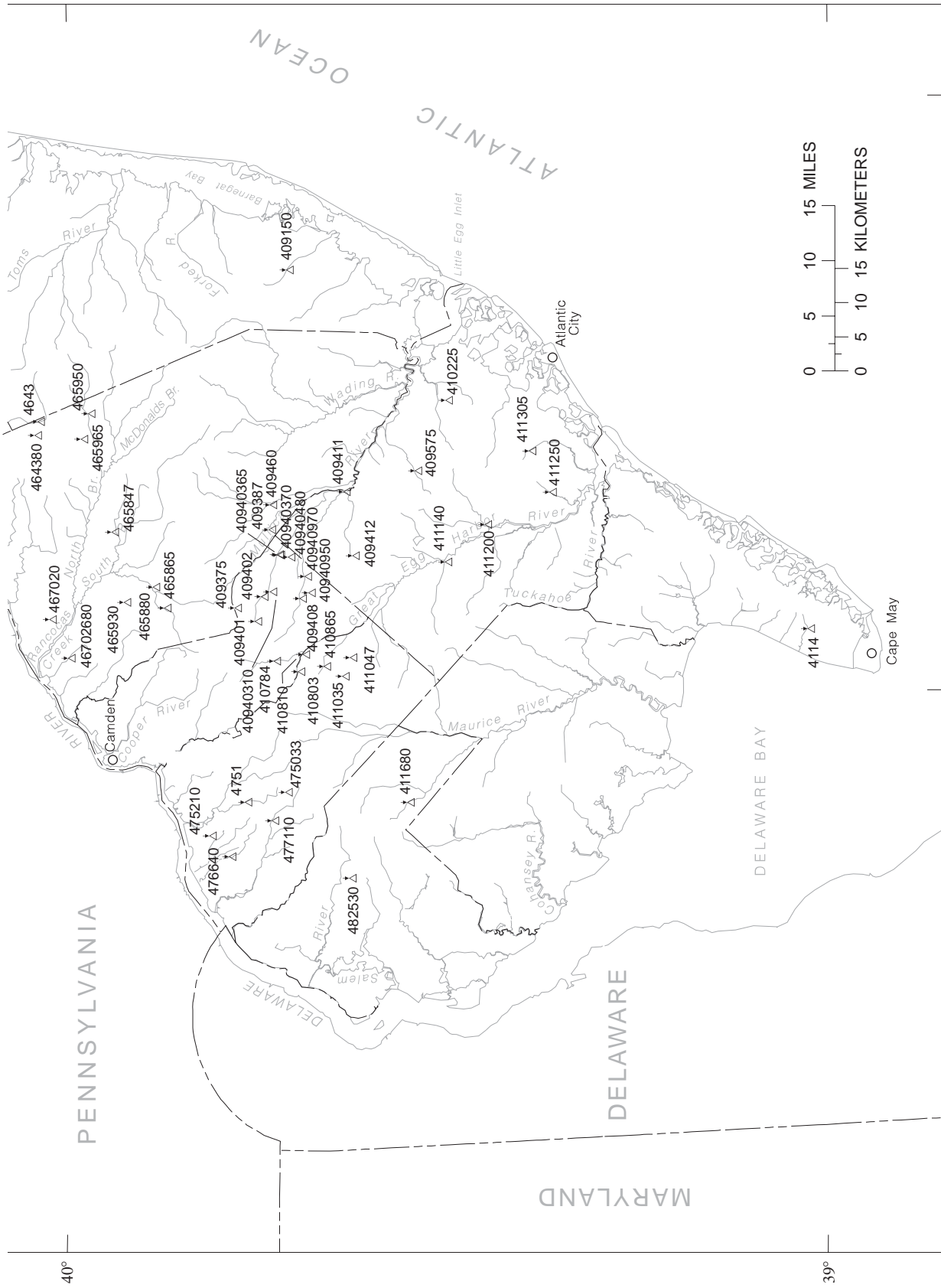
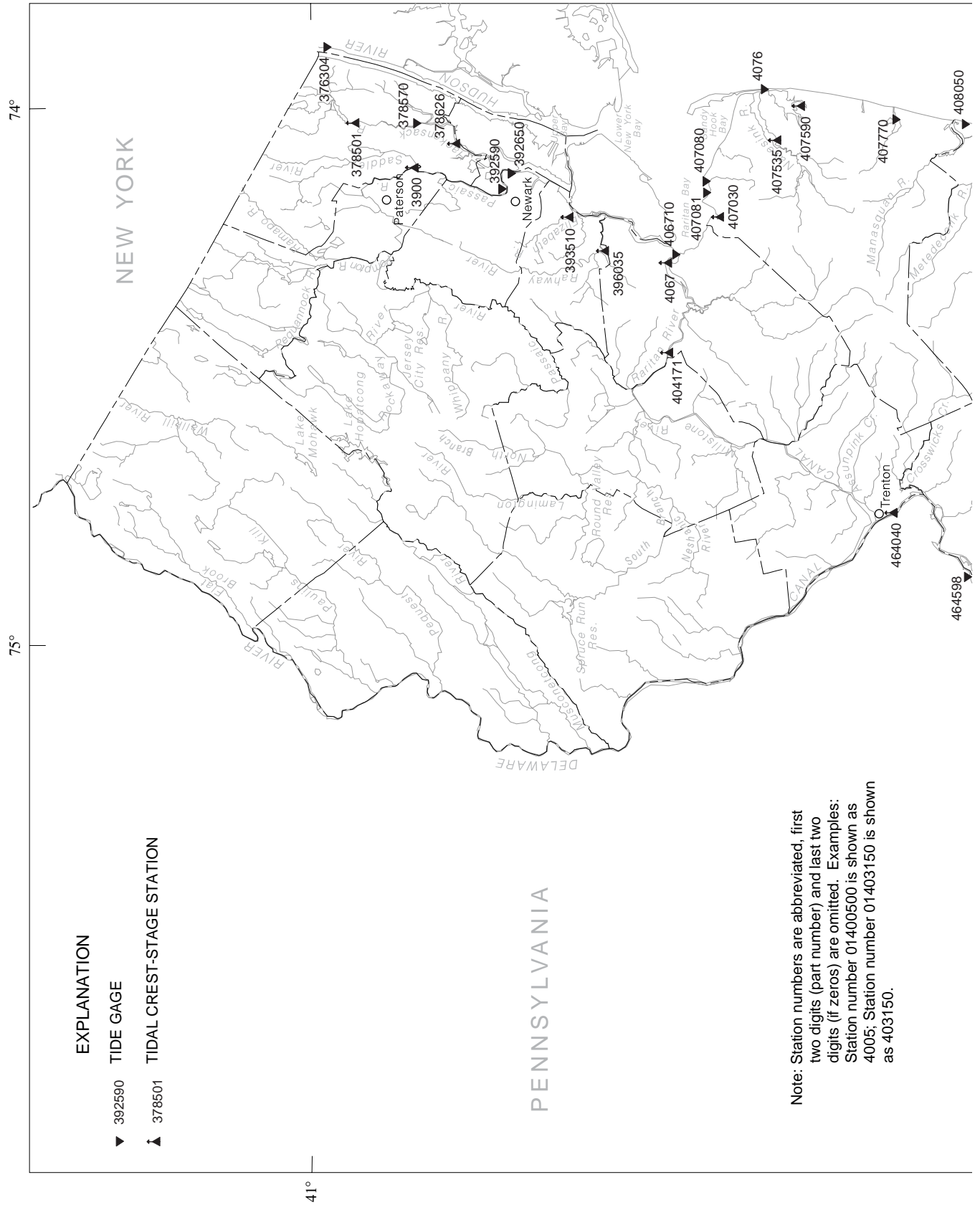


Figure 10. Map showing locations of low-flow partial-record stations.

WATER RESOURCES DATA-NEW JERSEY, 2005



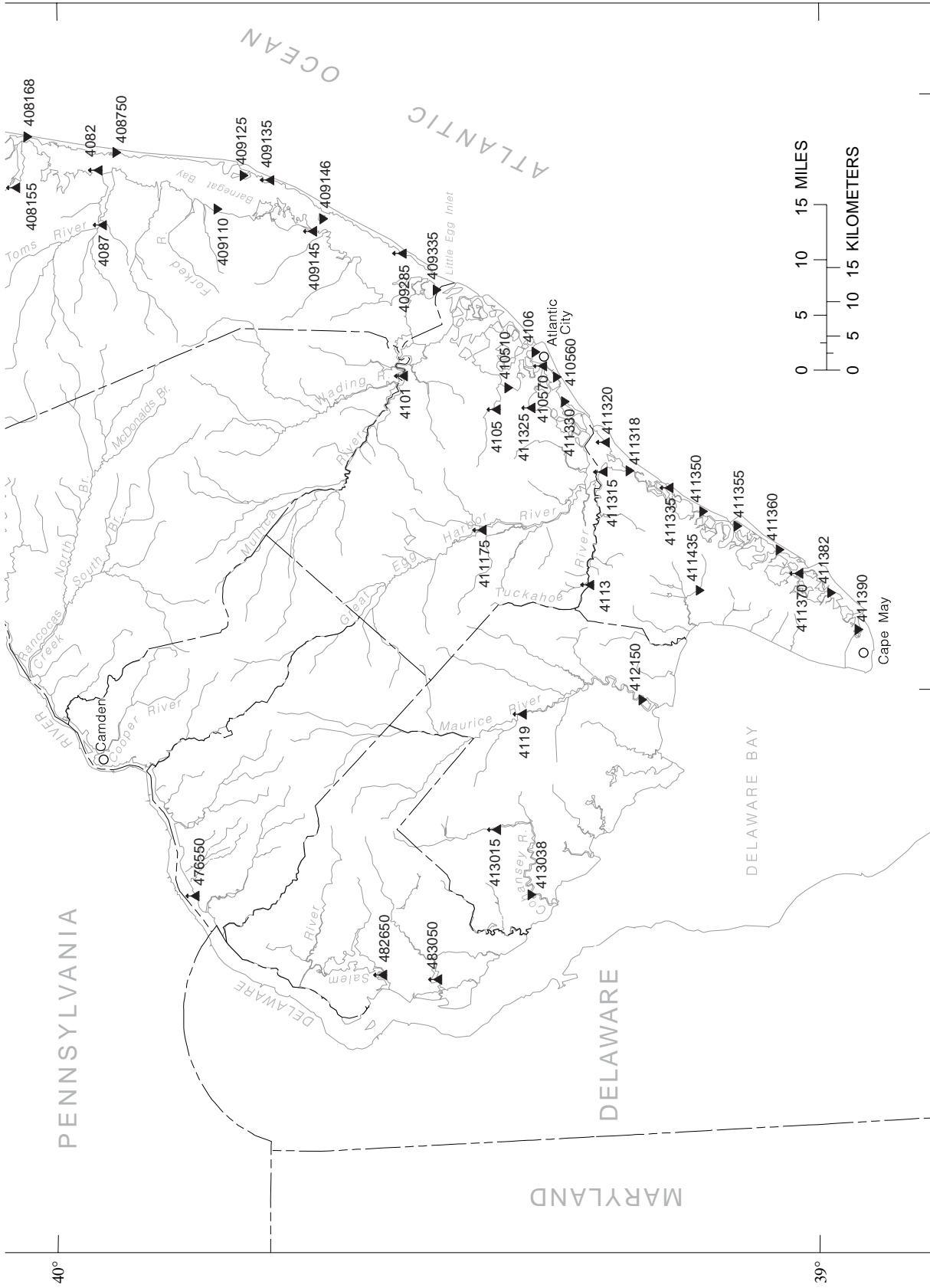


Figure 11. Map showing locations of tide gage and tidal crest-stage partial-record stations.

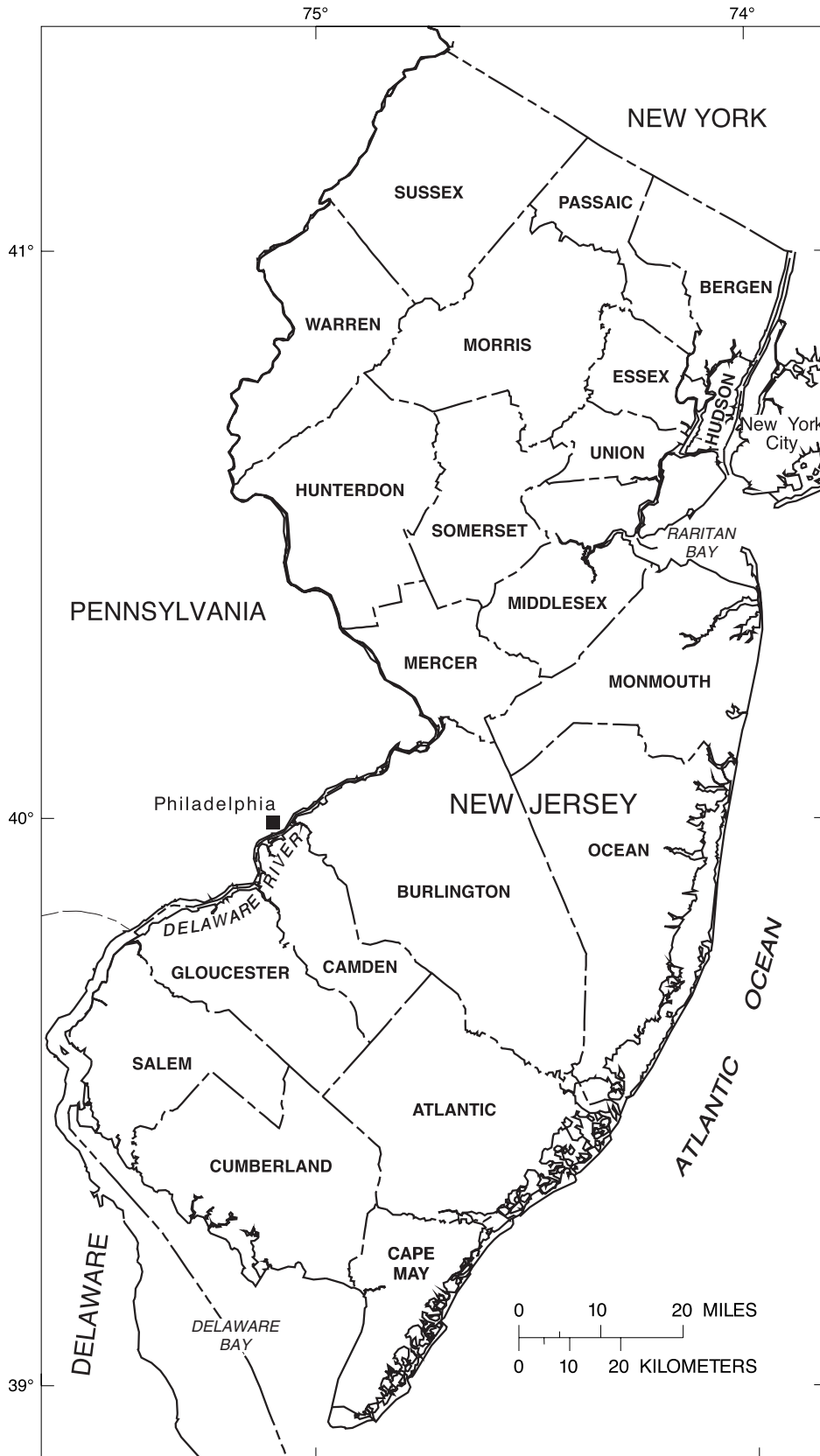


Figure 12. Counties in New Jersey.

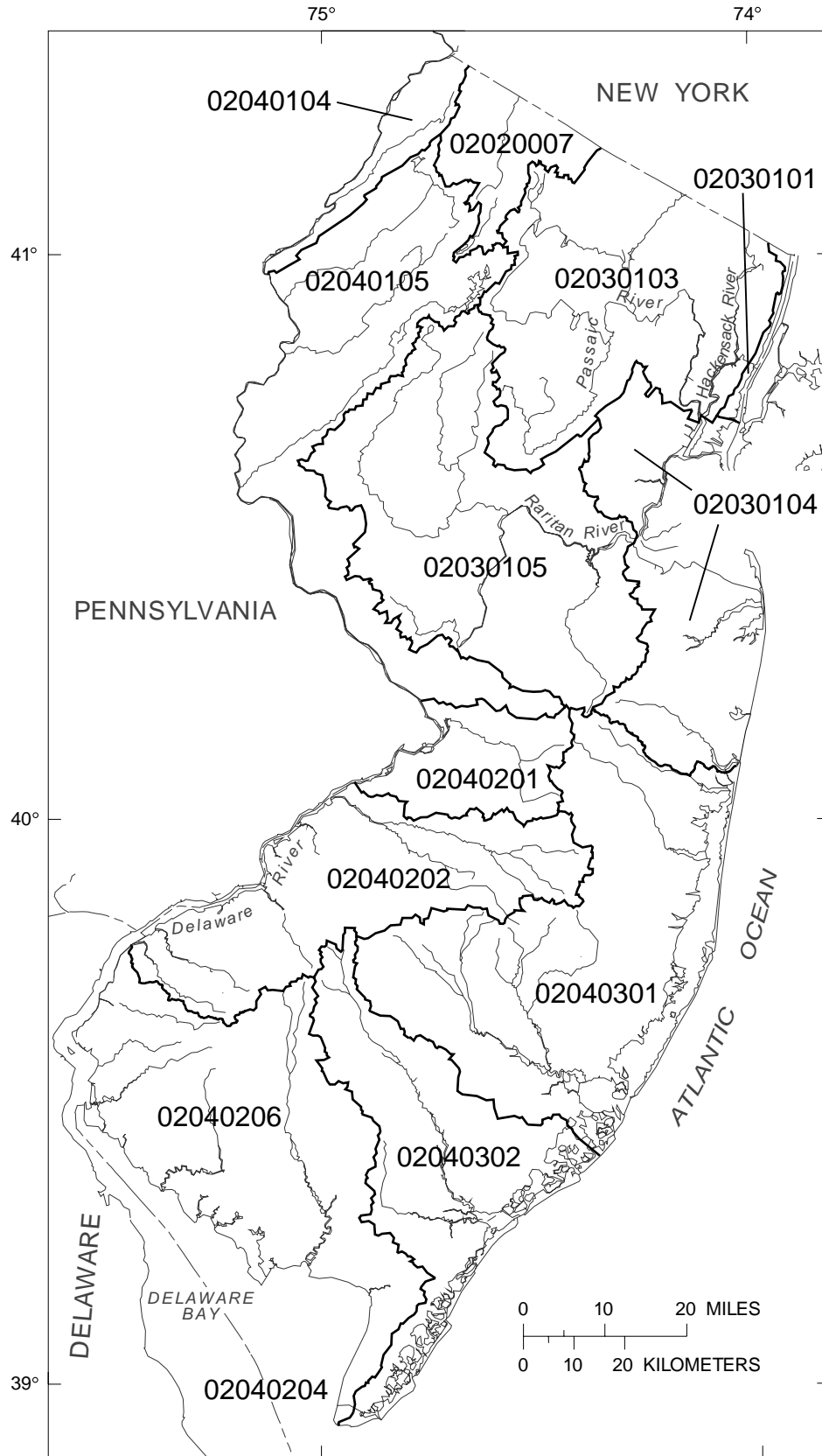


Figure 13. Cataloging units and codes in New Jersey. (Modified from Seaber and others, 1987)