REPORT OF

THE RIVER MASTER

OF THE DELAWARE RIVER

For the period
December 1, 1986 - November 30, 1987

by Stanley P. Sauer, William E. Harkness, and Bruce E. Krejmas
with a section on water quality by Kirk E. White

U.S. GEOLOGICAL SURVEY

Open-File Report 88-462

Reston, Virginia

1988

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

Delaware River Master
U.S. Geological Survey
433 National Center
Reston, VA 22092

or

Deputy Delaware River Master
U.S. Geological Survey
405 Broad Street
Milford, PA 18337

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FACTORS FOR CONVERTING INCH-POUND UNITS TO METRIC (INTERNATIONAL SYSTEM) UNITS

Multiply Inch-Pound unit	By	To Obtain Metric unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
million gallons (Mgal)	3,785	cubic meter (m^3)
billion gallon	3.785	cubic hectometer (m^3)
cubic foot per second-day (cfs-day)	0.002447	cubic hectometer (hm^3)
	Flow	
million gallons per day (mgd)	0.04381	cubic meter per second (m^3/s)
cubic foot per second (cfs)	0.02832	cubic meter per second (m^3/s)

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

Section I

RIVER MASTER LETTER OF TRANSMITTAL

and

SPECIAL REPORT

page 3 follows

OFFICE OF THE DELAWARE RIVER MASTER
United States Geological Survey
433 National Center, Reston, Virginia 22092

August 5, 1988

The Honorable
William H. Rehnquist
Chief Justice of the Supreme Court
of the United States

The Honorable
Michael N. Castle
Governor of Delaware

The Honorable
Thomas H. Kean
Governor of New Jersey

The Honorable
Mario M. Cuomo
Governor of New York

The Honorable
Robert P. Casey
Governor of Pennsylvania

The Honorable
Edward I. Koch
Mayor of the City of New York

New Jersey v. New York et al
No. 5 Original, October Term 1950

Dear Sirs:

For the record and in compliance with the provisions of the Amended Decree of the Supreme Court of the United States entered June 7, 1954, I am transmitting herewith the thirty-fourth Annual Report of the River Master of the Delaware River for the year December 1, 1986 to November 30, 1987.

Precipitation in the upper Delaware River basin during the 1987 River Master report year varied from 15 percent of the long-term average during February to 193 percent during September (See table 1). Total precipitation during the year was about 0.5 inches above average. Heavy precipitation (134 percent of average) occurred primarily as snow during January and resulted in fairly heavy snow cover over much of the upper basin.

A snow survey during the first week of February indicated an average of 3.2 inches equivalent above Cannonsville Reservoir, 3.6 inches above Pepacton and 5.4 inches above Neversink. Storage in the reservoirs at that time was 85 percent of capacity, Cannonsville was already spilling, and the potential existed for very high runoff during the spring thaw. However, precipitation during February and March was very low and melting proceeded slowly, thus reducing flood potential downstream. Most of the snow pack melted prior to any significant precipitation. The peak discharge at Montague was 65,200 cfs on April 5, 1987. This peak had approximately a 2-year recurrance interval and occurred as the result of rainfall averaging about 3.3 inches during the previous week.

On December 1, 1986, when the report year began, combined storage in the New York City reservoirs in the upper Delaware River basin was 225 billion gallons, 83 percent of capacity. All reservoirs filled to capacity during the winter and spring. Cannonsville began spilling on December 6 and spilled continuously until April 28 except for a brief period, February 24 to March 2, when the storage was within 0.8 ft. of spillway level. A total of 68.7 billion gallons spilled in addition to the augmented conservation releases and a few small directed releases during February.

Pepacton reservoir filled to capacity on April 7, and spilled a total of 13.2 billion gallons from April 7-24. Neversink Reservoir filled on April 6 and spilled a total of 8.3 billion gallons April 6 to May 5.

The reservoirs reached a maximum combined storage of 278.160 billion gallons, 102.7 percent of capacity on April 8, 1987. On June 1, 1987, the start of the water operations year, storage was 250.826 billion gallons, 92.6 percent of capacity. Median storage for June 1st is 270.194 billion gallons, 99.8 percent. The minimum combined storage during the year was 174.060 billion gallons, 64.3 percent of capacity on September 8, 1987.

Throughout the year, diversions for water supply for New York City and releases designed to maintain the flow of the Delaware River at Montague were made as directed by this office and as provided in the Decree. Diversions by New York City from the Delaware River basin reservoirs did not exceed the limit specified by the Decree.

Orange and Rockland Utilities, Inc. brought the Rio powerplant back on line in mid-February. The plant had not been used since the penstock collapsed in 1979. Records of forecast and actual releases used by this office for the Mongaup system are for Mongaup reservoir December 1 to February 25 and Rio reservoir February 26 to November 30.

The Delaware River Master Advisory Committee met at Shawnee-on-Delaware, Pennsylvania on May 13, 1987 to discuss hydrologic conditions in the basin and operational procedures during the 1987 release season. The River Master informed the committee that the excess release quantity that would be released beginning June 15 was 7.381 billion gallons. This quantity would be released at rates designed to maintain the Montague target flow at 100 cfs above the normal 1,750 cfs specified by the Decree.

A proposal by Pennsylvania at the advisory committee meeting in May 1986 to change the method currently being used to correct errors in forecasting releases required to maintain the Montague formula was discussed. The Milford office presented a study of the proposal which compared it with the method currently being used and recommended to the Advisory Committee that no change be made at this time. The Advisory Committee accepted that recommendation. However, it was also recommended that we continue to explore ways to improve the forecasting procedures.

Also discussed at the meeting were the plans by New Jersey and the U.S. Geological Survey for the installation of a new gage to correct the inadequacy of the monitoring system for the New Jersey diversions through the Delaware & Raritan Canal. At that time, plans were underway to install an accoustic velocity meter and remote transmission equipment designed to meet the need for information. The installation of the gage was completed in September but because some of the equipment was damaged in shipment, the gage was not yet in operation by the end of the report year. Diversions by New Jersey from the basin during the year were within the limits permitted by the Decree.

During June and July conditions in the upper basin resulted in an unusually high demand on the thermal stress relief bank provided for in the "Interstate Water Management Recommendations of the Parties to the 1954 Decree". By August 4, 4,103 cfs-days of the 6,000 cfs-days available in the bank had been expended and conditions indicated that the remainder would be expended within a few days. On August 5, at the request of New York State, the Parties to the Decree, the Delaware River Basin Commission and this office agreed to set aside 3,000 cfs-days from the excess release quantity to be used for thermal stress relief if needed prior to September 30, 1987 (DRBC Resolution No. 87-20). However, soon after the August 5 action was taken, conditions in the basin changed. The power companies reduced their releases and precipitation decreased resulting in a lower contribution from the upper basin and requiring large directed releases from New York City reservoirs. As a result, none of the 3,000 cfs-days which were set aside for thermal protection were used. The remainder of the excess release quantity was expended by August 31, 1987. In order to avoid reducing the Montague flow objective from 1,850 cfs to 1,750 cfs September 1 and then returning to 1,850 cfs in October, we requested New York State to relinquish one-half (1,500 cfs-days) of the set-aside as of September 1, so that it could be returned to the excess quantity at that time. New York State and the parties to the Decree agreed with this procedure. On October 1, 1987, when the original agreement expired, the other half of the set-aside was returned to the excess release quantity because none had been required for relief of thermal stress.

During the report year, the River Master and staff participated in meetings of the Delaware River Basin Commission to assess water-supply conditions. Upon invitation of the representatives of parties to the Decree, the Deputy River Master met periodically with those representatives as a member of the Flow Management Technical Advisory Committee. Discussions primarily centered on proposals for the management of releases from reservoirs in the basin and other measures designed to cope with streamflow deficiences whenever they occur.

The U.S. Geological Survey continued the operation of its field office of the Delaware River Master at Milford, Pennsylvania. William E. Harkness, Deputy Delaware River Master, continued in charge of the office, assisted by Bruce E. Krejmas and Beverly A. Roberts.

During the report year, the Milford office continued the weekly distribution of summary river data. These weekly reports contained preliminary data on releases from the New York City reservoirs to the Delaware River, diversions to the New York City water-supply system, reservoir contents, daily segregation of flow of the Delaware River at Montague gaging station, and diversions by New Jersey. The reports were made available to the State and City representatives on the Delaware River Master Advisory Committee and to other parties interested in the Delaware River operations. A special monthly summary of past hydrologic conditions, supplemented by an "outlook" of the river flow for the forthcoming month, was made available to the representatives on the Advisory Committee.

Section II of the report describes in detail Delaware River operations during the report year. As shown on page 18, the City of New York diverted a total of 244.499 billion gallons from the basin during the report year ending November 30, 1987 and released 65.246 billion gallons from Pepacton, Cannonsville, and Neversink Reservoirs to the Delaware River during the same period. The River Master directed releases to the Delaware River from these reservoirs totaling 26.710 billion gallons.

Section III of the report describes water quality at various sites in the Delaware River Estuary. It was prepared by Kirk E. White, U.S. Geological Survey, Malvern, Pennsylvania. It contains data showing the extent of salinity encroachment and other water-quality characteristics in the estuary.

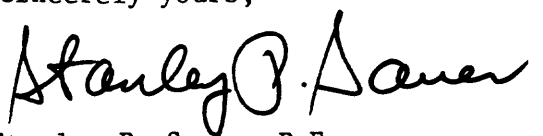
During the report year, the following individuals functioned as members of the River Master Advisory Committee:

Delaware	Dr. Robert R. Jordan
New Jersey	Dirk C, Hofman, P.E.
New York	William H. Lee
New York City	Harvey W. Schultz
Pennsylvania	R. Timothy Weston John E. McSparran

The appreciation of the River Master and staff is expressed for the continued excellent cooperation of all the representatives of the parties to the Decree. Also, appreciation is extended to the Pennsylvania Power & Light Company and the Orange and Rockland Utilities, Inc., for their cooperation in keeping us informed of their plans for power generation and resulting releases as requested by this office. As usual, it is gratifying to report that New York City complied willingly with the terms of the Decree and with the directives of the River Master.

A draft of this report was furnished to the Advisory Committee members for comment.

Sincerely yours,



Stanley P. Sauer, P.E.
Delaware River Master

Section II

REPORT OF DELAWARE RIVER OPERATIONS

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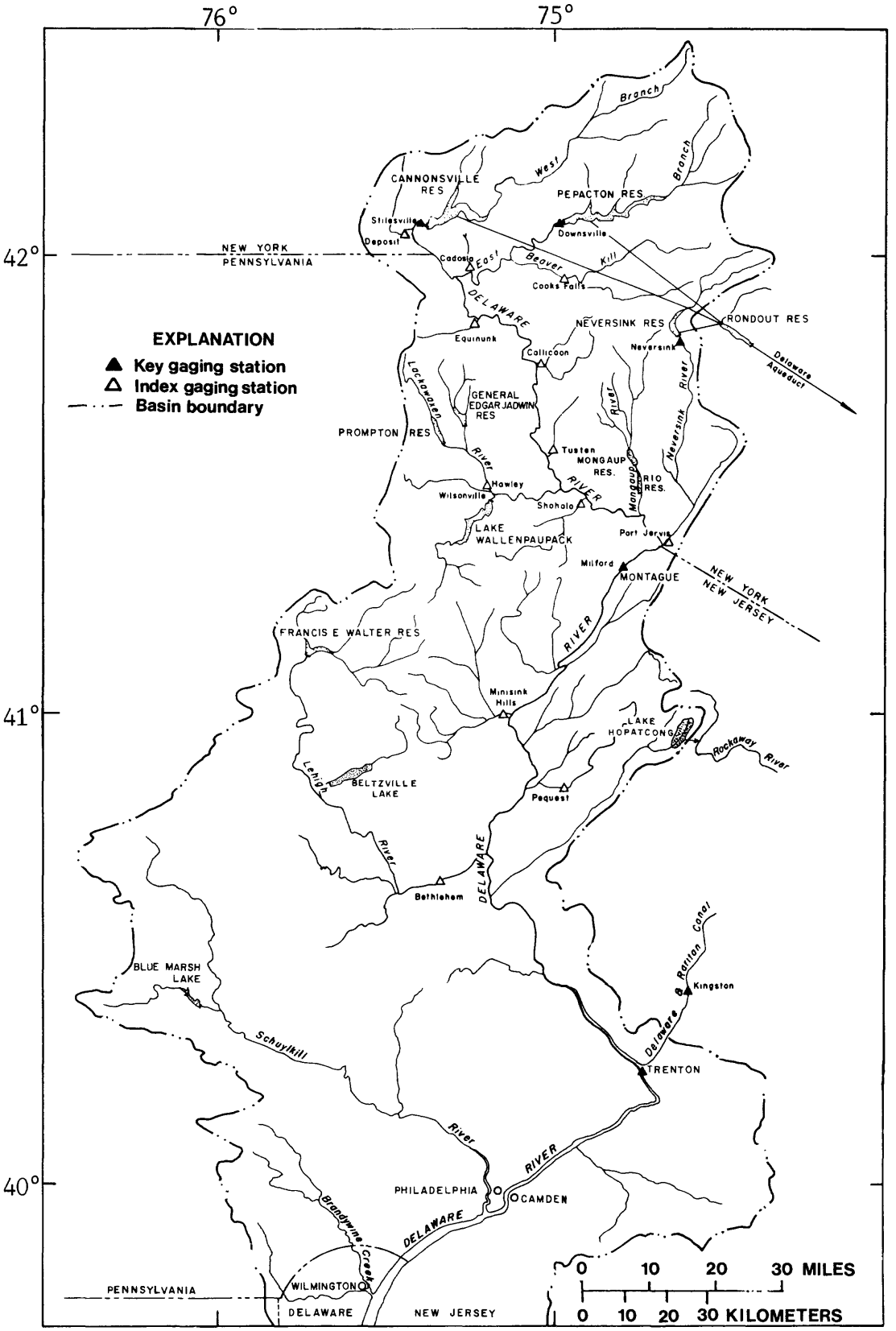

Figure 1. - Delaware River basin above Wilmington, Delaware.

Section II

REPORT OF DELAWARE RIVER OPERATIONS

by William E. Harkness and Bruce E. Krejmas

ABSTRACT

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin (Figure 1) and requires compensating releases from certain reservoirs by New York City to be made under the supervison and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated.

During the 1987 report year, December 1, 1986, to November 30, 1987, precipitation and runoff ranged from below average to above average in the Delaware River basin. For the year as a whole, precipitation was 0.49 inches above average. Conditions in the basin remained in the normal zone of the operation curves for the reservoirs throughout the year and operations were conducted as prescribed by the Decree for the entire report year. On December 1, 1986, combined storage in New York City Delaware River Basin reservoirs was 83 percent of capacity. During the winter months, storage increased to capacity and all three reservoirs spilled.

Diversions from the Delaware River basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 73 days during the year. Releases were made at augmented conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. The excess release quantity as defined by the Decree was not expended by the end of the report year.

New York City complied fully with the terms of the Decree and with the directives of the River Master during the year.

INTRODUCTION

The Amended Decree of the United States Supreme Court entered June 7, 1954 authorized diversions of water from the Delaware River basin and provided for releases of water from certain New York City reservoirs to the Delaware River to be made under the supervision and direction of the River Master. The Decree also stipulated that reports be made to the Court not less frequently than annually. This report describes the River Master operations from December 1, 1986 to November 30, 1987.

Part of the hydrologic data presented are records of U.S. Geological Survey gaging stations. These records were collected, computed and furnished by the Offices of the U.S. Geological Survey at Albany, New York, Malvern, Pennsylvania, and Trenton, New Jersey, in cooperation with the States of New York and New Jersey, the Commonwealth of Pennsylvania, and the City of New York.

Definitions of Terms and Procedures

The following definitions apply to various terms and procedures used in the operations described in this report. A table for converting inch-pound units to International System of Units (SI) is given on page v. The map of the Delaware River basin (fig. 1), indicates the location of pertinent streams and reservoirs.

Time of day. - Time of day is expressed in 24-hour eastern standard time, which included a 23-hour day April 5 and a 25-hour day October 25.

Rate of flow. - Mean discharge for any stated 24-hour period, in cubic feet per second (cfs) or million gallons per day (mgd).

Rate of flow at Montague. - Daily mean discharge of the Delaware River at Montague, N.J., on a calendar-day basis.

Reservoir-controlled releases. - Controlled releases from reservoirs passed through outlet valves in the dams or through turbines in powerplants. This does not include spillway overflow at the reservoirs.

Uncontrolled runoff at Montague. - Runoff from the drainage area above Montague exclusive of the drainage area above the Downsville, Cannonsville, Neversink, Wallenpaupack, and Mongaup dams but including spillway overflow at these dams.

Point of maximum reservoir depletion. - Elevation at the top of the highest outlet, sometimes referred to as minimum full-operation level.

Storage or contents. - Usable volume of water in a reservoir. Unless otherwise indicated, volume is computed on the basis of level pool and above the point of maximum depletion.

Capacity. - Total usable volume between the point of maximum depletion and the elevation of the lowest crest of the spillway.

Diversions. - New York City diverts water from Pepacton, Cannonsville, and Neversink Reservoirs in the upper Delaware River basin through the East Delaware, West Delaware, and Neversink Tunnels, respectively, to its water-supply system.

New Jersey diverts water from the Delaware River through the Delaware & Raritan Canal.

Excess quantity and seasonal period for its release. - As defined in the Decree, the excess quantity of water equals 83 percent of the amount by which the estimated consumption in New York City during the year is less than the City's estimate of continuous safe yield (1,665 mgd stipulated by 1954 Decree) from all its sources of supply obtainable without pumping, except that the excess quantity should not exceed 70 billion gallons. Each year the "seasonal period" for release of excess quantity begins on June 15. The design rate for that period becomes effective at Montague on that date and continues in effect until the following March 15, or until the cumulative total of excess-release credits becomes equal to the seasonal quantity, whichever occurs first.

Daily excess-release credits. - Daily credits and deficits during the seasonal period are equal to the algebraic difference between the daily mean discharge at Montague and 1,750 cfs; however, the daily credit cannot exceed the 24-hour period releases from Pepacton, Cannonsville and Neversink Reservoirs routed to Montague and made in accordance with direction, with the following exception. During the seasonal period, credits are also made for part or all of other releases from these reservoirs contributing to daily mean discharge at Montague between the excess-release rate and 1,750 cfs.

Precipitation

Precipitation observed on the basin above Montague totaled 43.79 inches for the 1987 report year and was 0.49 inches above the long term average. Precipitation ranged from 15 percent of the long-term average in February to almost 2 times the average in September. Table 1 compares the monthly precipitation during the report year with the long-term average.

Table 1.- Precipitation in inches,
Delaware River basin above Montague, N.J.

Month	December 1940 to November 1986 Average	December 1986 to November 1987			
		Amount	Percentage of average	Excess (+) or deficit (-) Month	Cumulative
December	3.47	2.87	83	-0.60	-0.60
January	2.89	3.86	134	+.97	+.37
February	2.81	.42	15	-2.39	-2.02
March	3.31	1.83	55	-1.48	-3.50
April	3.76	6.16	164	+2.40	-1.10
May	4.21	2.36	56	-1.85	-2.95
June	4.00	3.23	81	-.77	-3.72
July	4.12	4.47	108	+.35	-3.37
August	3.91	4.20	107	+.29	-3.08
September	3.68	7.12	193	+3.44	+.36
October	3.31	4.42	134	+1.11	+1.47
November	3.83	2.85	74	-.98	+.49
12 months	43.30	43.79	101	+.49	

These data were computed from records collected by the National Weather Service, New York City Department of Environmental Protection, Bureau of Water Supply and the River Master, at ten stations distributed over the basin area above Montague.

December to May is generally considered the normal time of year when surface- and ground-water reservoirs fill. During this period in 1986-87, precipitation totalling 17.50 inches was observed, which was 86 percent of the 46-year average. Precipitation during February was the second lowest in the period of record. During June to November, 26.29 inches of precipitation was observed, which was 115 percent of the long term average. The maximum monthly precipitation listed during the year for any of the ten stations was 8.91 inches in September at Neversink Dam; the minimum monthly precipitation observed was 0.31 inches in February at Cadosia, New York.

Acknowledgments

The River Master daily operation records were prepared by the Milford Office of the Delaware River Master from hydrologic data collected principally on a day-to-day basis. Data for these records were collected and computed by the Milford Office or were furnished by agencies, as follows: Data from Pepacton, Cannonsville and Neversink Reservoirs by the New York City Department of Environmental Protection, Bureau of Water Supply; from Lake Wallenpaupack by the Pennsylvania Power & Light Company; and from Mongaup and Rio Reservoirs by Orange and Rockland Utilities, Inc. Precipitation data and quantitative precipitation forecasts were provided by the National Oceanic and and Atmospheric Administration, National Weather Service.

OPERATIONS

December to May

During the first half of the report year, precipitation was 2.95 inches below average and ranged from 15 percent of the long term average in February to 164 percent in April (See table 1.) Runoff in the upper basin was above normal during April and was below normal during February and May.

On December 1, 1986, Pepacton Reservoir contained 113.025 billion gallons of water in storage above the point of maximum depletion, or 80.6 percent of the reservoir's storage capacity of 140.190 billion gallons. Cannonsville Reservoir contained 91.036 billion gallons, or 95.1 percent of the reservoir's storage capacity of 95.706 billion gallons and Neversink Reservoir contained 20.719 billion gallons, or 59.3 percent of the reservoir's storage capacity of 34.941 billion gallons. The combined storage in the three reservoirs as of December 1 was 224.780 billion gallons, or 83.0 percent of their combined capacity. Daily storages in Pepacton, Cannonsville and Neversink Reservoirs are shown in tables 9, 10 and 11, respectively and the combined storage is shown graphically in figure 2.

The excess release quantity for the seasonal period that began June 15, 1986 was 7.381 billion gallons (11,418 cfs-days). By December 1, 1986, the beginning of the report year, 5.877 billion gallons (9,092 cfs-days) had been credited against this quantity. Operations on this date were being conducted as prescribed by the Decree. The Montague flow objective was 1,850 cfs, 1,750 cfs from the Montague Formula and 100 cfs from the excess release quantity. Allowable diversions to New York City were 800 mgd and the average diversion since June 1, 1986 was 743 mgd. Allowable diversions to New Jersey were 100 mgd. Conservation releases from New York City reservoirs were being made at the augmented levels shown in table 2.

Table 2.- Conservation release rates for New York City Delaware River basin reservoirs

Reservoir	Operative dates	Conservation releases rates	
		Basic (cfs)	Augmented (cfs)
Neversink	April 1-7	5	45
	April 8 to October 31	15	45
	November 1 to March 31	5	25
Pepacton	April 1-7	6	70
	April 8 to October 31	19	70
	November 1 to March 31	6	50
Cannonsville	April 1-15	8	45
	April 16 to June 14	23	45
	June 15 to August 15	23	325
	August 16 to October 31	23	45
	November 1-30	23	33
	December 1 to March 31	8	33

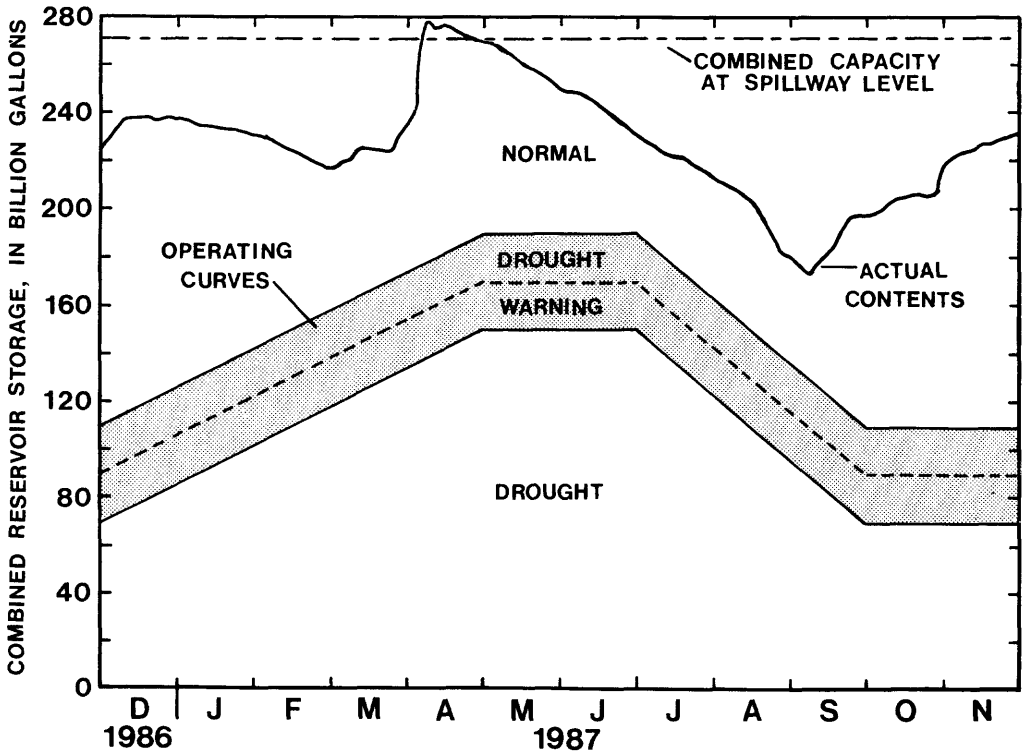

Figure 2. - Operating curves for New York City reservoirs in the Delaware River basin compared with the actual contents of reservoirs, December 1, 1986 to November 30, 1987. (Sources: Operating Curves from Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954, Reservoir contents from New York City Bureau of Water Supply data.)

Cannonsville Reservoir filled to capacity and began spilling on December 6, 1986. It spilled continuously from December 6 until April 28, except February 24 to March 2 when it was within 0.8 ft. of spillway level. The maximum volume of water in storage during this period was 102.997 billion gallons, 108 percent of capacity, on April 6. Approximately 68.7 billion gallons spilled during the year.

Pepacton Reservoir filled to capacity on April 7. The reservoir spilled April 7-24 with a total of 13.2 billion gallons being spilled.

Neversink Reservoir filled to capacity on April 6 and spilled continuously until May 5. A total of 8.3 billion gallons spilled during the period.

The combined storage in the reservoirs, as shown in figure 2, reached a peak for the year of 278.160 billion gallons, 102.7 percent of capacity, on April 8 when all reservoirs were spilling. During the December to May period, combined storage increased 28.264 billion gallons, or 10.4 percent of capacity.

Diversions to Rondout Reservoir by the City of New York totaled 112.030 billion gallons during the December 1 to May 31 period (616 mgd). During this same period, the anticipated discharge at Montague, exclusive of water released from the City reservoirs, fell below the applicable design rate on 16 days and releases totaling 3.142 billion gallons (4,861 cfs-days) were directed to meet the Montague flow objective. In addition to the River Master directed releases, New York City made releases for conservation purposes at the augmented conservation rates shown in table 2 throughout the period.

On March 14, the seasonal period for the release of the excess quantity that began June 15, 1986 expired with 6.207 billion gallons (9,602 cfs-days) of the available 7.381 billion gallons (11,418 cfs-days) having been released. The Montague design rate was changed from 1,850 cfs to 1,750 cfs on March 15.

There were seven days during the December to May period when the observed discharge at Montague was less than the prevailing design rate. (See table 15.) These deficiencies were the result of difficulty in predicting the effect of the accumulation of ice during cold weather on runoff and on transit time from the reservoirs.

Inflow to the City's reservoirs during the December through May period generally exceeds draft rates and therefore increases storage. The average inflow to Pepacton, Cannonsville, and Neversink Reservoirs for these six months during the 46-year period, December 1940 to May 1986, was 303.8 billion gallons. During the corresponding six months of the current report year, inflow to the three reservoirs totaled 253.0 billion gallons. Evaporation loss was not included in the computation. Storage in the three reservoirs increased from 223.121 billion gallons on November 30, 1986 to 251.385 billion gallons May 31, 1987.

June to November

Precipitation during the June to November period was below average in June and November, was above average in September and October and was near average in July and August. Precipitation for the period was 26.29 inches, which was 3.44 inches above average. (See table 1.) Heavy precipitation the last week of August and throughout September resulted in the flow at Montague, exclusive of releases from New York City reservoirs, being above the design rate from September 10 to November 30 and no releases were directed.

Diversions to Rondout Reservoir June 1 to November 30 totaled 132.469 billion gallons. The equivalent diversion rate did not exceed the limit specified by the Decree and was 724 mgd on November 30. Releases were directed to satisfy the Montague Formula on 57 days when the anticipated discharge at Montague exclusive of water released from the City reservoirs fell below the design rate. Releases at augmented conservation rates or at rates designed to relieve thermal stress were made at other times from each reservoir by the City of New York. A total of 5,112 cfs-days (3.304 billion gallons) was released for the relief of thermal stress between May 29 and September 9.

The New York City Department of Environmental Protection, Bureau of Water Supply, furnished the River Master with the following advance data for the 1987 calendar year:

1. The estimated continuous safe yield, from all the City's sour ces, obtainable without pumping, is 1,665 mgd, or a total during the calendar year 1987 of 1,665 x 365 days = 607,725 million gallons.

2. The estimated consumption that the City must provide from all its sources of supply during the calendar year 1987 is 591,582 + 7,250 = 598,832 million gallons.

On the basis of the provisions of the Decree and the above data, the aggregate quantity of excess-release water was 83 percent of (607,725 -598,832) or 7,381 million gallons. The Montague design rate during the excess release period beginning June 15, 1987, was computed as:

$$1{,}750 \text{ cfs} + \frac{7{,}381 \text{ Mgal} \times 1.547 \text{ cfs/mgd}}{120 \text{ days}} = 1{,}850 \text{ cfs}$$

Data on consumption of water by New York City for each calendar year, beginning in 1940, are shown in table 16.

The design rate of 1,850 cfs at Montague was required continuously after June 15 because the excess quantity was not expended by the end of the report year. Directed releases from the City reservoirs were designed to maintain the rate of 1,850 cfs at Montague but because the runoff from precipitation was high for much of the period, only 4,761 million gallons (7,366 cfs-days) of the available 7,381 million gallons (11,418 cfs days) was released by November 30.

During June to November there were 57 days when the advance estimate of flow at Montague exclusive of releases from New York City reservoirs was less than the design rate and releases were directed to meet the Montague Formula. Also during this period there were 24 days when the observed flow at Montague was less than the design rate.

The hydrographs of plate 1, show the total discharge at Montague; the portion derived from uncontrolled runoff downstream from the reservoirs; the portion contributed by the power reservoirs; and the portion contributed by Pepacton, Cannonsville and Neversink Reservoirs. In analyzing the water budget at Montague, the uncontrolled runoff downstream from the reservoirs was computed as the residual of observed flow less releases from all reservoirs and therefore was subject to all the errors in observations, transit times, and routing of the several components of flow. All of these uncertainties are contained in the computed hydrograph of uncontrolled runoff.

Summary

From December 1, 1986, to November 30, 1987, diversions to Rondout Reservoir totaled 244.499 billion gallons, and all releases from the New York City reservoirs to the Delaware River totaled 65.246 billion gallons (100,936 cfs-days).

During the year, maximum storage in Pepacton Reservoir was 142.043 billion gallons, on April 9 and 13. Maximum storage in Cannonsville Reservoir was 102.997 billion gallons, on April 6. Maximum storage in Neversink Reservoir was 35.363 billion gallons, on April 13. The maximum combined storage in the three reservoirs during the year was 278.160 billion gallons, or 102.7 percent of capacity, on April 8.

Minimum storage during the year in all three reservoirs occurred on September 8, 1987. Minimum storage in Pepacton Reservoir was 99.413 billion gallons (70.9 percent of capacity). Minimum storage in Cannonsville Reservoir was 54.638 billion gallons (57.1 percent of capacity) and minimum storage in Neversink Reservoir was 20.009 billion gallons (57.3 percent of capacity). Minimum combined storage in the three reservoirs was 174.060 billion gallons (64.3 percent of capacity).

A resume' of the combined storage of the three reservoirs on the first day of the month June 1967 to December 1987 is shown in figure 4. Storage was above the median December through March, October and November, and was below the median April through September.

On November 30, 1987, combined storage in the three reservoirs was 231.402 billion gallons, or 85.4 percent of their combined capacity. During the year, combined storage increased 8.281 billion gallons, or 3.1 percent of capacity.

SUPPLEMENTARY RELEASE FROM WALLENPAUPACK POWERPLANT

An agreement between Pennsylvania Power & Light Company and New York City provides for supplementary releases from Wallenpaupack hydroelectric powerplant if the Delaware River Basin Commission requests compensation for water consumed at the Company's Martins Creek steam-electric generating station. Releases may be requested if the flow of the Delaware River at Trenton, N.J. is expected to be less than 3,000 cfs for more than three consecutive days. No supplementary releases were requested during the year.

WATER BUDGET, DELAWARE RIVER AT MONTAGUE, N.J.

The data and computations of the water budget formed the basic operational records required to carry out the River Master's specific responsibilities with respect to the Montague Formula during the report year. The water budget has two parts: the advance estimates of the daily average flow at Montague, exclusive of controlled releases from New York City's reservoirs (table 14) and the segregation of the daily average flow at Montague among its various source components (table 15). The time intervals required for water to travel from the various sources to Montague were taken into account.

Discharge of the Delaware River at Montague was composed of the following source components:

1. Controlled releases from Lake Wallenpaupack on Wallenpaupack Creek in the production of hydroelectric power.

2. Controlled releases from Mongaup Reservoir on Mongaup River in the production of hydroelectric power prior to February 26 and Rio Reservoir thereafter.

3. Runoff from the uncontrolled area upstream from Montague.

4. Controlled releases from Pepacton, Cannonsville and Neversink Reservoirs of New York City.

The release from the City's reservoirs necessary to maintain the applicable rate of flow at Montague was computed from the advance estimates of flow at Montague, exclusive of controlled releases from the City's reservoirs.

TIME OF TRANSIT

The average times for the effective transit of water from the various sources of controlled supply to Montague used for discharge routing during the 1987 report year are as follows:

Source	Hours
Pepacton Reservoir	60
Cannonsville Reservoir	48
Neversink Reservoir	33
Lake Wallenpaupack	16
Mongaup Reservoir	12
Rio Reservoir	8

This schedule was developed from reservoir and powerplant operations and gaging-station records of prior years and was found generally suitable. At times, noticeable exceptions occur, for example, when a large release from Cannonsville Reservoir follows a small one, a large part of the release is expended in filling the channel en route, and the remainder may appear at Montague as much as 18 hours late. During the winter, the cold weather causes ice to form in the stream, which, together with the low streamflow, gradually increases the resistance to streamflow and lengthens the time of transit.

On several occasions when large releases were directed following small ones, these releases were directed to begin from 9 to 12 hours earlier than normal to compensate for the expected increase in travel time. These adjustments were helpful in getting the directed releases to Montague within the appropriate time frame, but were not fully successful. Therefore, the observed Montague flow tended to be low on the first day that these releases were expected to arrive and to be high on the second or third day. The average of the observed flow for approximately three days, when this procedure was used was usually close to the design rate.

SEGREGATION OF FLOW AT MONTAGUE

The River Master daily operation record of reservoir releases and daily segregation of flow among the various source components contributing to the flow of the Delaware River at Montague is shown in table 15 on page 54. The arrangement of data conforms with the downstream movement of water from the various sources to Montague. A horizontal summation of data in the table is equivalent to routing the various contributions to Montague, using the schedule for travel time of water discussed previously. The uncontrolled runoff was computed by subtracting the contributions of the several other sources from the observed discharge at Montague.

COMPUTATION OF DIRECTED RELEASES

In the daily operations, it was necessary that the River Master utilize: (1) discharges computed from recorded or reported stream gage heights for various 24-hour periods without current information about changes in stage-discharge relations that might have occurred; (2) daily discharge from New York City's three reservoirs obtained from venturi meters; (3) rainfall reports for the previous 24 hours; (4) actual powerplant operations converted to daily discharge; (5) advance estimates of power demand converted to daily discharge; (6) advance estimates of uncontrolled runoff at Montague; and (7) average times for routing of water from the several sources. Variable errors of estimate occur in projecting data, but these data must be used in the daily design and direction of releases from the reservoirs.

The time of transit of water from Pepacton Reservoir to Montague was greater than that from any other reservoir above Montague, therefore, the time of daily directed releases to maintain prescribed rates of flow at Montague was based on time of transit from Pepacton Reservoir. Releases from Cannonsville and Neversink Reservoirs were timed to arrive at Montague concurrently with releases from Pepacton Reservoir. To allow for the actual differences in transit times, daily directed releases began at Pepacton at 1200 hours, at Cannonsville at 2400 hours, and at 1500 hours the following day at Neversink.

The determination of the amount of release required from the City's reservoirs to maintain specified rates of flow at Montague was based on estimates of releases from Lake Wallenpaupack and Mongaup Reservoir or Rio Reservoir and an estimate of the uncontrolled runoff at Montague. Taking into account the time of transit from these sources to Montague, this determination required that advance estimates of the following components be made on the morning of each day: (1) the expected release of water from Lake Wallenpaupack for power production for a 24-hour period, beginning at 0800, two days later; (2) expected release of water from Mongaup Reservoir for power production for a 24-hour period, beginning at 1200, or from Rio Reservoir, beginning at 1600, two days later; and (3) expected uncontrolled runoff at Montague three days later. The River Master daily operation record for computing daily directed release from the City's reservoirs during the periods of low flow is shown in table 14.

The electric power companies cooperated fully in furnishing advance estimates of powerplant releases. As the hydroelectric plants were used chiefly for meeting peak-power demands of the system, advance estimates were subject to many modifying factors such as the influence of the vagaries of weather upon peak-power demand and unpredictable transmission and mechanical difficulties in electric-system operation. As a result, the actual use of water for power generation was at times at considerable variance with the advance estimates that were used by the River Master's office in design computation.

For computation purposes during periods of low flow, the estimate of uncontrolled runoff at Montague three days in advance was treated as two items: (1) present runoff and (2) estimated increase in runoff from precipitation. The present runoff was computed for 2,156 square miles (mi^2) of uncontrolled drainage area above Montague prior to February 26 when Rio Reservoir was put back in operation and 2,143 mi^2 thereafter based on conditions over the drainage area as of 0800 on the morning the estimate was made. The estimated increase in runoff was computed from precipitation which was forecast to occur on the day the estimate was made and the following two days. Estimated quantities for these items are shown in table 14.

During the winter period, the advance estimate of the uncontrolled runoff (present conditions) was based on flows at nearby gaging stations and on the recession curve of the uncontrolled flow at Montague projected to the design date, three days hence.

During open-river conditions, the present runoff portion of the advance estimate of uncontrolled runoff was based on discharges as of 0800 at gaging stations listed below:

Station	Drainage area (square miles)
Beaver Kill at Cooks Falls, N.Y.	241
Cadosia Creek at Cadosia, N.Y.	17.9
Oquaga Creek at Deposit, N.Y.	67.6
Equinunk Creek at Equinunk, Pa.	56.3
Callicoon Creek at Callicoon, N.Y.	110
Tenmile River at Tusten, N.Y.	45.6
Lackawaxen River at Hawley, Pa.	290
Shohola Creek near Shohola, Pa.	83.6
Neversink River at Port Jervis, N.Y.	336

The procedure for computing the advance estimate combined a routing and recession (as applicable) of the 0800 discharges of the Beaver Kill, Oquaga, Equinunk, Callicoon and Shohola Creeks and Tenmile, Lackawaxen, and Neversink Rivers gaging stations to Montague, with a computed yield from the remaining ungaged, uncontrolled drainage area. Releases from Neversink Reservoir were deducted from discharge of the Neversink River site. The yield from the ungaged, uncontrolled drainage area was estimated on the basis of the yield of Cadosia, Oquaga, Equinunk, and Callicoon Creeks, and Tenmile and Lackawaxen Rivers with routing and recession by individual gaging stations.

The advance estimate of increase in runoff from precipitation is shown in table 14 under the heading of "Weather Adjustment." The National Weather Service Office, Philadelphia, Pa., cooperated throughout the lowflow periods by furnishing quantitative forecasts of average precipitation over the drainage area above Montague and air temperatures for each day of the three-day period. During the winter, the probable increase in runoff was estimated from the current state of snow and ice and from forecasted temperature and precipitation for the several days under consideration. During open-river conditions, runoff from the forecasted precipitation was estimated from previously established relationships.

The total anticipated flow at Montague, exclusive of releases from the City's reservoirs (table 14), was the sum of the forecasted releases from the power reservoirs, the estimated uncontrolled runoff under then current conditions, and the weather adjustment. The amount by which this computed flow was less than the prescribed Montague rate indicated the expected deficiency at Montague, which would have to be made up by corresponding releases from New York City reservoirs.

There were times when revised forecasts of weather or powerplant releases became available before the completion of the required release from New York City reservoirs. At such times, the release required from New York City reservoirs was recomputed on the basis of the revised information, and the release required was changed to revised indicated deficiency. Usually this procedure resulted in a reduced release requirement from New York City reservoirs and the conservation of water. Only the final figures are shown in table 14.

ANALYSIS OF FORECASTS

Forecasts of the flow at Montague based on the anticipated flow of the several components (exclusive of the release from the City's reservoirs) vary somewhat with those actually experienced on most days even under the most favorable conditions. The daily variations in the several components are often partially compensating with the resulting forecast being fairly accurate.

The advance estimate of flow of the Delaware River at Montague exclusive of the releases from the New York City reservoirs was less than the design rate on five days during the winter, 11 days in May, 13 days in June, nine days in July, and on an almost continous basis from August 1 to September 9 and releases were directed. The table below compares the advance estimates of the various contributions to the flow at Montague to the observed operations during the July 31 to September 9, 1987 period when releases were directed on most days.

	Advance estimates (cfs-days)	Observed operations (cfs-days)
New York City releases		
Directed	[a] 27,546	[b] 27,469
Other		4,872
Power releases		
Lake Wallenpaupack	8,057	8,606
Rio Reservoir	1,769	2,695
Runoff from uncontrolled area	[c] 36,714	[c] 38,990

[a] Directed release as designed.
[b] Actual release in response to direction.
[c] July 31 to September 8.

The table shows that during the period of comparison, New York City released slightly less water, 0.3 percent, than was directed. The power companies released 6.8 percent more water from Lake Wallenpaupack and 52 percent more water from Rio reservoir than was forecast. The total power releases were 15 percent more than the forecast. The forecast runoff from the uncontrolled area during the period was 5.8 percent less than the observed runoff from the uncontrolled area.

On the basis of the observed discharges at Montague, exact forecasting of releases required from the City's reservoirs during the period, July 31 to September 9, would have totaled 28,602 cfs-days. The directed releases totaled 27,546 cfs-days, or 3.7 percent less than for exact fore-casting.

A comparison of the hydrographs on figure 3, of forecast uncontrolled runoff and the actual uncontrolled runoff indicate that the forecasting procedures were generally adequate. The forecast included anticipated uncontrolled runoff under then-existing conditions plus the weather adjustment based on forecast precipitation. Analysis of the hydrographs indicate that the forecast procedures tended to underestimate the runoff during high precipitation events.

DIVERSIONS TO NEW YORK CITY WATER SUPPLY

Table 13 shows diversions from Pepacton, Cannonsville and Neversink Reservoirs to the New York City water-supply system during the report year. The tabulation includes a running account of the average rates of the combined diversions from the reservoirs, computed as prescribed by the Decree. The tabulation shows that the allowable maximum equivalent diversion rate of 800 mgd was not exceeded at any time.

STORAGE IN NEW YORK CITY RESERVOIRS

The New York City Board of Water Supply determined the "point of maximum depletion" and other pertinent reservoir levels and contents of Pepacton, Cannonsville and Neversink Reservoirs as follows:

[Elev. is distance above sea level]

Reservoir level	Pepacton Res.		Cannonsville Res.		Neversink Res.	
	Elev. (feet)	Contents (billion gallons)	Elev. (feet)	Contents (billion gallons)	Elev. (feet)	Contents (billion gallons)
Full pool or spillway crest	1,280.00	*140.190	1,150.00	*95.706	1,440.00	*34.941
Point of maximum depletion	1,152.00	*3.511	1,040.00	*1.020	1,319.00	*0.525
Sill of diversion tunnel	1,143.00	*4.200	+1,035.00	*1.564	1,314.00	
Sill of river outlet tunnel	1,126.50		1,020.5		1,314.00	
Dead storage		1.800		0.328		1.680

*Contents shown are quantities stored between listed elevations.
+Elevation of mouth of inlet channel of diversion works.

Tables 9, 10 and 11 show storage in Pepacton, Cannonsville and Neversink Reservoirs, respectively, above "point of maximum depletion" or minimum full-operating level.

On December 1, 1986 combined storage in the three reservoirs was 224.780 billion gallons, which was 115 billion gallons above the drought warning level as defined by the Interstate Water Management Recommendations. Storage remained above the median levels throughout the winter months with only a slight drop in January and February because of reduced inflow during the cold weather. Combined storage reached 100 percent of capacity on April 6 and reached a maximum for the year of 278.160 billion gallons on April 8.

Storage decreased seasonally from May through August in response to normal diversions to the New York City water-supply system and releases required to maintain the Montague flow objective. Heavy precipitation averaging about three inches over the upper basin, occurred during September 7-9 and storage increased from a seasonal low of 174.060 billion gallons on September 8 to 197.472 billion gallons on September 30. Storage continued to increase gradually throughout the fall reaching 231.402 billion gallons on November 30.

COMPARISONS OF RIVER MASTER OPERATION DATA AND OTHER STREAMFLOW RECORDS

It has been explained that the River Master operations are, in effect, day-to-day operations, for which it is necessary to use preliminary records of streamflow. The following summaries show comparison of records used in the River Master operations and Geological Survey records. In the comparison of releases approximating conservation rates only, data were used in units of million gallons per day and converted to cubic feet per second in the summaries.

Releases from New York City Reservoirs

The River Master operations data on the controlled releases from Pepacton, Cannonsville and Neversink Reservoirs, to the Delaware River were obtained from calibrated instruments connected to venturi meters installed in the outlet conduits.

The Geological Survey gaging station on the East Branch Delaware River at Downsville, N.Y., is 0.5 mile downstream from Pepacton Reservoir dam. The discharge shown in table 3 includes releases and spillage from Pepacton Reservoir. It also includes a small amount of seepage, which enters the channel between the dam and gage site and, a small amount of runoff, which originates between the dam and gage site. The drainage area at the dam is 371 square miles and at the gaging station is 372 square miles.

Releases were made at conservation rates or at other rates designed by New York State to relieve thermal stress during the year. For flows of approximately 50, 70, and 100 cfs at the gaging station, the venturi meter instruments indicated -4.8, +8.0 and +12 percent difference, respectively, in rates of release from the reservoir than those shown by the gaging-station record.

The Geological Survey gaging station on the West Branch Delaware River at Stilesville, N.Y. is 1.4 miles downstream from Cannonsville Dam. The discharge shown in table 4 includes releases and spillage from Cannonsville Reservoir and the runoff from 2 square miles of drainage area between the dam and the gage site. The drainage area at the dam is 454 square miles, and that at the gaging station is 456 square miles.

Releases were made in a range from conservation to high rates during the year. For flows of approximately 40 and 50 cfs at the gaging station, the venturi meter instruments indicated 14 and 9.6 percent less water, respectively, being released from the reservoir than those shown by the gaging-station records. At flows of approximately 420 and 1,240 cfs, the venturi indicated 8.9 and 1.8 percent more discharge respectively, than that shown by the gaging station records. The gaging station records are considered good for flows above 750 cfs and fair below.

The Geological Survey gaging station on the Neversink River at Neversink, N.Y., is 1,650 feet downstream from Neversink Dam. The discharge shown in table 6 includes releases and spillage from Neversink Reservoir and, during storms, a small amount of runoff, which originates between the dam and gage site. The drainage area at the dam is 92.5 square miles and that at the gaging station is 92.6 square miles.

Releases were made at conservation or other low flows by New York City during the year. For flows of approximately 22, 42 and 62 cfs at the Geological Survey gaging station, the venturi meter instrument indicated +12, +11 and +13 percent difference, respectively, in rates of release from the reservoir than those shown by the gaging station records. During August through November, the agreement was somewhat closer being +5.3 percent at 24 cfs and +8.1 percent at 42 cfs at the gaging station.

The above comparisons indicate good agreement between the data from the venturi meters and U.S. Geological Survey gaging stations at Pepacton Reservoir and for flows above 700 cfs at Cannonsville Reservoir. The gaging station records are considered only fair at the Stilesville gage for flows below 700 cfs. Therefore, the venturi instruments are considered to provide more accurate records. The differences between the venturi instruments and gaging station records for Neversink Reservoir are larger than in previous years. It is uncertain what caused this difference. Improved instrumentation and data collection procedures are in progress with the goal of improving the agreement in the future.

Releases from Lake Wallenpaupack

In the River Master operations December 1 to November 30, records of daily discharge through the Wallenpaupack powerplant were furnished by the Pennsylvania Power & Light Company (see table 15). Daily discharges were computed on an 0800 to 0800-time basis to allow for the 16-hour average transit time to Montague.

The records of daily mean discharges for Wallenpaupack Creek at Wilsonville, Pa., published by the Geological Survey, were also furnished by the Company. These discharges, shown in table 5, represent the flow through the turbines of the powerplant and are computed on a midnight to midnight basis.

During December 1986 through November 1987, the River Master's record based on computations by Pennsylvania Power & Light Company, agrees with the Geological Survey record except for slight differences due to the difference in the time frame of the computations.

Delaware River at Montague, N.J.

The River Master's operation record indicated less than 0.1 percent less discharge for the year than the Geological Survey record, and daily records were generally in good agreement.

Diversion Tunnels

Records of diversions through the East Delaware, West Delaware, and Neversink Tunnels were furnished to the River Master's Office by the City of New York. These records were obtained from New York City's calibrated instruments connected to venturi meters installed in the tunnel conduits. Current-meter measurements were made by the River Master's office to verify the accuracy of the reported diversions. The current-meter measurements were made in the outlet channels downstream from the tunnels.

Water is diverted from Pepacton Reservoir through the East Delaware tunnel into Rondout Reservoir. The conditions in the outlet channel, which is used for measuring discharge from the tunnel by current meter were unfavorable for much of the year due to the high water levels in Rondout reservoir. The results of two current-meter measurements made during the year and one measurement just after the end of the report year showed on the average that the venturi-meter instruments gave higher figures by 8.3 percent for the totalizer, 8.5 percent for the manometer and 8.7 percent for the indicator needle.

Comparison of the data provided by New York City with discharges obtained from recorded gage-heights and the rating curve for the weir on the outlet channel indicate that the data provided by New York City were accurate.

The powerplant that used the water diverted through the tunnel operated most days of the year. On days when the powerplant was not in operation, there was a small amount of leakage through the wicket gates, which was not recorded on the totalizer. Results of a current-meter measurement March 4, 1982 indicated a rate of 10.9 cfs from cooling water and leakage. No measurements of the leakage were made during the year. Discharges obtained from recorded gage heights and the rating curve indicate that the leakage was approximately the same as when it was last measured.

When the power plant is not operating, the leakage by-passes the venturi instruments and is not measured. When the power plant is operating, the leakage is included in the measured flow. Since the power plant was not operated on only 17 days and operated a portion of the time on 34 additional days during the year, the unmeasured flow is small, approximately 0.2 billion gallons.

Based upon measurements obtained this year and in previous years, the record of quantity of water diverted through the East Delaware Tunnel should be substantially correct.

The West Delaware Tunnel is used to divert water from Cannonsville Reservoir into Rondout Reservoir. Three current-meter measurements made during the year, indicated that the venturi instruments gave higher results by 6.8 percent for the totalizer, 7.7 percent for the manometer and 6.2 percent for the indicator needle while it was in operation. Inspections of the channel downstream from the outlet, when valves were closed showed negligible leakage.

The results of these measurements and inspections made this year and during past years indicate that the reported record of the quantity of water diverted through the West Delaware Tunnel was substantially correct.

The Neversink Tunnel is used to divert water from Neversink Reservoir into Rondout Reservoir. Results of the comparative data from venturi measurements and two current-meter measurements showed that on average, the venturi was 1.8 percent lower for the totalizer, 6.2 percent higher for the manometer, and 2.6 percent higher for the indicator needle.

When the power plant that used the water diverted through the Neversink Tunnel was not in operation, a small amount of leakage occurred that was not recorded on the venturi instruments. Based on two measurements made during the year, the average rate of leakage is 13 cfs (8.4 mgd). When the power plant was operating, the leakage was included in the recorded flow. Based on the above rate and on records of power plant operations, approximately 1.7 billion gallons of water was diverted but was unrecorded. The recorded diversion from Neversink Reservoir was 38.2 billion gallons during the year (see table 13). Therefore, based on this computation, the unrecorded diversion was approximately 4.5 percent of the total.

DIVERSIONS BY NEW JERSEY

According to the terms of the Decree, New Jersey may divert for use outside the Delaware River basin from the Delaware River or its tributaries in New Jersey, without compensating releases, a quantity of water not to exceed 100 mgd (154.7 cfs) as a monthly average, with the diversion on any day not to exceed 120 mgd (185.6 cfs).

Prior to 1986, the diversions through the Delaware & Raritan Canal were measured at Kingston Lock. Since 1986, water has been diverted on a regular basis from the canal into Carnegie Lake and into the Millstone River upstream from the gaging station at the Kingston Lock. The New Jersey Water Supply Authority made computations of the amount being diverted on a daily basis and provided the data to the River Master office weekly. Table 12 is a listing of the data provided by the Water Supply Authority.

At the River Master Advisory committee meeting in May 1986 the apparent inadequacy of the current monitoring system was discussed. Following that meeting, the River Master requested New Jersey to improve the monitoring system to provide accurate records of their diversions. In response to the River Master's request, New Jersey began the installation of an accoustic velocity meter and remote sensing equipment at Port Mercer near the Delaware-Raritan divide. The installation was completed during 1987, but was not fully operational by the end of the year.

The 30-day average diversion was computed weekly throughout the year to monitor compliance with the terms of the decree. The maximum 30-day average was 100.6 mgd June 20 to July 19. On July 2,3,14, and 15, the data provided by the Water Supply Authority indicated that the maximum daily diversion allowed by the decree was exceeded. However, while the records indicate the flow in the canal exceeded the limitation, these values include significant but unmeasured amounts of inflow into the canal from heavy rains in the Raritan River Basin. It is not possible to determine exactly what the diversions on these days were, but they are considered to have been less than the amount allowed by the Decree.

The data provided by the New Jersey Water Supply Authority was compared to the Geological Survey record for the flow in the canal at the Kingston Lock and was found to be within one percent for the year.

CONFORMANCE OF OPERATIONS AS PROVIDED UNDER AMENDED DECREE OF THE U.S. SUPREME COURT, DATED JUNE 7, 1954

Operations were conducted as prescribed by the Decree for the entire report year. Diversions from the Delaware River basin to the New York City water-supply system of the City of New York were less than the 800 mgd authorized by the Decree. Allowable and actual diversions are shown in the following table:

Effective dates	Allowable diversions Equivalent rate not to exceed (mgd)	Actual diversions (mgd)
June 1, 1986 to May 31, 1987	800	679
June 1 to Nov. 30, 1987	800	724

Under Compensating Releases of the Montague Formula, the City released water from its reservoirs at rates designed by the River Master to maintain 1,850 cfs at Montague December 1, 1986 to March 14, 1987, 1,750 cfs March 15 to June 14, and 1,850 cfs June 15 to November 30. New York City complied fully with the directives of the River Master during the year.

Diversions from the Delaware River basin by the New Jersey were within the limits prescribed by the Decree.

Table 3.- Daily mean discharge, in cubic feet per second, of East Branch Delaware River at Downsville, N.Y. (01417000) for the year ending November 30, 1987. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	57	51	59	53	65	65	76	66	80	65	63	68
2	55	53	58	51	65	65	87	67	67	65	63	61
3	54	53	56	53	65	65	76	67	67	64	63	56
4	53	53	56	53	67	65	65	67	67	63	63	56
5	53	53	55	53	68	66	65	66	67	63	63	55
6	53	53	56	52	68	64	65	71	67	63	63	56
7	54	54	56	51	144	66	65	67	77	63	63	56
8	53	54	55	51	1,850	68	65	66	88	64	63	56
9	53	54	55	54	2,620	68	64	77	87	64	63	56
10	54	56	54	51	2,330	67	64	87	74	63	63	56
11	54	56	53	51	1,910	66	65	87	65	63	64	56
12	54	55	54	51	1,780	66	65	87	65	62	64	56
13	54	55	53	51	2,650	66	65	77	65	63	64	56
14	55	56	53	54	2,390	66	65	67	77	62	65	56
15	54	54	53	53	1,840	67	65	66	90	63	66	55
16	53	55	53	53	1,460	67	65	68	90	63	66	55
17	54	53	53	52	1,180	67	65	70	97	63	66	55
18	54	53	54	52	996	68	65	70	104	63	65	55
19	54	53	53	53	764	68	76	70	97	63	66	55
20	54	53	54	55	561	68	87	70	76	63	66	55
21	54	54	51	55	399	68	76	70	64	64	66	55
22	54	56	52	54	291	68	66	80	64	65	66	55
23	52	54	53	56	200	68	66	91	64	65	65	55
24	52	55	51	54	143	68	65	102	65	65	66	55
25	53	56	52	53	121	68	77	103	65	65	66	55
26	53	55	51	51	72	68	90	89	65	65	66	55
27	53	55	51	53	74	68	90	77	65	65	66	54
28	53	54	52	51	69	68	78	63	65	65	67	54
29	54	55		51	66	68	65	63	65	63	68	54
30	56	56		53	65	67	65	64	65	63	69	54
31	54	57		58		66		77	65		68	
Total	1,667	1,684	1,506	1,636	24,373	2,073	2,113	2,312	2,279	1,910	2,015	1,676
Mean	53.8	54.3	53.8	52.8	812	66.9	70.4	74.6	73.5	63.7	65.0	55.9

Year total 45,244 cfs-days Mean 124 cfs

Table 4.- Daily mean discharge, in cubic feet per second, of West Branch Delaware River at Stilesville, N.Y. (01425000) for the year ending November 30, 1987. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	44	563	316	44	1,870	71	326	327	904	207	47	43
2	44	565	313	43	1,720	56	331	388	341	58	46	40
3	46	561	314	75	1,570	50	228	331	326	43	47	40
4	42	505	313	269	2,320	50	65	331	326	299	46	39
5	38	475	307	360	7,290	49	166	331	326	519	46	39
6	64	420	295	372	8,050	49	102	332	326	578	45	39
7	276	421	291	358	6,530	49	52	336	561	309	47	40
8	481	416	291	572	5,560	50	53	344	474	304	46	41
9	636	400	288	1,280	4,380	49	51	336	333	184	45	41
10	827	394	275	1,530	3,460	49	49	336	326	52	45	40
11	914	403	270	1,390	2,780	50	193	447	325	43	47	40
12	886	392	268	1,220	2,370	50	294	642	338	43	46	42
13	840	378	266	1,000	2,870	49	154	813	542	50	46	43
14	722	360	256	787	3,180	49	100	357	943	47	46	43
15	674	355	242	605	2,760	50	282	334	965	45	45	43
16	670	381	231	494	2,310	49	330	334	756	44	46	43
17	646	386	223	515	1,920	173	379	326	1,030	45	45	44
18	644	360	220	516	1,590	243	506	332	1,050	47	45	45
19	648	382	216	503	1,290	162	719	332	1,130	46	45	38
20	611	392	201	393	1,030	61	480	333	1,140	45	46	37
21	566	377	144	296	823	271	337	331	1,180	46	46	37
22	512	378	110	228	631	245	333	331	1,320	47	46	37
23	468	375	248	228	432	249	331	436	1,340	46	45	37
24	445	345	346	328	262	102	331	490	1,400	46	45	38
25	533	330	316	556	185	52	330	630	1,440	45	47	38
26	693	324	330	1,060	137	49	647	499	1,350	45	45	38
27	742	325	270	1,600	110	50	723	326	734	45	46	37
28	716	319	97	1,770	99	49	341	326	374	45	60	37
29	680	313		1,750	87	192	326	326	310	45	52	39
30	647	314		1,610	84	326	328	426	98	51	49	46
31	612	321		1,550		327		890	127		48	
Total	16,367	12,230	7,257	23,302	67,700	3,370	8,887	12,653	22,135	3,469	1,446	1,204
Mean	528	395	259	752	2,257	109	296	408	714	116	46.6	40.1

Year total 180,020 cfs-days Mean 493 cfs

Table 5.- Daily mean discharge, in cubic feet per second, of Wallenpaupack Creek at Wilsonville, Pa. (01432000) for the year ending November 30, 1987. Record furnished by Pennsylvania Power & Light Company.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	458	1,210	440	0	0	0	570	705	0	0	1,340	0
2	401	1,200	704	16	465	0	689	455	0	0	1,390	475
3	458	1,200	702	25	946	0	702	0	680	0	1,660	543
4	741	750	356	0	922	223	698	0	583	0	1,660	529
5	694	1,200	355	0	960	0	710	0	584	0	1,370	537
6	0	949	345	0	1,810	0	0	460	599	0	1,370	532
7	0	933	0	0	1,810	0	0	453	552	0	1,380	0
8	556	942	0	0	1,820	0	739	465	0	549	1,370	0
9	703	695	767	431	1,830	0	702	560	0	802	1,340	222
10	685	0	713	579	941	0	695	468	456	905	1,640	957
11	908	0	702	626	922	0	372	0	463	888	1,640	539
12	933	704	719	827	942	0	348	0	462	1,150	253	696
13	705	720	722	895	921	0	0	463	460	1,130	255	664
14	0	729	0	0	933	0	0	669	464	877	343	0
15	697	701	85	0	940	0	811	713	0	1,400	293	0
16	951	691	60	612	1,450	0	695	814	0	1,320	258	356
17	0	0	726	703	1,450	0	701	824	796	1,330	0	353
18	492	0	700	692	1,440	0	718	0	0	1,460	0	586
19	949	779	784	796	1,440	0	341	0	0	1,700	177	358
20	0	685	765	708	718	0	0	877	0	1,710	223	359
21	0	690	0	0	0	0	0	926	0	1,710	189	168
22	194	699	0	0	0	0	348	972	0	1,700	232	0
23	923	811	73	695	0	0	348	953	0	1,450	232	359
24	939	661	0	694	0	0	348	895	0	1,420	0	355
25	0	664	0	733	0	0	462	820	152	1,400	0	449
26	924	1,200	0	718	0	0	347	0	0	1,680	437	0
27	0	1,190	79	722	0	255	0	807	0	1,680	237	0
28	0	1,160	0	0	0	228	0	809	0	1,340	523	0
29	1,190	1,170		0	0	829	459	813	0	1,330	232	0
30	1,210	957		0	0	0	673	815	0	1,620	507	236
31	1,200	361		83		0		834	157		0	
Total	16,911	23,651	9,797	10,555	22,660	1,535	12,476	16,570	6,408	30,551	20,551	9,273
Mean	546	763	350	340	755	49.5	416	535	207	1,018	663	309

Year total 180,938 cfs-days Mean 496 cfs

Table 6.- Daily mean discharge, in cubic feet per second, of Neversink River at Neversink, N.Y. (01436000) for the year ending November 30, 1987. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	24	23	22	23	38	149	46	40	60	37	42	28
2	24	23	22	23	40	132	57	40	54	40	43	20
3	24	22	22	23	42	115	49	40	42	40	43	20
4	24	22	22	23	41	133	41	40	48	40	42	21
5	24	22	22	23	41	47	41	40	51	40	42	24
6	23	22	22	23	121	35	41	40	40	40	43	24
7	23	22	22	23	931	36	41	40	47	40	43	25
8	23	22	22	23	835	37	41	40	59	41	43	25
9	24	22	22	22	607	37	40	47	59	42	44	25
10	23	22	22	22	476	37	40	55	47	41	43	25
11	24	22	22	23	356	36	41	78	40	41	44	25
12	23	22	22	23	251	36	41	78	40	41	44	25
13	22	22	21	22	1,260	36	41	72	40	41	43	25
14	23	23	21	23	868	36	41	55	47	40	44	25
15	22	23	21	23	530	36	41	42	59	42	44	25
16	23	22	21	22	435	38	41	42	59	42	44	25
17	23	23	21	22	408	38	41	42	66	43	44	25
18	23	23	22	22	511	36	41	42	78	43	43	25
19	22	23	22	22	447	38	41	42	72	42	44	25
20	22	23	22	22	365	40	47	49	53	42	44	25
21	23	22	22	22	325	40	52	61	40	35	44	24
22	23	22	22	22	288	40	41	61	40	42	44	24
23	23	22	22	22	268	40	41	62	39	42	44	25
24	23	22	22	23	258	40	41	68	40	42	44	25
25	23	22	21	23	262	40	41	72	40	42	43	25
26	22	22	22	23	231	40	48	60	40	42	44	25
27	22	22	22	23	206	40	59	61	40	42	44	25
28	23	22	23	23	199	40	52	60	40	42	44	24
29	23	22		23	239	40	38	61	40	42	44	25
30	23	22		23	256	40	40	61	40	42	44	26
31	22	22		29		40		60	40		44	
Total	713	690	611	708	11,135	1,568	1,306	1,651	1,500	1,231	1,349	735
Mean	23.0	22.3	21.8	22.8	371	50.6	43.5	53.3	48.4	41.0	43.5	24.5

Year total 23,197 cfs-days Mean 63.6 cfs

Table 7.- Daily mean discharge, in cubic feet per second, of the Delaware River at Montague, N.J. (01438500) for the year ending November 30, 1987. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	8,980	5,900	3,600	2,000	15,800	3,250	1,920	2,310	2,190	2,350	4,950	6,680
2	7,320	5,780	3,100	4,200	13,300	2,910	2,800	2,310	1,690	2,630	4,830	5,650
3	9,620	5,730	3,500	6,700	11,400	2,700	3,360	2,590	1,850	1,990	4,500	5,160
4	11,900	5,130	3,500	7,100	18,300	4,100	3,020	3,110	2,710	1,490	5,490	4,930
5	10,300	4,640	3,300	5,900	58,000	4,610	2,980	2,470	2,750	1,210	5,430	4,600
6	8,010	4,860	3,000	5,100	40,000	4,130	2,770	2,020	2,580	1,160	5,220	4,330
7	6,690	4,770	2,900	5,600	32,200	3,730	1,860	2,440	2,250	1,510	4,540	4,100
8	6,350	4,610	2,500	8,020	27,200	3,450	1,650	2,720	2,180	1,810	4,790	3,090
9	6,810	4,270	2,300	15,800	23,000	2,880	2,260	3,330	1,780	16,500	4,810	3,030
10	7,450	3,790	3,300	16,200	19,100	2,590	2,500	3,330	1,720	17,400	4,400	3,780
11	8,660	3,380	2,900	12,800	15,800	2,530	2,390	2,840	2,150	9,630	4,430	4,050
12	8,100	3,680	2,800	11,200	13,500	2,410	1,760	1,940	2,010	6,880	4,250	4,110
13	7,250	4,250	2,800	9,770	17,000	2,130	1,790	2,030	1,780	10,800	3,760	4,300
14	6,050	3,980	2,800	8,240	22,600	2,020	2,020	3,310	1,620	26,300	3,420	4,080
15	5,360	4,070	1,800	6,340	18,100	1,940	2,200	7,920	1,700	16,800	3,440	3,450
16	5,880	4,710	1,900	5,960	15,500	1,860	2,690	7,830	1,590	11,400	3,100	3,700
17	5,480	4,550	2,000	6,150	13,500	1,780	2,360	5,030	1,780	9,140	2,690	3,690
18	4,560	3,310	2,800	5,750	12,700	1,930	2,340	3,880	2,650	9,970	2,240	4,480
19	5,740	3,430	2,900	5,710	11,700	1,880	2,390	2,880	1,650	19,300	2,350	5,640
20	5,670	4,440	2,900	6,040	10,400	2,180	2,420	2,550	1,640	15,300	2,350	5,080
21	4,450	4,210	2,800	5,650	8,170	2,100	1,900	3,260	1,720	11,700	2,260	4,610
22	3,950	4,190	1,700	4,810	7,290	2,280	1,600	3,290	1,600	9,700	2,510	3,850
23	4,050	3,700	1,700	5,320	6,490	2,060	1,860	3,110	1,660	8,280	2,810	3,370
24	4,400	4,100	1,700	6,900	5,880	2,230	2,590	2,970	1,770	7,320	2,390	4,220
25	5,860	3,800	1,800	7,780	5,490	2,840	2,610	2,950	1,750	6,550	1,990	3,990
26	8,790	4,100	2,000	9,160	5,200	2,410	2,290	2,780	1,940	6,100	2,080	3,550
27	8,450	4,400	1,700	11,000	4,700	2,130	1,990	2,450	2,060	5,710	2,630	3,280
28	6,630	4,800	1,800	10,500	3,970	2,320	2,080	2,750	2,490	5,190	8,190	3,250
29	6,100	4,700		9,550	3,670	2,350	2,010	2,380	2,780	4,710	14,400	2,820
30	6,870	4,400		8,560	3,630	2,830	2,160	2,200	3,930	4,620	10,400	7,410
31	6,480	4,000		9,340		1,800		2,100	2,750		8,610	
Total	212,210	135,680	71,800	243,150	463,590	80,360	68,570	97,080	64,720	253,450	139,260	128,280
Mean	6,845	4,377	2,564	7,844	15,450	2,592	2,286	3,132	2,088	8,448	4,492	4,276

Year total 1,958,150 cfs-days

Mean 5,365 cfs

Table 8.- Daily mean discharge, in cubic feet per second, of Delaware River at Trenton, N.J. (01463500) for the year ending November 30, 1987. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	19,700	14,300	8,190	10,200	21,800	9,840	5,340	3,850	4,290	6,580	10,100	14,800
2	17,000	14,200	7,850	20,300	26,700	9,280	4,850	6,090	3,950	6,120	10,000	12,500
3	24,700	14,100	7,920	19,200	22,800	8,580	5,410	7,790	3,850	5,820	9,850	11,100
4	25,100	13,100	8,690	19,500	37,400	9,450	6,460	5,310	3,510	5,440	11,800	10,800
5	24,400	12,100	8,820	17,700	67,100	11,500	7,120	5,500	3,700	4,620	12,100	9,450
6	20,900	10,600	7,980	15,200	83,600	12,200	6,030	5,300	5,430	3,850	11,500	9,000
7	17,300	10,400	7,440	14,000	65,700	11,200	5,790	4,630	5,300	3,670	10,900	8,610
8	15,100	10,100	7,540	15,200	57,300	9,980	5,080	4,540	4,820	5,490	10,200	8,370
9	15,100	9,960	7,240	19,200	48,900	9,220	4,550	5,850	4,440	40,600	10,000	7,470
10	17,300	9,550	6,630	29,400	42,300	8,470	4,450	8,480	7,250	44,400	9,750	7,050
11	17,100	9,870	6,500	27,800	33,600	7,680	4,650	7,220	6,400	33,100	8,850	11,300
12	17,400	9,480	7,190	23,100	27,900	7,290	4,660	6,620	4,800	22,500	9,020	10,600
13	16,300	9,070	6,820	20,400	25,900	7,020	4,460	5,730	4,640	20,900	9,040	9,910
14	14,400	9,600	6,240	18,100	29,800	6,460	4,190	6,490	4,030	57,500	8,430	10,300
15	12,600	9,560	5,940	16,000	32,500	6,230	4,660	14,200	3,640	51,100	7,670	10,000
16	11,400	9,880	5,370	13,600	27,600	6,230	4,410	15,500	3,400	38,900	7,200	9,260
17	11,900	10,400	4,420	12,500	25,200	5,880	4,560	15,300	3,320	31,100	6,800	8,940
18	13,500	10,700	5,050	12,200	24,000	5,610	4,340	11,000	3,300	26,600	6,520	9,810
19	18,700	10,600	5,500	11,600	22,300	5,540	4,090	8,400	3,530	28,600	6,010	13,200
20	16,900	11,100	5,660	11,300	20,600	6,270	3,990	6,810	3,890	35,600	5,530	13,600
21	15,400	11,000	5,590	11,500	18,800	6,490	4,010	5,830	3,090	29,300	5,940	12,800
22	13,100	10,600	5,540	11,400	15,900	6,540	4,500	5,640	3,080	25,400	5,470	11,500
23	11,600	9,660	5,420	10,100	14,300	6,260	4,810	5,730	3,150	22,200	5,560	10,400
24	10,800	9,030	5,200	9,830	13,600	6,170	4,220	5,390	3,010	18,900	5,850	8,880
25	24,700	7,600	4,940	11,400	16,500	6,780	4,010	5,220	2,940	17,000	5,660	9,200
26	23,400	7,900	4,930	12,300	14,800	7,010	4,680	5,290	3,020	14,900	5,190	9,520
27	22,400	8,600	5,080	13,400	13,000	6,820	4,630	6,070	3,320	13,400	4,940	9,190
28	20,400	8,700	5,110	15,200	12,000	6,340	4,450	4,980	4,280	12,800	9,690	8,090
29	16,800	8,600		15,400	11,500	6,010	4,340	4,900	5,700	11,900	16,900	8,280
30	15,100	8,400		14,200	10,500	5,800	4,120	4,630	7,210	10,700	23,100	19,000
31	15,300	8,580		15,900		5,890		4,510	7,140		17,600	
Total	535,800	317,340	178,800	487,130	883,900	234,040	142,860	212,800	133,430	648,990	287,170	312,930
Mean	17,280	10,240	6,386	15,710	29,460	7,550	4,762	6,865	4,304	21,630	9,264	10,430

Year total 4,375,190 cfs-days Mean 11,990 cfs

Table 9. - Storage in Pepacton Reservoir, N.Y., for year ending November 30, 1987
(Storage in millions of gallons above elevation 1,152.00 ft. Add 7,711 million gallons for total contents above sill of outlet tunnel, elevation 1,126.50 ft.) Storage at spillway level is 140,190 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	113,025	117,316	110,860	101,445	116,412	139,197	129,908	119,274	111,972	102,227	105,669	110,811
2	113,272	117,333	110,583	101,648	117,889	138,976	129,589	118,867	111,645	101,836	106,084	111,056
3	113,667	117,215	110,323	102,180	119,257	138,700	129,341	118,901	111,580	101,414	105,685	111,236
4	114,711	117,065	110,095	102,367	120,735	138,498	128,954	118,614	111,498	101,024	105,447	111,416
5	115,442	116,814	109,771	102,446	131,007	138,223	128,743	118,327	111,236	100,513	105,320	111,743
6	116,027	116,629	109,413	102,446	135,711	137,986	128,409	118,024	111,007	100,172	106,036	111,465
7	116,596	116,429	109,121	102,461	138,976	137,804	127,917	117,670	110,696	99,769	106,468	111,334
8	117,115	116,244	108,814	102,759	141,469	137,548	127,565	117,383	110,501	99,413	106,980	111,171
9	117,249	115,993	108,427	103,815	142,043	137,256	127,233	117,081	110,193	99,738	107,108	111,105
10	117,569	115,776	108,073	104,796	141,950	136,928	126,989	116,780	109,933	99,986	107,525	110,942
11	117,805	115,608	107,750	105,399	141,709	136,672	126,464	116,378	109,771	99,877	107,573	110,827
12	117,940	115,409	107,412	105,940	141,524	136,345	126,028	116,020	109,430	99,753	107,815	110,664
13	118,007	115,160	107,076	106,244	142,043	136,019	125,714	115,742	109,105	99,660	107,895	110,485
14	117,973	114,944	106,756	106,484	141,950	135,711	125,437	115,459	108,508	100,451	107,783	110,371
15	117,990	114,678	106,420	106,612	141,691	135,421	124,968	115,960	108,121	100,854	107,928	110,290
16	118,024	114,529	106,036	106,692	141,432	135,076	124,621	116,010	107,799	100,869	107,863	110,144
17	118,007	114,280	105,669	106,676	141,246	134,714	124,222	115,910	107,412	101,055	107,734	109,900
18	117,990	114,047	105,336	106,676	141,116	134,408	123,860	115,675	107,012	101,398	107,847	109,998
19	117,990	113,832	104,955	106,628	140,987	134,085	123,308	115,442	106,548	103,500	107,573	110,128
20	117,973	113,733	104,589	106,596	140,839	133,743	122,809	115,177	106,132	104,796	107,396	110,128
21	117,957	113,486	104,224	106,532	140,672	133,383	122,447	115,010	105,669	105,574	107,412	110,274
22	117,822	113,255	103,830	106,500	140,542	133,024	122,173	114,662	105,288	106,004	106,756	110,193
23	117,704	113,107	103,500	106,516	140,412	132,702	122,053	114,379	104,859	106,340	106,548	110,095
24	117,619	112,893	103,106	106,756	140,338	132,345	121,779	113,981	104,367	106,532	106,404	110,193
25	117,602	112,629	102,790	107,044	140,209	131,988	121,488	113,536	103,862	106,500	106,116	110,323
26	117,721	112,382	102,446	107,702	140,098	131,613	121,078	113,470	103,436	106,372	105,828	110,339
27	117,704	112,152	102,055	108,734	139,951	131,327	120,770	113,470	103,106	106,356	105,685	110,095
28	117,721	111,858	101,695	109,965	139,730	131,078	120,412	113,222	102,853	106,212	106,692	109,917
29	117,687	111,613		111,416	139,546	130,759	120,055	112,926	103,011	106,084	108,363	109,836
30	117,687	111,416		112,744	139,362	130,440	119,614	112,712	102,885	105,908	109,836	109,998
31	117,619	111,089		113,799		130,068		112,349	102,492		110,388	
Change	+5,056	-6,530	-9,394	+12,104	+25,563	-9,294	-10,454	-7,265	-9,857	+3,416	+4,480	-390
Eqyuv, mgd	+163.1	-210.6	-335.5	+390.5	+852.1	-299.8	-348.5	-234.4	-318.0	+113.9	+144.5	-13.0
Equiv. cfs	+252	-326	-519	+604	+1,318	-464	-539	-363	-492	+176	+224	-20.1

Change for year -2,565 million gallons Equiv. for year -7.03 mgd Equiv. for year -10.9 cfs

Table 10. - Storage in Cannonsville Reservoir, N.Y., for year ending November 30, 1987
(Storage in millions of gallons above elevation 1,040.00 ft. Add 2,584 million gallons for total contents above sill of outlet tunnel, elevation 1,020.50 ft.) Storage at spillway level is 95,706 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	91,036	96,881	96,462	94,489	98,281	95,478	89,591	85,123	77,089	57,191	66,834	81,250
2	91,903	96,832	96,382	94,869	98,168	95,584	89,530	84,646	76,744	56,886	67,051	82,117
3	92,862	96,945	96,462	95,722	97,927	95,447	89,530	84,530	76,744	56,641	67,166	82,839
4	94,079	96,945	96,478	96,221	98,281	95,326	89,651	84,299	76,647	56,495	67,370	83,475
5	94,976	96,897	96,494	96,462	101,629	95,143	89,910	84,010	76,537	55,994	67,688	84,068
6	95,706	96,832	96,446	96,494	102,997	94,991	90,032	83,663	76,412	55,518	68,006	84,632
7	96,253	96,832	96,430	96,591	101,967	94,763	90,275	83,316	76,288	55,005	68,444	85,008
8	96,784	96,671	96,430	96,720	101,452	94,611	90,518	83,013	76,011	54,638	68,987	85,470
9	97,041	96,607	96,414	97,637	100,518	94,474	90,640	82,651	75,735	54,895	69,410	85,831
10	97,202	96,607	96,350	97,975	99,778	94,352	90,853	82,305	75,721	55,799	69,781	86,294
11	97,331	96,671	96,334	97,862	99,231	94,215	91,020	81,943	75,265	56,092	70,059	86,756
12	97,315	96,720	96,317	97,653	98,812	94,018	90,868	81,625	74,602	56,275	70,483	87,103
13	97,251	96,720	96,317	97,412	99,054	93,881	90,777	81,250	74,160	56,385	70,907	87,435
14	97,154	96,671	96,334	97,106	99,456	93,729	90,670	80,777	73,079	57,374	71,106	87,825
15	97,106	96,607	96,350	96,881	99,070	93,546	90,518	80,888	72,218	57,972	71,265	88,283
16	97,154	96,575	96,317	96,671	98,764	93,348	90,275	80,888	71,265	58,363	71,503	88,663
17	97,154	96,575	96,317	96,704	98,474	93,105	89,910	80,777	70,602	58,729	71,808	89,043
18	97,122	96,510	96,285	96,720	98,265	92,801	89,545	80,556	69,410	59,547	72,099	89,530
19	97,106	96,607	96,237	96,704	98,040	92,497	89,043	80,335	68,112	60,842	72,430	90,062
20	97,025	96,720	96,189	96,543	97,830	92,223	88,541	80,101	66,924	62,263	72,748	90,534
21	96,913	96,720	96,012	96,301	97,573	91,994	88,161	79,852	65,803	63,319	73,066	91,036
22	96,832	96,687	95,867	96,140	97,379	91,568	87,811	79,590	64,555	64,198	73,397	91,507
23	96,768	96,671	95,819	96,108	97,218	91,294	87,854	79,217	63,625	64,784	73,755	91,842
24	96,752	96,543	95,523	96,301	96,768	91,036	87,825	78,871	62,759	65,230	73,940	92,284
25	96,832	96,430	95,311	96,736	96,478	90,853	87,710	78,567	61,588	65,599	74,229	92,481
26	97,154	96,414	95,022	97,299	96,269	90,640	87,580	78,304	60,353	65,815	74,492	92,877
27	97,251	96,446	94,778	97,991	96,012	90,579	86,655	78,304	59,254	66,019	74,809	93,242
28	97,235	96,510	94,504	98,184	95,835	90,564	86,178	78,194	58,778	66,121	75,680	93,577
29	97,186	96,510		98,200	95,706	90,488	85,831	78,083	58,375	66,223	77,793	93,866
30	97,090	96,494		98,072	95,569	90,214	85,412	77,876	58,375	66,388	79,203	94,596
31	96,961	96,510		97,862		89,925		77,614	57,679		80,377	
Change	+7,036	-451	-2,006	+3,358	-2,293	-5,644	-4,513	-7,798	-19,935	+8,709	+13,989	+14,219
Equiv. mgd	+227.0	-14.5	-71.6	+108.3	-76.4	-182.1	-150.4	-251.5	-643.1	+290.3	+451.3	+474.0
Equiv. cfs	+351	-22.5	-111	+168	-118	-282	-233	-389	-995	+449	+698	+733

Change for year +4,671 million gallons Equiv. for year +12.8 mgd Equiv. for year 19.8 cfs

Table 11. - Storage in Neversink Reservoir, N.Y. for year ending November 30, 1987
(Storage in millions of gallons above elevation 1,319.00. Add 525 million gallons for total contents above sill of outlet tunnel, elevation 1,314.00 ft.)
(River Master daily operation record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	20,719	22,662	23,469	20,357	27,129	34,996	31,327	26,228	23,206	20,588	25,172	27,129
2	20,784	22,638	23,509	20,536	27,771	35,001	31,104	26,106	23,048	20,518	25,130	27,193
3	20,934	22,634	23,553	20,592	28,206	35,011	30,919	26,013	23,075	20,436	25,097	27,240
4	21,348	22,603	23,597	20,566	28,597	35,095	30,740	25,917	23,234	20,350	25,184	27,266
5	21,653	22,568	23,481	20,555	33,712	34,971	30,588	25,808	23,103	20,275	25,242	27,305
6	21,884	22,517	23,357	20,540	34,709	34,724	30,405	25,662	23,020	20,161	25,358	27,313
7	22,085	22,486	23,234	20,536	35,249	34,483	30,241	25,566	22,949	20,072	25,487	27,292
8	22,275	22,548	23,107	20,603	35,239	34,243	30,073	25,499	22,854	20,009	25,733	27,275
9	22,330	22,599	22,992	20,900	35,194	33,949	29,905	25,441	22,756	20,897	25,845	27,270
10	22,447	22,662	22,866	21,196	35,155	33,727	29,706	25,362	22,658	21,581	25,908	27,344
11	22,568	22,756	22,760	21,332	35,140	33,437	29,513	25,230	22,579	21,753	25,950	27,348
12	22,638	22,835	22,634	21,435	35,204	33,470	29,324	25,134	22,447	21,818	26,034	27,344
13	22,705	22,909	22,517	21,508	35,363	33,379	29,142	25,031	22,353	21,953	26,081	27,344
14	22,681	22,960	22,384	21,542	35,239	33,249	28,986	24,977	22,267	23,127	26,106	27,331
15	22,698	23,016	22,248	21,569	35,190	33,139	28,799	25,043	22,162	23,437	26,152	27,335
16	22,717	23,087	22,097	21,581	35,165	33,005	28,619	25,039	22,050	23,633	26,156	27,309
17	22,721	23,147	21,969	21,584	35,145	32,866	28,425	24,965	21,899	23,713	26,228	27,258
18	22,752	23,206	21,837	21,569	35,185	32,743	28,228	24,895	21,707	23,862	26,156	27,232
19	22,780	23,254	21,703	21,565	35,175	32,657	28,031	24,826	21,561	24,445	26,085	27,305
20	22,760	23,337	21,569	21,546	35,145	32,552	27,831	24,723	21,439	24,793	26,055	27,305
21	22,748	23,385	21,462	21,546	35,130	32,453	27,619	24,645	21,332	24,969	26,055	27,279
22	22,709	23,433	21,302	21,535	35,115	32,344	27,430	24,531	21,237	25,130	26,039	27,193
23	22,681	23,509	21,150	21,638	35,115	32,241	27,301	24,425	21,154	25,188	26,013	27,120
24	22,650	23,553	21,029	21,791	35,105	32,137	27,202	24,295	21,063	25,234	25,976	27,077
25	22,654	23,589	20,885	22,012	35,110	32,024	27,060	24,048	20,927	25,259	25,938	27,026
26	22,725	23,633	20,746	22,353	35,095	31,897	26,902	23,930	20,833	25,269	25,900	26,958
27	22,756	23,533	20,600	22,772	35,090	31,803	26,753	23,866	20,712	25,242	25,875	25,881
28	22,756	23,425	20,473	23,155	35,085	31,733	26,667	23,693	20,663	25,234	26,244	26,842
29	22,736	23,321		23,601	35,080	31,639	26,507	23,565	20,663	25,230	26,770	26,765
30	22,713	23,361		24,100	35,016	31,508	26,363	23,461	20,652	25,176	26,953	26,808
31	22,701	23,421		24,977		31,392		23,325	20,615		27,043	
Change	-2,068	+720	-2,948	+4,504	+10,039	-3,624	-5,029	-3,038	-2,710	+4,561	+1,867	-235
Equiv. mgd	-66.7	+23.2	-105.3	+145.3	+334.6	-116.9	-167.6	-98.0	-87.4	+152.0	+60.2	-7.83
Equiv. cfs	-103	+35.9	-163	+225	+518	-181	-259	-152	-135	+235	+93.2	-12.1

Change for year +6,175 million gallons Equiv. for year +16.9 mgd Equiv. for year 26.2 cfs

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons
Record furnished by New Jersey Water Supply Authority

Day	December 1986				January 1987				February			
	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total
1	27	0	52	79	5	0	52	57			71	71
2	14	8	52	74	13	0	56	69			72	72
3	17	28	36	81	16	0	58	74			72	72
4	22	16	35	73	22	0	58	80			70	70
5	20	0	55	75	20	0	56	76			70	70
6	14	0	55	69	14	0	55	69			67	67
7	16	0	53	69	8	0	53	61			69	69
8	6	0	53	59	6	0	53	59			70	70
9	6	0	53	59	12	0	53	65			68	68
10	31	0	57	88	12	0	53	65			66	66
11	14	0	55	69	7	31	17	55			64	64
12	0	0	57	57	21	39	0	60			66	66
13	0	0	54	54	20	19	23	62			67	67
14	0	0	54	54	14	0	53	67			67	67
15	0	0	54	54	5	0	20	25			67	67
16	0	0	52	52	28	0	0	28			63	63
17	11	0	53	64	33	0	40	73			64	64
18	11	0	53	64	5	0	64	69			65	65
19	15	0	56	71	7	0	19	26			66	66
20	0	0	56	56	18	48	19	85			66	66
21	12	0	56	68	2	37	25	64			69	69
22	5	0	54	59	2	0	45	47			70	70
23	5	0	54	59	0	0	52	52			71	71
24	5	0	52	57	0	0	68	68			69	69
25	28	0	59	87	0	0	69	69			69	69
26	18	0	57	75	0	0	68	68			67	67
27	22	0	57	79	0	0	67	67			67	67
28	19	0	56	75	0	0	67	67			68	68
29	15	0	45	60	0	0	65	65				
30	11	0	45	56	0	0	65	65				
31	8	0	44	52	0	0	68	68				
Total				2,048				1,925				1,900
Mean				66.1				62.1				67.9
Maximum				88				80				72

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons-continued
Record furnished by New Jersey Water Supply Authority

Day	March				April				May			
	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total
1		0	68	68		0	70	70			69	69
2		40	77	117		0	69	69			69	69
3		15	69	84		0	69	69			67	67
4		0	69	69		40	73	113			66	66
5		0	67	67		33	72	105			69	69
6		0	69	69		0	70	70			68	68
7		0	69	69		0	70	70			68	68
8		0	69	69		0	70	70			67	67
9		0	70	70		0	69	69			67	67
10		0	69	69		0	66	66			67	67
11		0	69	69		0	66	66			67	67
12		0	69	69		0	65	65			67	67
13		0	71	71		0	65	65			64	64
14		0	70	70		0	65	65			64	64
15		0	69	69		0	68	68			63	63
16		0	68	68		0	69	69			63	63
17		0	68	68		0	69	69			63	63
18		0	68	68		0	70	70			62	62
19		0	66	66		0	71	71			63	63
20		0	67	67		0	69	69			64	64
21		0	67	67		0	69	69			65	65
22		0	67	67		0	69	69			64	64
23		0	67	67		0	67	67			63	63
24		0	67	67		0	67	67			64	64
25		0	67	67		0	74	74			64	64
26		0	67	67		0	75	75			64	64
27		0	67	67		0	73	73			64	64
28		0	69	69		0	69	69			64	64
29		0	69	69		0	69	69			62	62
30		0	69	69		0	69	69			62	62
31		0	70	70							62	62
Total				2,182				2,149				2,015
Mean				70.4				71.6				65.0
Maximum				117				113				69

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons-continued
Record furnished by New Jersey Water Supply Authority

Day	June				July				August			
	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total
1	0		76	76		0	86	86		0	80	80
2	0		86	86		32	89	121		0	78	78
3	0		80	80		97	98	195		0	77	77
4	0		81	81		26	63	89		0	77	77
5	0		83	83		4	74	78		0	82	82
6	0		81	81		11	79	90		0	86	86
7	0		81	81		33	85	118		0	85	85
8	0		77	77		32	75	107		0	84	84
9	0		84	84		18	76	94		0	85	85
10	0		89	89		0	81	81		24	88	112
11	0		90	90		14	84	98		1	84	85
12	0		90	90		34	84	118		0	70	70
13	0		93	93		19	91	120		0	71	71
14	0		75	75		45	91	136		0	74	74
15	0		55	55		101	94	195		0	76	76
16	-17		48	31		35	84	119		0	77	77
17	-48		48	0		23	77	100		0	77	77
18	-4		57	53		22	77	99		0	77	77
19	0		57	57		12	73	85		0	77	77
20	0		75	75		0	73	73		0	76	76
21	0		77	77		0	75	75		0	77	77
22	0		77	77		0	76	76		0	80	80
23	0		79	79		0	75	75		0	80	80
24	0		78	78		0	78	78		0	80	80
25	0		83	83		0	78	78		0	81	81
26	0		81	81		0	79	79		0	81	81
27	0		84	84		20	87	107		0	84	84
28	0		84	84		6	80	86		0	82	82
29	0		84	84		0	78	78		0	83	83
30	0		86	86			72	72		0	82	82
31							75	75		0	81	81
Total				2,150				3,081				2,497
Mean				75.0				99.4				80.5
Maximum				90				195				112

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons-continued
Record furnished by New Jersey Water Supply Authority

Day	September				October				November			
	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total	Carnegie Lake	Waste gate	Kingston Lock	Daily Total
1	0		77	77			0	0		0	88	88
2	0		63	63			0	0		0	82	82
3	0		67	67			0	0		0	59	59
4	0		71	71			37	37		0	59	59
5	0		74	74			78	78		0	59	59
6	0		74	74			75	75		0	58	58
7	0		75	75			70	70		0	62	62
8	0		75	75			69	69		0	64	64
9	0		76	76			64	64		0	67	67
10	0		76	76			63	63		0	79	79
11	0		75	75			63	63		0	79	79
12	0		72	72			58	58		0	65	65
13	0		73	73			56	56		0	67	67
14	0		76	76			58	58		0	70	70
15	0		75	75			57	57		0	71	71
16	0		65	65			58	58		0	68	68
17	0		47	47			78	78		0	64	64
18	0		50	50			80	80		0	64	64
19	0		50	50			78	78		0	66	66
20	-11		43	32			65	65		0	69	69
21	-32		43	11			61	61		0	71	71
22	0		0	0			61	61		0	75	75
23	0		0	0			57	57		0	74	74
24	0		0	0			59	59		0	74	74
25	0		0	0			58	58		0	75	75
26	0		0	0			58	58		0	74	74
27	0		0	0			58	58		0	74	74
28	0		0	0			64	64		0	72	72
29	0		0	0			67	67		0	72	72
30	0		0	0			79	79		24	77	101
31							92	92				
Total				1,154				1,821				2,162
Mean				45.1				58.7				70.7
Maximum				77				92				101

Table 13. - Diversions to New York City water supply
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1986	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date
Dec. 1	445	0	146	742	Jan. 1	403	0	101	687
2	450	0	148	741	2	403	0	103	686
3	75	0	141	738	3	403	0	100	685
4	0	0	0	735	4	402	0	99	684
5	0	0	0	731	5	396	0	106	683
6	0	0	0	727	6	395	0	98	682
7	0	0	0	723	7	398	0	0	681
8	299	0	107	721	8	402	0	0	680
9	297	0	103	720	9	402	0	0	679
10	300	0	102	718	10	402	0	0	677
11	301	0	107	716	11	402	0	0	676
12	298	0	106	715	12	389	0	0	675
13	298	0	105	713	13	398	0	0	674
14	298	0	101	712	14	400	0	0	672
15	304	0	105	710	15	400	0	0	671
16	309	0	106	709	16	400	0	0	670
17	303	0	91	707	17	400	0	0	669
18	298	0	105	705	18	399	0	0	668
19	306	0	108	704	19	399	0	0	667
20	306	0	108	703	20	401	0	0	665
21	306	0	109	701	21	401	0	0	664
22	294	0	107	700	22	400	0	0	663
23	302	0	104	698	23	400	0	0	662
24	301	0	104	697	24	400	0	0	661
25	300	0	101	695	25	400	0	0	660
26	296	0	99	694	26	398	0	147	659
27	297	0	98	693	27	400	0	142	659
28	297	0	98	691	28	401	0	149	658
29	291	0	96	690	29	401	0	0	657
30	292	0	100	688	30	402	0	0	656
31	377	0	103	687	31	402	0	0	655
Total	8,240	0	2,908			12,399	0	1,045	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date
Feb. 1	402	0	0	654	Mar. 1	451	181	158	654
2	390	0	0	653	2	422	352	157	655
3	396	0	0	652	3	450	394	156	657
4	435	0	153	652	4	451	395	109	658
5	449	0	151	652	5	450	396	99	659
6	449	0	157	652	6	450	472	105	660
7	449	0	153	651	7	450	498	106	661
8	449	0	153	651	8	451	498	107	663
9	453	0	152	651	9	448	500	104	664
10	452	17	154	651	10	450	499	102	666
11	452	0	146	651	11	449	500	109	667
12	452	0	151	650	12	450	498	103	668
13	448	0	153	650	13	451	499	108	670
14	448	0	160	650	14	451	499	107	671
15	448	0	162	650	15	452	499	110	672
16	447	0	155	650	16	448	192	107	673
17	438	0	135	649	17	449	181	112	673
18	450	0	174	649	18	450	181	105	673
19	450	0	128	649	19	450	425	110	674
20	450	170	154	650	20	450	499	106	675
21	450	185	186	650	21	450	499	104	677
22	450	185	181	651	22	448	499	0	678
23	449	183	148	651	23	451	499	0	679
24	451	182	158	652	24	452	420	0	679
25	450	182	155	652	25	450	390	0	680
26	450	182	164	653	26	450	391	0	680
27	450	181	151	653	27	298	491	0	681
28	450	181	165	654	28	0	499	0	680
					29	0	499	0	679
					30	452	498	0	680
					31	450	501	0	681
Total	12,407	1,648	3,899			12,874	13,344	2,384	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1986 to date
Apr. 1	299	490	0	682	May 1	451	392	0	658
2	0	500	0	681	2	451	392	0	659
3	0	38	0	679	3	451	392	0	659
4	0	0	0	677	4	451	395	164	660
5	0	0	0	675	5	450	389	340	662
6	0	0	0	672	6	449	393	346	663
7	0	0	0	670	7	450	391	326	665
8	0	0	0	668	8	451	300	357	666
9	0	0	0	666	9	451	292	309	667
10	0	0	0	664	10	451	292	341	668
11	0	0	0	662	11	448	294	25	669
12	0	0	0	660	12	452	295	153	669
13	376	0	0	659	13	449	292	171	670
14	464	0	0	658	14	449	296	172	671
15	448	0	0	657	15	451	295	177	671
16	450	0	0	657	16	450	294	175	672
17	450	0	0	656	17	450	294	171	673
18	449	0	0	655	18	450	294	170	674
19	449	0	0	655	19	450	294	145	674
20	452	0	0	654	20	450	293	148	675
21	449	0	0	654	21	449	294	141	675
22	451	0	0	653	22	450	294	145	676
23	450	391	0	654	23	450	294	140	677
24	450	391	0	654	24	450	293	145	677
25	450	391	0	655	25	449	293	148	678
26	450	391	0	655	26	450	197	146	678
27	450	393	0	656	27	450	179	148	678
28	450	392	0	656	28	450	179	148	679
29	449	393	0	657	29	451	178	162	679
30	450	391	0	657	30	451	178	146	679
31					31	452	177	144	679
Total	8,336	4,161	0			13,957	9,125	5,303	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
June 1	450	0	212	662	July 1	449	292	153	775
2	449	0	215	663	2	449	292	151	779
3	450	0	196	657	3	448	292	152	782
4	449	0	201	656	4	448	291	152	785
5	449	0	197	654	5	448	291	153	788
6	449	0	208	654	6	451	291	103	790
7	449	0	196	653	7	450	291	103	792
8	451	0	207	654	8	451	291	104	793
9	451	0	196	653	9	451	291	103	794
10	450	0	196	652	10	452	228	101	794
11	450	0	198	652	11	452	228	102	794
12	450	172	198	666	12	451	227	102	793
13	451	180	197	678	13	447	227	102	793
14	451	180	201	689	14	448	227	106	793
15	452	177	199	698	15	451	227	101	792
16	448	178	199	706	16	450	227	106	792
17	447	178	211	714	17	461	228	104	792
18	449	179	196	720	18	451	227	104	792
19	449	178	202	726	19	450	227	105	792
20	449	177	210	731	20	450	226	102	791
21	449	176	189	735	21	451	227	105	791
22	450	177	153	737	22	451	226	92	791
23	448	177	151	739	23	452	227	115	791
24	452	177	151	741	24	448	60	219	790
25	449	289	149	747	25	450	0	102	785
26	449	293	154	752	26	450	0	111	781
27	449	293	155	758	27	449	0	101	777
28	449	293	147	762	28	449	0	108	774
29	450	293	154	767	29	358	0	100	768
30	451	292	150	771	30	450	0	115	765
31						450	0	95	761
Total	13,489	4,059	5,588			13,866	5,861	3,572	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
Aug. 1	449	0	133	758	Sept.1	450	392	108	792
2	449	0	89	755	2	449	222	103	792
3	451	0	38	751	3	450	221	104	791
4	451	0	173	749	4	449	221	104	791
5	453	0	104	746	5	449	221	107	791
6	449	0	102	743	6	450	220	103	791
7	401	0	103	739	7	450	220	104	791
8	449	0	100	737	8	450	220	105	791
9	449	0	104	734	9	452	220	133	791
10	448	477	101	738	10	450	220	82	790
11	449	494	102	742	11	450	220	104	790
12	450	493	110	747	12	450	220	104	790
13	450	493	101	757	13	450	221	101	790
14	450	492	104	755	14	450	221	139	790
15	450	492	102	758	15	451	221	75	790
16	450	491	110	762	16	451	221	113	790
17	451	490	191	767	17	450	221	132	790
18	451	489	105	770	18	450	59	102	788
19	449	489	103	774	19	451	0	88	786
20	450	487	84	777	20	451	0	97	784
21	450	485	86	780	21	450	0	101	782
22	450	168	83	779	22	450	141	103	781
23	449	0	87	776	23	449	174	107	780
24	449	311	103	777	24	449	174	109	780
25	449	394	102	779	25	450	174	102	780
26	450	394	100	781	26	450	173	102	779
27	450	393	109	783	27	450	173	100	779
28	450	393	99	785	28	450	173	102	778
29	450	393	120	787	29	451	173	106	778
30	451	392	93	788	30	450	173	99	777
31	451	393	102	790					
Total	13,898	9,103	3,243			13,502	5,509	3,139	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
Oct. 1	450	173	108	777	Nov. 1	451	0	103	751
2	451	173	106	777	2	448	0	105	750
3	450	173	103	776	3	449	0	118	749
4	450	173	102	776	4	449	0	86	748
5	450	219	105	776	5	451	0	102	746
6	452	223	106	776	6	450	0	101	745
7	452	223	113	776	7	450	0	102	744
8	451	223	102	776	8	449	0	100	743
9	453	223	105	776	9	449	0	104	742
10	451	223	102	776	10	448	0	99	740
11	452	223	105	776	11	448	0	102	739
12	451	223	124	776	12	449	0	99	738
13	451	223	105	776	13	449	0	108	737
14	451	224	72	776	14	449	0	100	736
15	450	223	118	776	15	449	0	103	735
16	450	36	0	774	16	449	0	148	734
17	451	0	179	773	17	450	0	155	733
18	450	0	162	772	18	450	0	154	732
19	449	0	100	770	19	450	0	150	732
20	448	0	102	769	20	449	0	160	731
21	450	0	106	767	21	451	0	154	730
22	450	0	104	766	22	451	0	154	730
23	450	0	104	764	23	452	0	159	729
24	469	0	111	763	24	451	0	149	728
25	450	0	101	761	25	450	0	152	727
26	451	0	102	760	26	450	0	161	727
27	357	0	107	758	27	450	0	139	726
28	449	0	100	757	28	450	0	146	725
29	452	0	102	755	29	450	0	148	725
30	453	0	110	754	30	449	0	145	724
31	452	0	104	753					
Total	13,896	3,178	3,270			13,490	0	3,806	

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack cfs	Rio Reservoir cfs	Uncontrolled runoff: Present conditions cfs	Weather adjustment cfs	Date	Discharge cfs	Indicated deficiency cfs	Balancing adjustment cfs	Directed release: Daily cfs	Directed release: Cumulative cfs	Actual deficiency: Daily cfs	Actual deficiency: Cumulative cfs	Cumulative difference cfs-days	Balancing adjustment cfs
1986/87	1	2	3	4		5	6	7	8	9	10	11	12	13

MONTAGUE DESIGN RATE = 1,850 CFS DECEMBER 1, 1986 TO MARCH 14, 1987 AND 1,750 CFS MARCH 15 TO JUNE 14

The estimated Montague discharge was greater than the Montague design rate
December 1, 1986 to February 24, 1987, March 2 to May 16 and 27-30

Feb. 22	0	0	1,530	0	Feb. 25	1,530	320	+51	371	41,087	413	42,415	-1,328	+100
23	0	0	1,500	0	26	1,500	350	+77	427	41,514	285	42,700	-1,186	+100
24	0	0	1,500	0	27	1,500	350	+100	450	41,964	600	43,300	-1,336	+100
25	0	0	1,500	0	28	1,500	350	+100	450	42,414	499	43,799	-1,385	+100
26	0	0	1,430	150	Mar. 1	1,580	270	+100	370	42,784	223	44,022	-1,238	+100
May 14	0	0	1,607	74	May 17	1,681	69		69					
15	0	70	1,369	202	18	1,641	109		109					
16	0	70	1,316	44	19	1,430	320		320					
17	0	70	1,225	65	20	1,360	390		390					
18	0	140	1,158	172	21	1,470	280		280					
19	0	282	1,366	38	22	1,686	64		64					
20	0	0	1,276	16	23	1,292	458		458					
21	0	0	1,352	28	24	1,380	370		370					
22	0	0	1,264	58	25	1,322	428		428					
23	0	135	1,190	332	26	1,657	93		93					
28	0	0	1,509	29	31	1,538	212		212					

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±100.

Table 14.- New York City Reservoir release design data - continued

(River Master daily operation record)

Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases							Indicated deficiency	Balancing adjustment	Directed release		Actual deficiency		Cumulative difference	Balancing adjustment
Date of advance estimate	Powerplant release forecasts: Lake Wallenpaupack cfs	Powerplant release forecasts: Rio Reservoir cfs	Uncontrolled runoff: Present conditions cfs	Uncontrolled runoff: Weather adjustment cfs	Date	Discharge cfs	cfs	cfs	Daily cfs	Cumulative cfs	Daily cfs	Cumulative cfs	cfs-days	cfs
1987	1	2	3	4		5	6	7	8	9	10	11	12	13
MONTAGUE DESIGN RATE = 1,750 CFS MARCH 15 TO JUNE 14 AND 1,850 CFS JUNE 15 TO NOVEMBER 30														
The estimated Montague discharge was greater than the Montague design rate June 2-6 and 8-13														
May 29	0	283	1,312	62	June 1	1,657	97		93					
June 4	0	0	1,259	135	7	1,394	356		356					
11	0	0	839	305	14	1,144	606		606					
12	0	340	953	232	15	1,525	325		325	325	26	26	299	-30
13	353	340	1,064	129	16	1,886	0		0	325	0	26	299	-30
14	353	340	1,352	0	17	2,045	0		0	325	0	26	299	-30
15	353	255	1,233	0	18	1,841	9		9	334	0	26	308	-31
16	706	340	1,023	0	19	2,069	0	-30	0	334	0	26	308	-31
17	706	340	898	0	20	1,944	0	-30	0	334	0	26	308	-31
18	0	0	804	7	21	811	1,039	-30	1,009	1.343	948	974	369	-37
19	0	340	749	42	22	1,131	719	-31	688	2,031	909	1,883	148	-15
20	353	340	664	140	23	1,497	353	-31	322	2,353	524	2,407	-54	+5
21	353	340	673	188	24	1,554	296	-31	265	2,618	0	2,407	211	-21
22	353	0	697	1,258	25	2,308	0	-37	0	2,618	0	2,407	211	-21
23	353	0	2,360	0	26	2,713	0	-15	0	2,618	17	2,424	194	-19
24	353	0	1,391	0	27	1,744	96	+5	101	2,719	356	2,780	-61	+6
25	0	0	925	25	28	950	900	-21	879	3,598	680	3,460	138	-14
26	0	0	813	78	29	891	959	-21	938	4,536	756	4,216	320	-32
27	471	0	870	9	30	1,350	500	-19	481	5,017	202	4,418	599	-60

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±100.

Table 14.- New York City Reservoir release design data - continued

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack	Powerplant release forecasts: Rio Reservoir	Uncontrolled runoff: Present conditions	Uncontrolled runoff: Weather adjustment	Date	Discharge	Indicated deficiency	Balancing adjustment	Directed release: Daily	Directed release: Cumulative	Actual deficiency: Daily	Actual deficiency: Cumulative	Cumulative difference	Balancing adjustment
1987	cfs	cfs	cfs	cfs		cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs-days	cfs
	1	2	3	4		5	6	7	8	9	10	11	12	13
June 28	471	100	877	56	July 1	1,504	346	+6	352	5,369	24	4,442	927	-93
29	471	0	781	123	2	1,375	475	-14	461	5,830	29	4,471	1,359	-100
30	471	0	686	204	3	1,361	489	-32	457	6,287	0	4,471	1,816	-100
July 1	0	0	727	515	4	1,242	608	-60	548	6,835	0	4,471	2,364	-100
2	0	0	682	1,248	5	1,930	0	-93	0	6,835	0	4,471	2,364	-100
3	0	0	1,596	296	6	1,892	0	-100	0	6,835	317	4,788	2,047	-100
4	472	150	1,259	74	7	1,955	0	-100	0	6,835	0	4,788	2,047	-100
5	472	150	1,072	0	8	1,694	156	-100	56	6,891	0	4,788	2,103	-100
6	472	350	1,099	53	9	1,974	0	-100	0	6,891	0	4,788	2,103	-100
7	472	250	843	315	10	1,880	0	-100	0	6,891	0	4,788	2,103	-100
8	472	350	1,432	81	11	2,335	0	-100	0	6,891	0	4,788	2,103	-100
9	0	200	1,229	152	12	1,581	269	-100	169	7,060	416	5,204	1,856	-100
10	0	150	1,175	320	13	1,645	205	-100	105	7,165	446	5,650	1,515	-100

The estimated Montague discharge was greater than the Montague design rate July 14-26

24	0	142	872	43	27	1,057	793	-100	693	7,858	307	5,957	1,901	-100
25	827	71	775	134	28	1,807	43	-100	0	7,858	0	5,957	1,901	-100
26	827	0	1,142	85	29	2,054	0	-100	0	7,858	21	5,978	1,880	-100
27	827	0	1,069	0	30	1,896	0	-100	0	7,858	160	6,138	1,720	-100
28	827	0	859	0	31	1,686	164	-100	64	7,922	259	6,397	1,525	-100

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±100.

Table 14.- New York City Reservoir release design data - continued

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack	Powerplant release forecasts: Rio Reservoir	Uncontrolled runoff: Present conditions	Uncontrolled runoff: Weather adjustment	Date	Discharge	Indicated deficiency	Balancing adjustment	Directed release: Daily	Directed release: Cumulative	Actual deficiency: Daily	Actual deficiency: Cumulative	Cumulative difference	Balancing adjustment
	cfs	cfs	cfs	cfs		cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs-days	cfs
1987	1	2	3	4		5	6	7	8	9	10	11	12	13
July 29	827	0	783	15	Aug. 1	1,625	225	-100	125	8,047	189	6,586	1,461	-100
30	0	0	487	13	2	500	1,350	-100	1,250	9,297	1,343	7,929	1,358	-100
31	0	0	663	0	3	663	1,187	-100	1,087	10,384	1,089	9,018	1,366	-100
Aug. 1	593	99	605	237	4	1,534	316	-100	216	10,600	0	9,018	1,582	-100
2	593	400	555	433	5	1,981	0	-100	0	10,600	0	9,018	1,582	-100
3	593	400	1,325	28	6	2,373	0	-100	0	10,600	0	9,018	1,582	-100
4	593	350	957	29	7	1,929	0	-100	0	10,600	3	9,021	1,579	-100
5	593	120	897	67	8	1,677	173	-100	73	10,673	121	9,142	1,531	-100
6	0	0	986	35	9	1,021	829	-100	729	11,402	787	9,929	1,473	-100
7	0	100	814	169	10	1,083	767	-100	667	12,069	787	10,716	1,353	-100
8	475	150	744	225	11	1,594	256	-100	156	12,225	235	10,951	1,274	-100
9	475	150	700	247	12	1,572	278	-100	178	12,403	355	11,306	1,097	-100
10	475	0	917	0	13	1,392	458	-100	358	12,761	533	11,839	922	-92
11	475	0	779	0	14	1,254	596	-100	496	13,257	707	12,546	711	-71
12	475	0	662	0	15	1,137	713	-100	613	13,870	763	13,309	561	-56
13	0	0	526	0	16	526	1,324	-100	1,224	15,094	1,483	14,792	302	-30
14	0	0	603	0	17	603	1,247	-92	1,155	16,249	1,253	16,045	204	-20
15	238	0	567	22	18	827	1,023	-71	952	17,201	151	16,196	1,005	-100
16	0	0	511	30	19	541	1,309	-56	1,253	18,454	1,462	17,658	796	-80
17	0	0	505	38	20	543	1,307	-30	1,277	19,731	1,473	19,131	600	-60
18	0	0	483	0	21	483	1,367	-20	1,347	21,078	1,467	20,598	480	-48
19	0	0	455	0	22	455	1,395	-100	1,295	22,373	1,528	22,126	247	-25
20	0	0	451	0	23	451	1,399	-80	1,319	23,692	1,501	23,627	65	-6
21	0	0	310	27	24	337	1,513	-60	1,453	25,145	1,542	25,169	-24	+2
22	0	0	299	23	25	322	1,528	-48	1,480	26,625	1,574	26,743	-118	+12
23	0	0	292	0	26	292	1,558	-25	1,533	28,158	1,443	28,186	-28	+3
24	0	0	264	0	27	264	1,586	-6	1,580	29,738	1,376	29,562	+176	-18
25	0	0	244	124	28	368	1,482	+2	1,484	31,222	811	30,373	849	-85
26	0	0	335	891	29	1,226	760	+12	772	31,994	0	30,373	1,621	-100
27	0	0	389	887	30	1,276	574	+3	577	32,571	0	30,373	2,198	-100
28	0	0	870	591	31	1,461	389	-18	371	32,942	0	30,373	2,569	-100

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±100.

Table 14.- New York City Reservoir release design data - continued

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack	Powerplant release forecasts: Rio Reservoir	Uncontrolled runoff: Present conditions	Uncontrolled runoff: Weather adjustment	Date	Discharge	Indicated deficiency	Balancing adjustment	Directed release: Daily	Directed release: Cumulative	Actual deficiency: Daily	Actual deficiency: Cumulative	Cumulative difference	Balancing adjustment
	cfs	cfs	cfs	cfs		cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs-days	cfs
1987	1	2	3	4		5	6	7	8	9	10	11	12	13
Aug. 29	0	0	2,568	4	Sept. 1	2,572	0	-85	0	32,942	0	30,373	2,569	-100
30	0	0	2,071	0	2	2,071	0	-100	0	32,942	0	30,373	2,569	-100
31	0	0	1,316	140	3	1,456	394	-100	294	33,236	114	30,487	2,749	-100
Sept. 1	0	0	1,637	60	4	1,697	153	-100	53	33,289	443	30,930	2,359	-100
2	0	0	1,620	15	5	1,635	215	-100	115	33,404	733	31,663	1,741	-100
3	0	0	1,229	0	6	1,229	621	-100	521	33,925	1,170	32,833	1,092	-100
4	0	0	1,065	0	7	1,065	785	-100	685	34,610	1,044	33,877	733	-73
5	0	0	864	157	8	1,003	847	-100	747	35,357	863	34,740	617	-62
6	825	0	714	164	9	1,703	147	-100	47	35,404	0	34,740	664	-66
7	825	0	767	204	10	1,796	54	-100	0	35,404	0	34,740	664	-66

September 11 to November 30 estimated Montague discharge was greater than the Montague design rate

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to $\pm$100.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Mongaup Reservoir	Date	Controlled releases N.Y.C. reservoirs		Power-plants	Computed uncon-trolled	Total	Excess Release Credits	
Date	Amount								Directed	Other				Daily	Cumul.
1986	1	2	3	4		5	6		7	8	9	10	11	12	13
Nov. 28		50	37	26	Nov. 30	627	335	Dec. 1		113	962	7,855	8,930		9,092
29		50	37	26	Dec. 1	458	427	2		113	885	6,282	7,280		9,092
30		48	37	26	2	427	400	3		111	827	8,562	9,500		9,092
Dec. 1		48	37	26	3	458	437	4		111	895	10,794	11,800		9,092
2		51	37	26	4	770	427	5		114	1,197	8,889	10,200		9,092
3		51	36	26	5	639	421	6		113	1,060	6,717	7,890		9,092
4		50	34	26	6	0	400	7		110	400	6,150	6,660		9,092
5		50	34	26	7	0	389	8		110	389	5,811	6,310		9,092
6		50	34	26	8	556	410	9		110	966	5,724	6,800		9,092
7		51	34	26	9	703	410	10		111	1,113	6,126	7,350		9,092
8		50	34	26	10	685	416	11		110	1,101	7,429	8,640		9,092
9		50	34	26	11	908	410	12		110	1,318	6,632	8,060		9,092
10		50	34	26	12	933	383	13		110	1,316	5,794	7,220		9,092
11		51	34	25	13	705	410	14		110	1,115	4,785	6,010		9,092
12		51	34	25	14	0	416	15		110	416	4,834	5,360		9,092
13		51	34	25	15	697	389	16		110	1,086	4,664	5,860		9,092
14		51	34	25	16	951	162	17		110	1,113	4,217	5,440		9,092
15		51	34	25	17	0	124	18		110	124	4,316	4,550		9,092
16		51	34	25	18	492	302	19		110	794	4,836	5,740		9,092
17		51	34	25	19	949	232	20		110	1,181	4,339	5,630		9,092
18		51	34	25	20	0	211	21		110	211	4,109	4,430		9,092
19		51	34	25	21	27	54	22		110	81	3,719	3,910		9,092
20		51	34	25	22	167	292	23		110	459	3,471	4,040		9,092
21		51	34	25	23	923	216	24		110	1,139	3,131	4,380		9,092
22		51	34	25	24	939	216	25		110	1,155	4,595	5,860		9,092
23		50	34	25	25	0	86	26		109	86	8,605	8,800		9,092
24		51	34	25	26	924	227	27		110	1,151	7,129	8,390		9,092
25		51	34	25	27	0	200	28		110	200	6,280	6,590		9,092
26		51	34	25	28	0	54	29		110	54	5,936	6,100		9,092
27		50	34	25	29	1,188	421	30		109	1,609	5,132	6,850		9,092
28		51	34	25	30	1,211	405	31		110	1,616	4,724	6,450		9,092
Total	0	1,565	1,071	788		16,337	9,682		0	3,424	26,019	181,587	211,030		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1200 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1986 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed								Controlled releases			Computed		Excess Release Credits	
									N.Y.C. reservoirs		Power-	uncon-			
Date	Amount	Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Mongaup Reservoir	Date	Directed	Other	plants	trolled	Total	Daily	Cumul.
1986/87	1	2	3	4		5	6		7	8	9	10	11	12	13
Dec. 29		51	34	25	Dec. 31	1,205	232	Jan. 1		110	1,437	4,303	5,850		9,092
30		51	34	25	Jan. 1	1,209	329	2		110	1,538	4,142	5,790		9,092
31		50	34	25	2	1,206	254	3		109	1,460	4,131	5,700		9,092
Jan. 1		50	34	25	3	1,200	178	4		109	1,378	3,593	5,080		9,092
2		50	34	25	4	750	238	5		109	988	3,493	4,590		9,092
3		50	34	25	5	1,204	292	6		109	1,496	3,225	4,830		9,092
4		50	60	25	6	949	378	7		135	1,327	3,288	4,750		9,092
5		50	34	25	7	933	216	8		109	1,149	3,332	4,590		9,092
6		50	34	25	8	942	211	9		109	1,153	2,988	4,250		9,092
7		50	34	25	9	695	151	10		109	846	2,805	3,760		9,092
8		51	34	25	10	0	151	11		110	151	3,099	3,360		9,092
9		51	34	25	11	0	22	12		110	22	3,548	3,680		9,092
10		51	34	25	12	704	254	13		110	958	3,152	4,220		9,092
11		51	34	25	13	720	270	14		110	990	2,880	3,980		9,092
12		50	34	25	14	729	281	15		109	1,010	2,931	4,050		9,092
13		50	34	25	15	701	319	16		109	1,020	3,571	4,700		9,092
14		50	34	25	16	691	281	17		109	972	3,419	4,500		9,092
15		50	34	25	17	0	227	18		109	227	2,944	3,280		9,092
16		50	34	25	18	0	313	19		109	313	3,028	3,450		9,092
17		50	34	25	19	779	302	20		109	1,081	3,230	4,420		9,092
18		50	34	25	20	685	281	21		109	966	3,105	4,180		9,092
19		50	34	25	21	690	319	22		109	1,009	3,072	4,190		9,092
20		50	34	25	22	699	281	23		109	980	2,611	3,700		9,092
21		51	34	25	23	1,030	292	24		110	1,322	2,668	4,100		9,092
22		51	34	25	24	663	238	25		110	901	2,789	3,800		9,092
23		48	34	25	25	695	286	26		107	981	3,012	4,100		9,092
24		50	34	25	26	1,178	281	27		109	1,459	2,832	4,400		9,092
25		50	34	25	27	1,186	329	28		109	1,515	3,176	4,800		9,092
26		50	34	25	28	1,160	232	29		109	1,392	3,199	4,700		9,092
27		50	34	25	29	954	400	30		109	1,354	2,937	4,400		9,092
28		50	34	25	30	957	308	31		109	1,265	2,626	4,000		9,092
Total	0	1,556	1,080	775		24,514	8,146		0	3,411	32,660	99,129	135,200		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1200 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1986 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Mongaup/ Rio Reservoir		Controlled releases N.Y.C. reservoirs		Power-plants	Computed uncon-trolled		Excess Release Credits	
Date	Amount								Date	Directed	Other			Total	Daily	Cumul.
1987	1		2	3	4		5	6		7	8	9	10	11	12	13
Jan. 29	0		50	34	25	Jan. 31	361	189	Feb. 1	0	109	550	2,941	3,600	0	9,092
30	0		54	34	25	Feb. 1	440	86	2	0	113	526	2,461	3,100	0	9,092
31	0		50	34	25	2	704	232	3	0	109	936	2,455	3,500	0	9,092
Feb. 1	0		51	34	25	3	702	238	4	0	110	940	2,450	3,500	0	9,092
2	0		50	34	25	4	356	292	5	0	109	648	2,543	3,300	0	9,092
3	0		50	34	25	5	355	232	6	0	109	587	2,304	3,000	0	9,092
4	0		50	34	25	6	345	259	7	0	109	604	2,187	2,900	0	9,092
5	0		50	34	25	7	0	173	8	0	109	173	2,218	2,500	0	9,092
6	0		50	34	25	8	0	92	9	0	109	92	2,099	2,300	0	9,092
7	0		50	34	25	9	767	232	10	0	109	999	2,192	3,300	0	9,092
8	0		53	34	25	10	713	0	11	0	112	713	2,075	2,900	0	9,092
9	0		53	34	25	11	702	130	12	0	112	832	1,856	2,800	0	9,092
10	0		51	34	25	12	719	32	13	0	110	751	1.939	2,800	0	9,092
11	0		53	34	25	13	722	157	14	0	112	879	1,809	2,800	0	9,092
12	0		53	34	25	14	0	0	15	0	112	0	1,688	1,800	50	9,142
13	0		51	34	25	15	85	0	16	0	110	85	1,705	1,900	60	9,202
14	0		51	34	25	16	60	0	17	0	110	60	1,830	2,000	0	9,202
15	0		51	34	25	17	726	124	18	0	110	850	1,840	2,800	0	9,202
16	0		53	34	25	18	700	0	19	0	112	700	2,088	2,900	0	9,202
17	0		53	34	25	19	784	0	20	0	112	784	2,004	2,900	0	9,202
18	0		53	34	25	20	765	0	21	0	112	765	1,923	2,800	0	9,202
19	0		51	34	25	21	0	0	22	0	110	0	1,590	1,700	-50	9,152
20	0		46	34	25	22	0	0	23	0	105	0	1,595	1,700	-50	9,102
21	0		50	34	25	23	73	0	24	0	109	73	1,518	1,700	-50	9,052
22	371		50	288	25	24	0	0	25	363	0	0	1,437	1,800	50	9,102
23	427		53	358	25	25	0	340	26	435	0	340	1,225	2,000	250	9,352
24	450		51	374	25	26	0	95	27	450	0	95	1,155	1,700	-50	9,302
25	450		51	373	25	27	79	121	28	449	0	200	1,151	1,800	50	9,352
Total	1,698		1,432	2,208	700		10,158	3,024		1,697	2,643	13,182	54,278	71,800		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1200 of date shown. Flow controlled by Rio Reservoir Feb. 25, 1987 beginning at 1600 hours.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1986 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
									Controlled releases					Excess Release Credits	
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	N.Y.C. reservoirs		Power-plants	Computed uncon-trolled	Total	Daily	Cumul.
Date	Amount								Directed	Other					
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Feb. 26	370	51	297	25	Feb. 28	0	0	Mar. 1	373	0	0	1,627	2,000	250	9,602
27	0	51	34	25	Mar. 1	0	149	2	0	110	149	3,941	4,200	0	9,602
28	0	53	34	25	2	16	383	3	0	112	399	6,189	6,700	0	9,602
Mar. 1	0	51	34	25	3	25	386	4	0	110	411	6,579	7,100	0	9,602
2	0	51	34	25	4	0	351	5	0	110	351	5,439	5,900	0	9,602
3	0	53	34	25	5	0	0	6	0	112	0	4,988	5,100	0	9,602
4	0	53	34	25	6	0	365	7	0	112	365	5,123	5,600	0	9,602
5	0	53	34	25	7	0	372	8	0	112	372	7,616	8,100	0	9,602
6	0	50	34	25	8	0	390	9	0	109	390	15,801	16,300	0	9,602
7	0	50	34	25	9	448	379	10	0	109	827	15,164	16,100	0	9,602
8	0	51	34	25	10	562	329	11	0	110	891	11,799	12,800	0	9,602
9	0	53	34	25	11	669	376	12	0	112	1,045	10,043	11,200	0	9,602
10	0	50	34	25	12	844	379	13	0	109	1,223	8,398	9,730	0	9,602
11	0	50	34	25	13	835	394	14	0	109	1,229	6,922	8,260	0	9,602
12	0	50	34	25	14	0	0	15	0	109	0	6,261	6,370		
13	0	51	34	25	15	23	156	16	0	110	179	5,661	5,950		
14	0	54	34	25	16	636	411	17	0	113	1,047	4,950	6,110		
15	0	51	34	25	17	700	372	18	0	110	1,072	4,538	5,720		
16	0	51	34	25	18	690	429	19	0	110	1,119	4,451	5,680		
17	0	50	34	25	19	754	369	20	0	109	1,123	4,788	6,020		
18	0	48	34	25	20	708	404	21	0	107	1,112	4,411	5,630		
19	0	54	34	25	21	0	400	22	0	113	400	4,287	4,800		
20	0	54	34	25	22	0	270	23	0	113	270	4,897	5,280		
21	0	54	34	25	23	695	400	24	0	113	1,095	5,682	6,890		
22	0	53	34	25	24	694	262	25	0	112	956	6,702	7,770		
23	0	54	34	25	25	733	283	26	0	113	1,016	8,061	9,190		
24	0	51	34	25	26	718	259	27	0	110	977	9,913	11,000		
25	0	51	34	25	27	722	348	28	0	110	1,070	9,320	10,500		
26	0	53	34	25	28	0	400	29	0	112	400	9,028	9,540		
27	0	53	34	25	29	0	209	30	0	112	209	8,239	8,560		
28	0	53	34	25	30	0	387	31	0	112	387	8,841	9,340		
Total	370	1,605	1,317	775		10,472	9,612		373	3,324	20,084	219,659	243,440		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1986 to March 14, 1987 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir		Controlled releases N.Y.C. reservoirs		Power-plants	Computed uncon-trolled		Excess Release Credits	
Date	Amount							Date	Directed	Other			Total	Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Mar. 29		53	34	26	Mar. 31	83	443	Apr. 1		113	526	15,261	15,900		
30		54	34	43	Apr. 1	0	602	2		131	602	12,567	13,300		
31		70	45	43	2	465	443	3		158	908	10,334	11,400		
Apr. 1		70	45	45	3	946	726	4		160	1,672	18,368	20,200		
2		70	45	43	4	922	741	5		158	1,663	56,379	58,200		
3		70	45	44	5	1,562	769	6		159	2,331	37,310	39,800		
4		71	45	43	6	1,809	744	7		159	2,553	29,388	32,100		
5		73	45	45	7	1,820	730	8		163	2,550	24,287	27,000		
6		73	45	45	8	1,823	712	9		163	2,535	20,302	23,000		
7		70	46	45	9	1,218	716	10		161	1,934	16,905	19,000		
8		70	46	37	10	941	737	11		153	1,678	14,069	15,900		
9		70	45	45	11	922	531	12		160	1,453	11,887	13,500		
10		70	45	46	12	942	705	13		161	1,647	15,492	17,300		
11		70	45	42	13	921	720	14		157	1,641	20,702	22,500		
12		70	45	45	14	933	599	15		160	1,532	16,308	18,000		
13		70	45	45	15	1,420	723	16		160	2,143	13,197	15,500		
14		70	45	46	16	1,448	680	17		161	2,128	11,211	13,500		
15		70	45	45	17	1,446	727	18		160	2,173	10,267	12,600		
16		70	46	45	18	1,445	712	19		161	2,157	9,382	11,700		
17		70	45	46	19	1,441	695	20		161	2,136	8,103	10,400		
18		70	45	46	20	237	432	21		161	669	7,340	8,170		
19		70	45	46	21	0	698	22		161	698	6,421	7,280		
20		70	45	46	22	0	709	23		161	709	5,620	6,490		
21		70	45	45	23	0	539	24		160	539	5,181	5,880		
22		70	45	46	24	0	355	25		161	355	4,984	5,500		
23		70	45	46	25	0	457	26		161	457	4,592	5,210		
24		70	45	46	26	0	578	27		161	578	3,961	4,700		
25		70	45	46	27	0	343	28		161	343	3,476	3,980		
26		68	45	46	28	0	156	29		159	156	3,355	3,670		
27		70	71	46	29	0	85	30		187	85	3,378	3,650		
Total	0	2,072	1,357	1,323		22,744	17,807		0	4,752	40,551	420,027	465,330		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
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Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
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Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
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Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed								Controlled releases					Excess Release Credits	
						Lake			N.Y.C. reservoirs		Power-	Computed			
Date	Amount	Pepacton	Cannonsville	Neversink	Date	Wallen-paupack	Rio Reservoir	Date	Directed	Other	plants	uncon-trolled	Total	Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Apr. 28	0	73	45	46	Apr. 30	0	0	May 1	0	164	0	3,126	3,290		
29	0	71	70	45	May 1	0	0	2	0	186	0	2,764	2,950		
30	0	73	45	45	2	0	0	3	0	163	0	2,567	2,730		
May 1	0	73	45	45	3	0	0	4	0	163	0	3,907	4,070		
2	0	73	46	45	4	223	202	5	0	164	425	4,011	4,600		
3	0	73	45	46	5	0	556	6	0	164	556	3,450	4,170		
4	0	73	45	43	6	0	301	7	0	161	301	3,258	3,720		
5	0	73	45	43	7	0	393	8	0	161	393	2,846	3,400		
6	0	70	45	43	8	0	88	9	0	158	88	2,644	2,890		
7	0	74	45	45	9	0	0	10	0	164	0	2,436	2,600		
8	0	74	45	45	10	0	138	11	0	164	138	2,238	2,540		
9	0	73	45	45	11	0	205	12	0	163	205	2,042	2,410		
10	0	73	45	43	12	0	0	13	0	161	0	1,979	2,140		
11	0	73	46	43	13	0	0	14	0	162	0	1,858	2,020		
12	0	73	45	43	14	0	0	15	0	161	0	1,769	1,930		
13	0	73	45	43	15	0	0	16	0	161	0	1,699	1,860		
14	69	73	45	45	16	0	0	17	69	94	0	1,617	1,780		
15	109	73	45	46	17	0	64	18	109	55	64	1,702	1,930		
16	320	73	201	43	18	0	0	19	317	0	0	1,563	1,880		
17	390	73	283	43	19	0	50	20	399	0	50	1,741	2,190		
18	280	73	161	46	20	0	00	21	280	0	0	1,830	2,110		
19	64	73	48	46	21	0	407	22	64	103	407	1,716	2,290		
20	458	73	342	46	22	0	0	23	461	0	0	1,619	2,080		
21	370	73	252	46	23	0	0	24	371	0	0	1,859	2,230		
22	428	73	314	46	24	0	0	25	433	0	0	2.397	2,830		
23	93	73	43	46	25	0	156	26	93	69	156	2,092	2,410		
24	0	73	43	46	26	0	159	27	0	162	159	1,809	2,130		
25	0	73	43	46	27	255	255	28	0	162	510	1,668	2,340		
26	0	73	43	46	28	228	418	29	0	162	646	1,482	2,290		
27	0	68	43	46	29	832	421	30	0	157	1,253	950	2,360		
28	212	71	269	46	30	0	255	31	213	173	255	1,119	1,760		
Total	2,793	2,253	2,922	1,391		1,538	4,068		2,809	3,757	5,606	67,758	79,930		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1986 to March 14, 1987 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed								Controlled releases					Excess Release Credits	
						Lake			N.Y.C. reservoirs		Power-	Computed			
Date	Amount	Pepacton	Cannonsville	Neversink	Date	Wallen-paupack	Rio Reservoir	Date	Directed	Other	plants	uncon-trolled	Total	Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
May 29	93	73	374	46	May 30	0	177	June 1	93	400	177	1,240	1,910		
30	0	71	370	46	June 1	570	482	2	0	487	1,052	1,281	2,820		
31	0	71	370	65	2	689	624	3	0	506	1,313	1,551	3,370		
June 1	0	99	370	63	3	702	227	4	0	532	929	1,559	3,020		
2	0	99	203	46	4	698	166	5	0	348	864	1,748	2,960		
3	0	71	43	46	5	710	0	6	0	160	710	1,890	2,760		
4	356	71	243	46	6	0	0	7	360	0	0	1,500	1,860		
5	0	71	43	46	7	0	0	8	0	160	0	1,510	1,670		
6	0	71	43	46	8	739	0	9	0	160	739	1,381	2,280		
7	0	71	43	46	9	702	124	10	0	160	826	1,524	2,510		
8	0	71	43	46	10	695	351	11	0	160	1,046	1,174	2,380		
9	0	71	45	46	11	372	71	12	0	162	443	1,165	1,770		
10	0	71	45	46	12	348	92	13	0	162	440	1,198	1,800		
11	606	71	490	45	13	0	260	14	606	0	260	1,154	2,020		
12	325	71	210	45	14	0	287	15	326	0	287	1,537	2,150	325	325
13	0	71	43	45	15	811	379	16	0	159	1,190	1,341	2,690	0	325
14	0	71	373	45	16	695	102	17	0	489	797	1,074	2,360	0	325
15	9	71	371	45	17	701	244	18	9	478	945	908	2,340	9	334
16	0	70	430	45	18	718	177	19	0	545	895	980	2,420	0	334
17	0	70	441	45	19	341	748	20	0	556	1,089	765	2,410	0	334
18	1,009	70	893	45	20	0	383	21	1,008	0	383	519	1,910	160	494
19	688	97	517	65	21	0	135	22	679	0	135	806	1,620	-130	364
20	322	97	371	46	22	348	35	23	322	192	383	943	1,840	90	454
21	265	71	371	45	23	348	0	24	265	222	348	1,775	2,610	265	719
22	0	71	371	45	24	348	32	25	0	487	380	1,723	2,590	0	719
23	0	71	371	45	25	462	0	26	0	487	462	1,371	2,320	17	736
24	101	70	371	45	26	347	0	27	101	385	347	1,147	1,980	100	836
25	879	102	713	65	27	0	0	28	880	0	0	1,170	2,050	300	1,136
26	938	102	769	65	28	0	0	29	936	0	0	1,094	2,030	280	1,416
27	481	101	368	43	29	459	124	30	481	31	583	1.065	2,160	410	1,826
Total	6,072	2,328	9,708	1,458		11,803	5,220		6,066	7,428	17,023	38,093	68,610		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
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Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed								Controlled releases			Computed		Excess Release Credits	
Date	Amount	Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	N.Y.C. reservoirs Directed	N.Y.C. reservoirs Other	Power-plants	uncon-trolled	Total	Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
June 28	352	71	368	45	June 30	673	160	July 1	352	132	833	993	2,310	352	2,178
29	461	70	364	45	July 1	705	152	2	461	18	857	964	2,300	461	2,639
30	457	70	373	45	2	455	0	3	457	31	455	1,617	2.560	457	3,096
July 1	548	71	432	45	3	0	0	4	548	0	0	2,572	3,120	548	3,644
2	0	71	373	45	4	0	0	5	0	489	0	2,001	2,490	0	3,644
3	0	71	371	45	5	0	0	6	0	487	0	1,533	2,020	100	3,744
4	0	71	370	45	6	460	262	7	0	486	722	1,212	2,420	0	3,744
5	56	76	368	45	7	453	468	8	56	433	921	1,300	2,710	56	3,800
6	0	71	367	45	8	465	433	9	0	483	898	1,949	3,330	0	3,800
7	0	71	377	45	9	560	567	10	0	493	1,127	1,730	3,350	0	3,800
8	0	71	370	65	10	468	471	11	0	506	939	1,355	2,800	0	3,800
9	169	97	370	79	11	0	99	12	169	377	99	1,335	1,980	100	3,900
10	105	97	489	90	12	0	230	13	105	571	230	1,174	2,080	100	4,000
11	0	97	679	90	13	463	507	14	0	866	970	1,504	3,340	0	4,000
12	0	97	825	71	14	669	298	15	0	993	967	5,950	7,910	0	4,000
13	0	71	365	48	15	713	180	16	0	484	893	6,453	7,830	0	4,000
14	0	71	365	48	16	814	0	17	0	484	814	3,762	5,060	0	4,000
15	0	71	367	48	17	824	57	18	0	486	881	2,573	3,940	0	4,000
16	0	74	359	48	18	0	390	19	0	481	390	2,039	2,910	0	4,000
17	0	74	368	48	19	0	362	20	0	490	362	1,688	2,540	0	4,000
18	0	74	367	48	20	877	382	21	0	489	1,259	1,572	3,320	0	4,000
19	0	74	365	70	21	926	372	22	0	509	1,298	1,533	3,340	0	4,000
20	0	74	364	70	22	972	411	23	0	508	1,383	1,289	3,180	0	4,000
21	0	74	364	70	23	953	418	24	0	508	1,371	1,161	3,040	0	4,000
22	0	102	484	70	24	903	436	25	0	656	1,339	1,005	3,000	0	4,000
23	0	101	524	91	25	820	291	26	0	716	1,111	963	2,790	0	4,000
24	693	131	678	68	26	0	0	27	693	184	0	1,543	2,420	486	4,486
25	0	99	520	68	27	807	0	28	0	687	807	1,266	2,760	0	4,486
26	0	99	364	68	28	809	0	29	0	531	809	1,020	2,360	21	4,507
27	0	68	364	68	29	813	0	30	0	500	813	877	2,190	100	4,607
28	64	67	364	68	30	815	0	31	64	435	815	776	2,090	100	4,707
Total	2,905	2,496	13,078	1,844		16,417	6,946		2,905	14,513	23,363	56,709	97,490		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
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Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallenpaupack	Rio Reservoir	Date	Controlled releases N.Y.C. reservoirs		Power-plants	Computed uncontrolled	Total	Excess Release Credits	
Date	Amount								Directed	Other				Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
July 29	125	67	364	68	July 31	834	0	Aug. 1	125	374	834	827	2,160	100	4,807
30	1,250	67	1,028	68	Aug. 1	0	0	2	1,163	0	0	507	1,670	-80	4,727
31	1,087	99	922	68	2	0	0	3	1,089	0	0	761	1,850	100	4,827
Aug. 1	216	71	367	48	3	680	120	4	216	270	800	1,464	2,750	216	5,043
2	0	71	367	48	4	583	199	5	0	486	782	1,522	2,790	0	5,043
3	0	71	367	65	5	584	184	6	0	503	768	1,339	2,610	0	5,043
4	0	71	367	45	6	599	180	7	0	483	779	1,068	2,330	3	5,046
5	73	71	365	45	7	552	88	8	73	408	640	1,089	2,210	100	5,146
6	729	71	608	68	8	0	241	9	747	0	241	822	1,810	60	5,206
7	667	96	523	68	9	0	227	10	687	0	227	836	1,750	0	5,206
8	156	96	367	62	10	456	252	11	156	369	708	907	2,140	100	5,306
9	178	93	367	45	11	463	142	12	178	327	605	890	2,000	100	5,406
10	358	70	368	45	12	462	71	13	358	125	533	784	1,800	50	5,456
11	496	70	382	45	13	460	0	14	497	0	460	683	1,640	-110	5,346
12	613	70	498	45	14	464	0	15	613	0	464	623	1,700	-50	5,296
13	1,224	70	1,085	68	15	0	0	16	1,223	0	0	367	1,590	-160	5,136
14	1,155	101	985	67	16	0	237	17	1,153	0	237	360	1,750	0	5,136
15	952	101	783	67	17	796	386	18	951	0	1,182	517	2,650	900	6,036
16	1,253	101	1,063	88	18	0	0	19	1,252	0	0	388	1,640	-110	5,926
17	1,277	118	1,067	88	19	0	0	20	1,273	0	0	377	1,650	-100	5,826
18	1,347	118	1,149	70	20	0	0	21	1,337	0	0	383	1,720	-30	5,796
19	1,295	99	1,154	45	21	0	0	22	1,298	0	0	322	1,620	-130	5,666
20	1,319	68	1,208	45	22	0	0	23	1,321	0	0	349	1,670	-80	5,586
21	1,453	68	1,349	45	23	0	0	24	1,462	0	0	308	1,770	20	5,606
22	1,480	68	1,361	45	24	0	0	25	1,474	0	0	276	1,750	0	5,606
23	1,533	68	1,420	45	25	152	0	26	1,533	0	152	255	1,940	190	5,796
24	1,580	68	1,463	45	26	0	0	27	1,576	0	0	474	2,050	300	6,096
25	1,484	68	1,368	45	27	0	53	28	1,481	0	53	986	2,520	770	6,866
26	772	68	659	45	28	0	0	29	772	0	0	2,038	2,810	772	7,638
27	577	68	458	45	29	0	0	30	571	0	0	3,439	4,010	577	8,215
28	371	68	347	45	30	0	0	31	370	90	0	2,310	2,770	371	8,586
Total	25,020	2,474	24,179	1,731		7,085	2,380		24,949	3,435	9,465	27,271	65,120		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.- continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount							Date	Directed	Other				Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Aug. 29	0	68	40	45	Aug. 31	157	64	Sept. 1	0	153	221	1,986	2,360	0	8,586
30	0	68	193	45	Sept. 1	0	120	2	0	306	120	2,224	2,650	0	8,586
31	294	68	181	45	2	0	0	3	294	0	0	1,736	2,030	280	8,866
Sept. 1	53	68	40	45	3	0	0	4	53	100	0	1,407	1,560	-190	8,676
2	115	68	40	45	4	0	0	5	115	38	0	1,117	1,270	-480	8,196
3	521	68	407	45	5	0	0	6	520	0	0	680	1,200	-550	7,646
4	685	68	571	45	6	0	0	7	684	0	0	806	1,490	-260	7,386
5	747	68	630	45	7	0	0	8	743	0	0	987	1,730	-20	7,366
6	47	68	339	45	8	549	131	9	47	405	680	15,468	16,600	0	7,366
7	0	67	334	45	9	802	280	10	0	446	1,082	15,872	17,400	0	7,366
8	0	68	147	45	10	905	404	11	0	260	1,309	8,021	9,590	0	7,366
9	0	68	40	45	11	888	421	12	0	153	1,309	5,388	6,850	0	7,366
10	0	68	40	46	12	1,150	457	13	0	154	1,607	8,939	10,700	0	7,366
11	0	68	40	45	13	1,130	751	14	0	153	1,881	24,166	26,200	0	7,366
12	0	68	40	45	14	1,392	812	15	0	153	2,204	14,343	16,700	0	7,366
13	0	68	40	45	15	1,393	535	16	0	153	1,928	9,219	11,300	0	7,366
14	0	68	40	45	16	1,308	815	17	0	153	2,123	6,824	9,100	0	7,366
15	0	68	40	45	17	1,352	812	18	0	153	2,164	7,673	9,990	0	7,366
16	0	68	40	45	18	1,510	801	19	0	153	2,311	16,836	19,300	0	7,366
17	0	68	40	45	19	1,699	805	20	0	153	2,504	12,543	15,200	0	7,366
18	0	67	40	45	20	1,706	776	21	0	152	2,482	9,066	11,700	0	7,366
19	0	68	40	42	21	1,701	450	22	0	150	2,151	7,359	9,660	0	7,366
20	0	68	42	45	22	1,650	638	23	0	155	2,288	5,757	8,200	0	7,366
21	0	68	42	45	23	1,451	808	24	0	155	2,259	4,866	7,280	0	7,366
22	0	68	42	45	24	1,419	609	25	0	155	2,028	4,327	6,510	0	7,366
23	0	68	42	45	25	1,454	596	26	0	155	2,050	3,875	6,080	0	7,366
24	0	68	42	45	26	1,683	468	27	0	155	2,151	3,384	5,690	0	7,366
25	0	68	42	45	27	1,605	602	28	0	155	2,207	2,808	5,170	0	7,366
26	0	68	42	45	28	1,363	581	29	0	155	1,944	2,601	4,700		
27	0	68	42	45	29	1,314	946	30	0	155	2,260	2,215	4,630	0	7,366
Total	2,462	2,038	3,698	1,348		29,581	13,682		2,456	4,628	43,263	202,493	252,840		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
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(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
	Directed								Controlled releases					Excess Release Credits	
Date	Amount	Pepacton	Cannonsville	Neversink	Date	Lake Wallenpaupack	Rio Reservoir	Date	N.Y.C. reservoirs Directed	N.Y.C. reservoirs Other	Powerplants	Computed uncontrolled	Total	Daily	Cumul.
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Sept. 28		68	42	45	Sept. 30	1,636	680	Oct. 1		155	2,316	2,469	4,940		7,366
29		68	42	45	Oct. 1	1,317	645	2		155	1,962	2,693	4,810		7,366
30		68	42	45	2	1,463	443	3		155	1,906	2,419	4,480		7,366
Oct. 1		68	42	45	3	1,658	85	4		155	1,743	3,542	5,440		7,366
2		68	42	45	4	1,591	946	5		155	2,537	2,748	5,440		7,366
3		68	42	45	5	1,382	382	6		155	1,764	3,391	5,310		7,366
4		68	42	45	6	1,376	82	7		155	1,458	2,917	4,530		7,366
5		68	42	45	7	1,377	0	8		155	1,377	3,248	4,780		7,366
6		68	42	46	8	1,379	0	9		156	1,379	3,245	4,780		7,366
7		68	42	46	9	1,387	0	10		156	1,387	2,837	4,380		7,366
8		68	42	46	10	1,642	0	11		156	1,642	2,612	4,410		7,366
9		68	42	46	11	1,092	78	12		156	1,170	2,884	4,210		7,366
10		68	42	46	12	253	270	13		156	523	3,041	3,720		7,366
11		68	42	46	13	291	145	14		156	436	2,788	3,380		7,366
12		68	42	46	14	307	503	15		156	810	2,414	3,380		7,366
13		68	42	46	15	293	127	16		156	420	2,464	3,040		7,366
14		70	42	46	16	258	127	17		158	385	2,107	2,650		7,366
15		70	42	46	17	0	0	18		158	0	2,102	2,260		7,366
16		70	42	46	18	0	160	19		158	160	2,072	2,390		7,366
17		70	42	46	19	177	170	20		158	347	1,885	2,390		7,366
18		68	42	45	20	223	0	21		155	223	1,962	2,340		7,366
19		68	42	46	21	189	113	22		156	302	2,112	2,570		7,366
20		68	42	46	22	232	323	23		156	555	2,179	2,890		7,366
21		70	43	46	23	232	0	24		159	232	2,059	2,450		7,366
22		70	43	46	24	0	0	25		159	0	1,861	2,020		7,366
23		68	43	45	25	0	195	26		156	195	1,719	2,070		7,366
24		67	43	46	26	437	368	27		156	805	1,649	2,610		7,366
25		68	43	46	27	237	202	28		157	439	7,484	8,080		7,366
26		68	43	46	28	523	748	29		157	1,271	13,072	14,500		7,366
27		68	43	46	29	232	674	30		157	906	9,237	10,300		7,366
28		70	43	46	30	507	769	31		159	1,276	7,205	8,640		7,366
Total	0	2,121	1,310	1,416		21,691	8,235		0	4,847	29,926	104,417	139,190		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
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Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 cfs-days.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants			Daily	Cumul.
Date	Amount							Date	Directed	Other					
1987	1	2	3	4		5	6		7	8	9	10	11	12	13
Oct. 29		71	43	46	Oct. 31	0	348	Nov. 1		160	348	6,152	6,660		7,366
30		71	43	39	Nov. 1	0	543	2		153	543	4,914	5,610		7,366
31		71	36	25	2	475	411	3		132	886	4,102	5,120		7,366
Nov. 1		68	36	23	3	543	265	4		127	808	3,945	4,880		7,366
2		53	36	23	4	529	394	5		112	923	3,525	4,560		7,366
3		53	36	23	5	537	379	6		112	916	3,282	4,310		7,366
4		53	36	25	6	532	401	7		114	933	3,043	4,090		7,366
5		53	36	26	7	0	152	8		115	152	2,833	3,100		7,366
6		53	36	26	8	0	269	9		115	269	2,636	3,020		7,366
7		53	36	26	9	390	496	10		115	886	2,739	3,740		7,366
8		53	36	26	10	789	301	11		115	1,090	2,825	4,030		7,366
9		53	34	26	11	539	472	12		113	1,011	2,996	4,120		7,366
10		53	34	26	12	696	699	13		113	1,395	2,752	4,260		7,366
11		53	34	26	13	664	379	14		113	1,043	2,844	4,000		7,366
12		53	34	26	14	0	99	15		113	99	3,218	3,430		7,366
13		53	34	26	15	0	425	16		113	425	3,112	3,650		7,366
14		53	34	26	16	356	287	17		113	643	2,894	3,650		7,366
15		53	34	26	17	353	436	18		113	789	3,498	4,400		7,366
16		53	34	26	18	586	351	19		113	937	4,530	5,580		7,366
17		53	34	26	19	358	237	20		113	595	4,312	5,020		7,366
18		53	34	26	20	359	433	21		113	792	3,625	4,530		7,366
19		53	34	26	21	168	230	22		113	398	3,299	3,810		7,366
20		53	34	26	22	0	220	23		113	220	2,987	3,320		7,366
21		53	34	26	23	359	422	24		113	781	3,256	4,150		7,366
22		53	34	26	24	355	478	25		113	833	3,004	3,950		7,366
23		53	34	26	25	449	234	26		113	683	2,744	3,540		7,366
24		53	34	26	26	0	266	27		113	266	2,811	3,190		
25		53	34	26	27	0	394	28		113	394	2,683	3,190		7,366
26		53	34	26	28	0	113	29		113	113	2,584	2,810		7,366
27		53	34	26	29	0	305	30		113	305	6,832	7,250		7,366
Total	0	1,659	1,056	802		9,037	10,439		0	3,517	19,476	103,977	126,970		

Col. 2 - 24 hours beginning 1200 of date shown.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 cfs, computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning

Table 16. - Consumption of Water by New York City - 1940 to 1987.
Data furnished by New York City, Department of
Environmental Protection, Bureau of Water Supply
[*Provisional; mgd - million gallons per day;
gpcd - gallons per capita per day; bg - billion gallons]

Year	Consumption in City proper (mgd)	Consumption in City proper (gpcd)	Furnished to outside communities (mgd)	Total (mgd)	Annual (bg)
1940	922.7	124	21.6	944.3	345.614
41	964.2	130	24.8	989.0	360.985
42	906.7	124	21.5	928.2	338.793
43	942.7	133	21.5	964.2	351.933
44	1,004.9	144	26.5	1,031.4	377.492
1945	1,056.2	146	22.0	1,078.2	393.543
46	1,117.1	146	24.1	1,141.2	416.538
47	1,159.0	149	30.4	1,189.4	434.131
48	1,172.3	150	31.5	1,203.8	440.591
49	1,166.9	149	36.2	1,203.1	439.132
1950	953.3	121	29.1	982.4	358.576
51	1,041.9	131	28.1	1,070.0	390.550
52	1,087.0	136	32.7	1,119.7	409.810
53	1,093.9	135	44.6	1,138.5	415.552
54	1,063.4	131	46.3	1,109.7	405.040
1955	1,109.9	136	45.3	1,155.2	421.648
56	1,111.3	136.2	48.9	1,160.2	424.633
57	1,169.0	143	57.2	1,226.2	447.563
58	1,152.9	140.8	49.6	1,202.5	438.912
59	1,204.3	146.8	60.3	1,264.6	461.579
1960	1,199.4	153.9	58.9	1,258.3	460.529
61	1,221.0	156.0	64.0	1,285.0	469.022
62	1,207.6	153.5	68.8	1,276.4	465.896
63	1,218.0	154.1	76.7	1,294.7	472.582
64	1,189.2	149.8	79.4	1,268.6	464.295
1965	1,052.1	131.9	71.2	1,123.3	409.995
66	1,044.9	130.4	73.2	1,118.1	408.128
67	1,135.3	141.0	71.0	1,206.3	440.302
68	1,242.0	153.6	78.2	1,320.2	483.175
69	1,328.7	163.5	80.1	1,408.8	514.229
1970	1,400.3	177.3	90.4	1,490.7	544.116
71	1,423.6	182.1	87.9	1,511.5	551.695
72	1,412.4	182.6	83.0	1,495.4	547.340
73	1,448.9	189.4	95.4	1,544.3	563.681
74	1,441.8	190.5	96.3	1,538.1	561.409
1975	1,415.0	189.0	92.1	1,507.1	550.093
76	1,435.0	193.9	95.8	1,530.8	560.264
77	1,483.0	202.6	104.7	1,587.7	579.510
78	1,479.4	204.4	103.0	1.582.4	577.566
79	1,513.0	211.5	104.6	1,617.6	590.426
1980	1,506.3	213.0	110.1	1,616.3	591.582
81	1,309.5	184.6*	100.0	1,409.5	514.475
82	1,383.0	194.2*	104.8	1,487.8	543.060
83	1,424.2	199.4*	112.6	1,536.8	561.010
84	1,465.2	204.4*	113.9	1,579.1	577.963
1985	1,325.4	184.4*	106.5	1,431.9	522.656
86	1,351.1	187.3*	115.2	1,466.3	535.200
87	1,447.1	200.6*	119.8	1,566.9	571.885

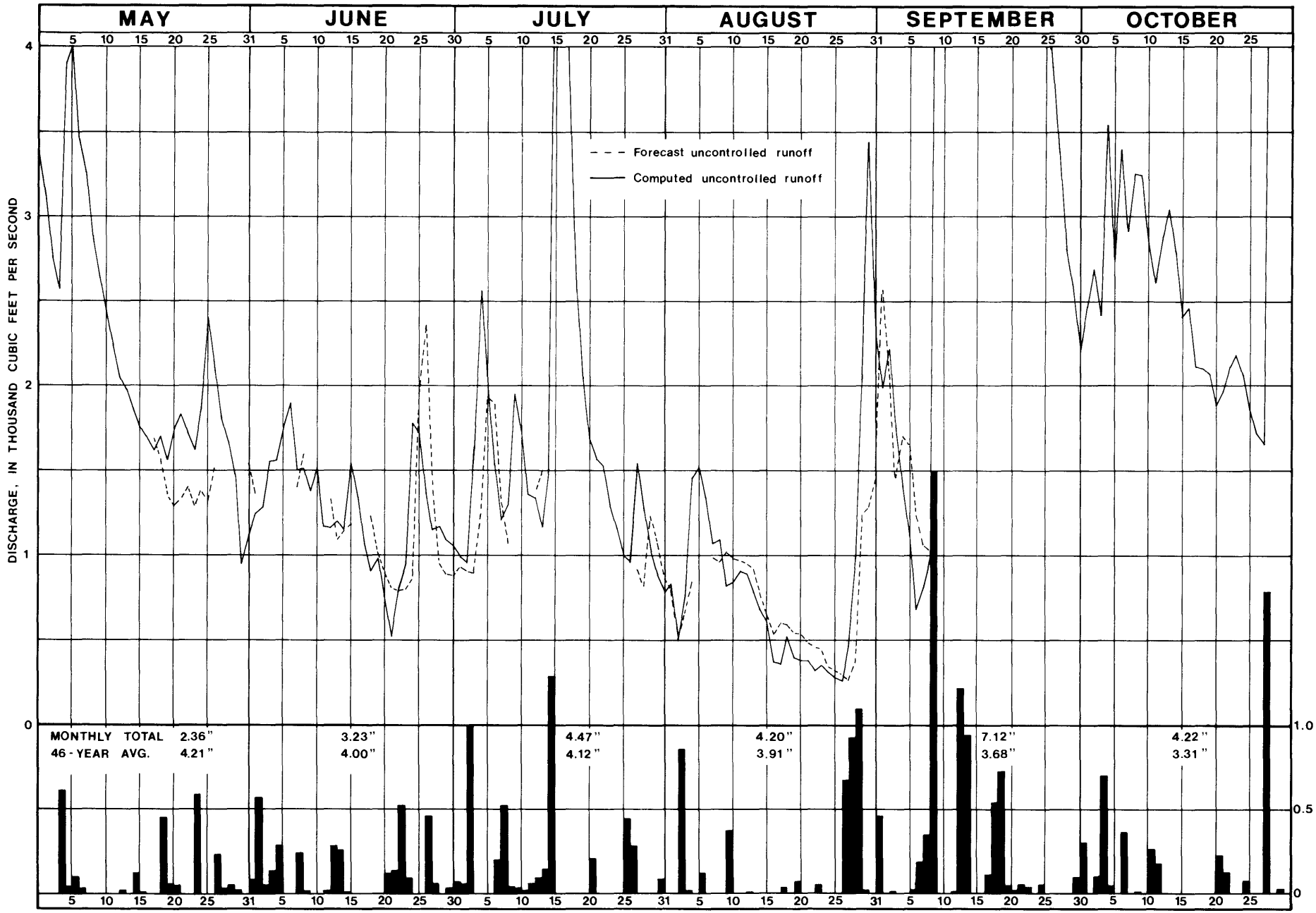


Figure 3.-Uncontrolled runoff component, Delaware River at Montague, N.J., May 1 to October 31,1987.

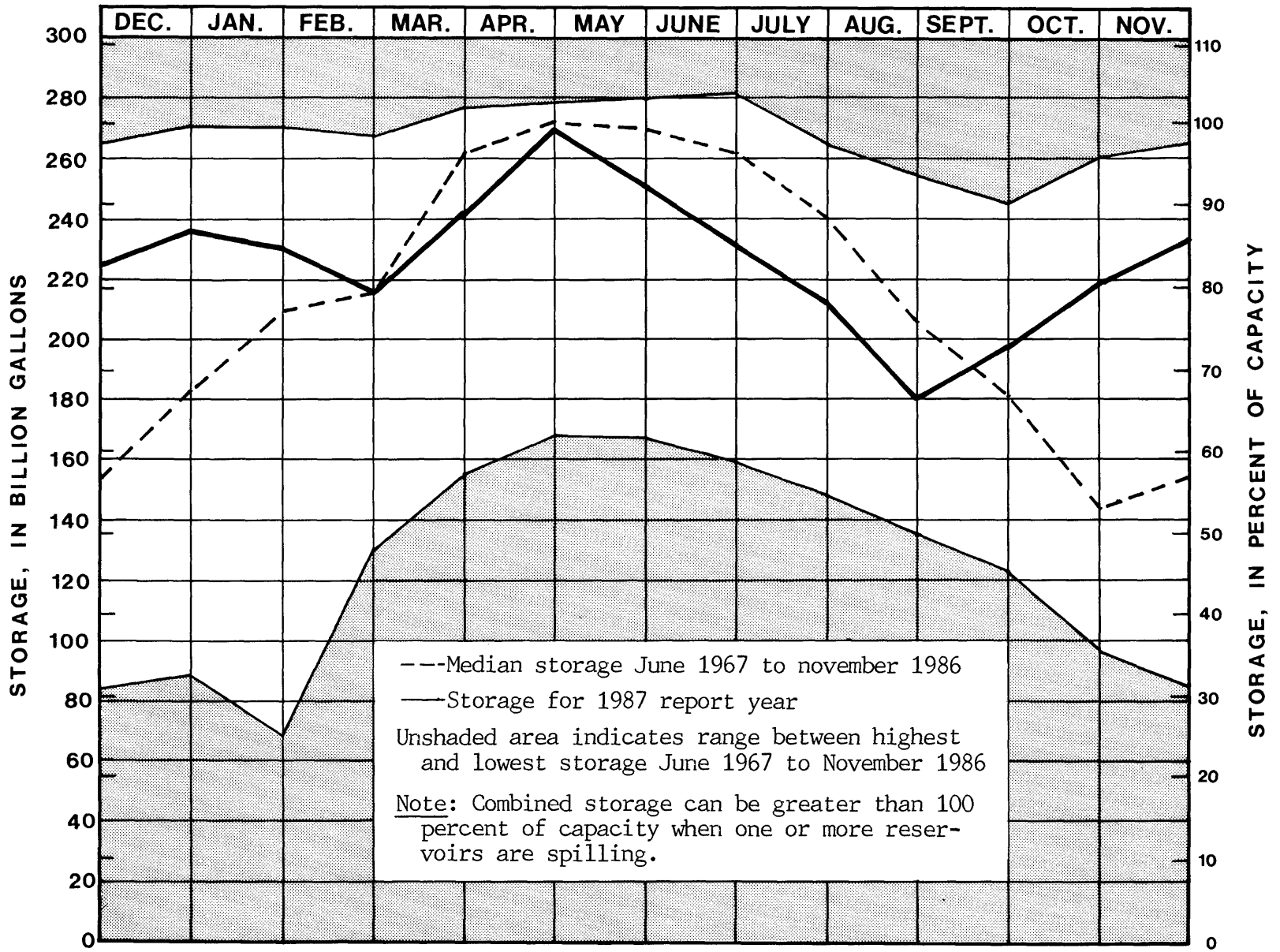
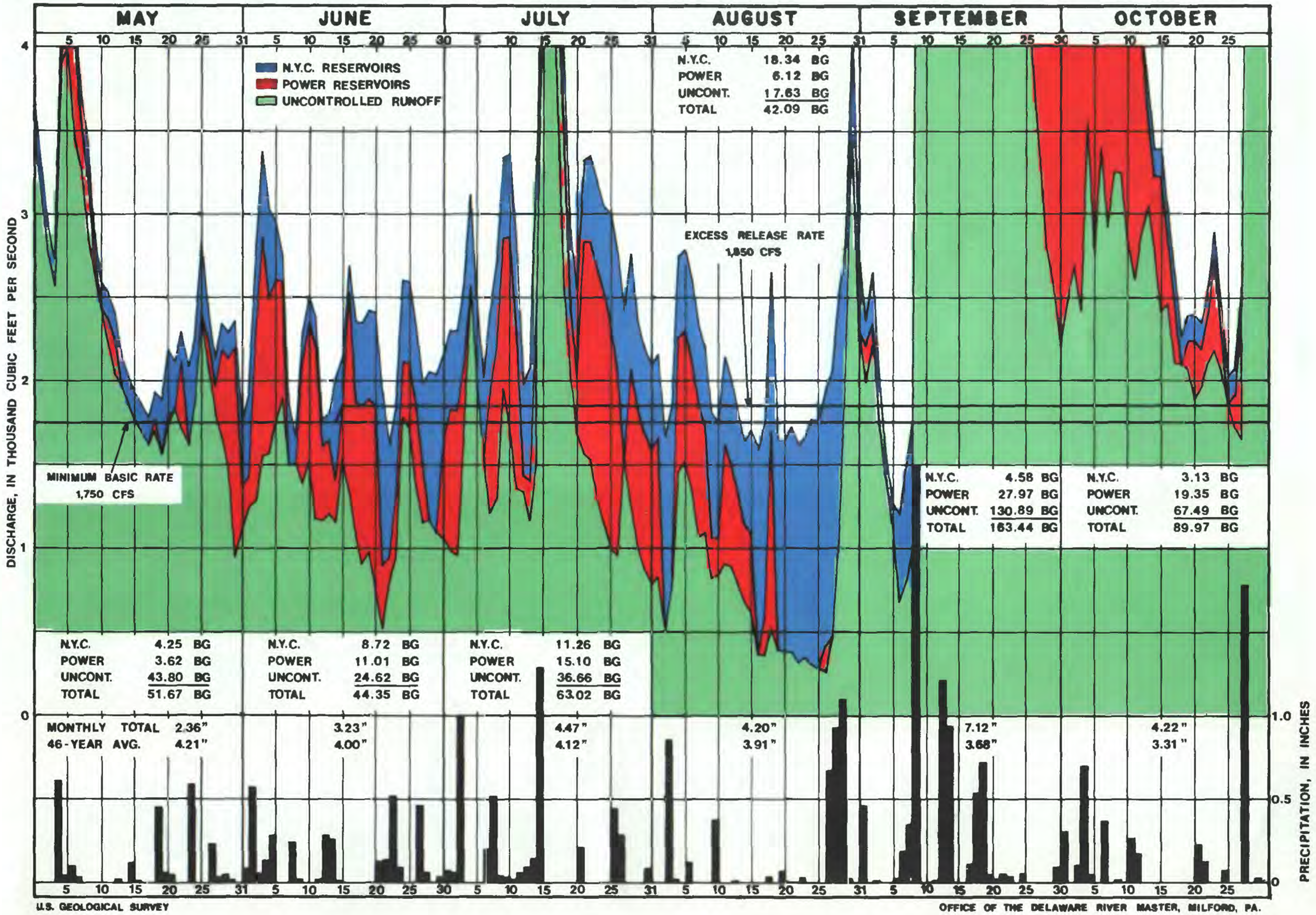


Figure 4.- Combined storage in Pepacton, Cannonsville, and Neversink Reservoirs on the first day of the month, December 1, 1986 to November 30, 1987

PLATE I. COMPONENTS OF FLOW, DELAWARE RIVER AT MONTAGUE, N.J. 1987



U.S. GEOLOGICAL SURVEY

OFFICE OF THE DELAWARE RIVER MASTER, MILFORD, PA.

Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

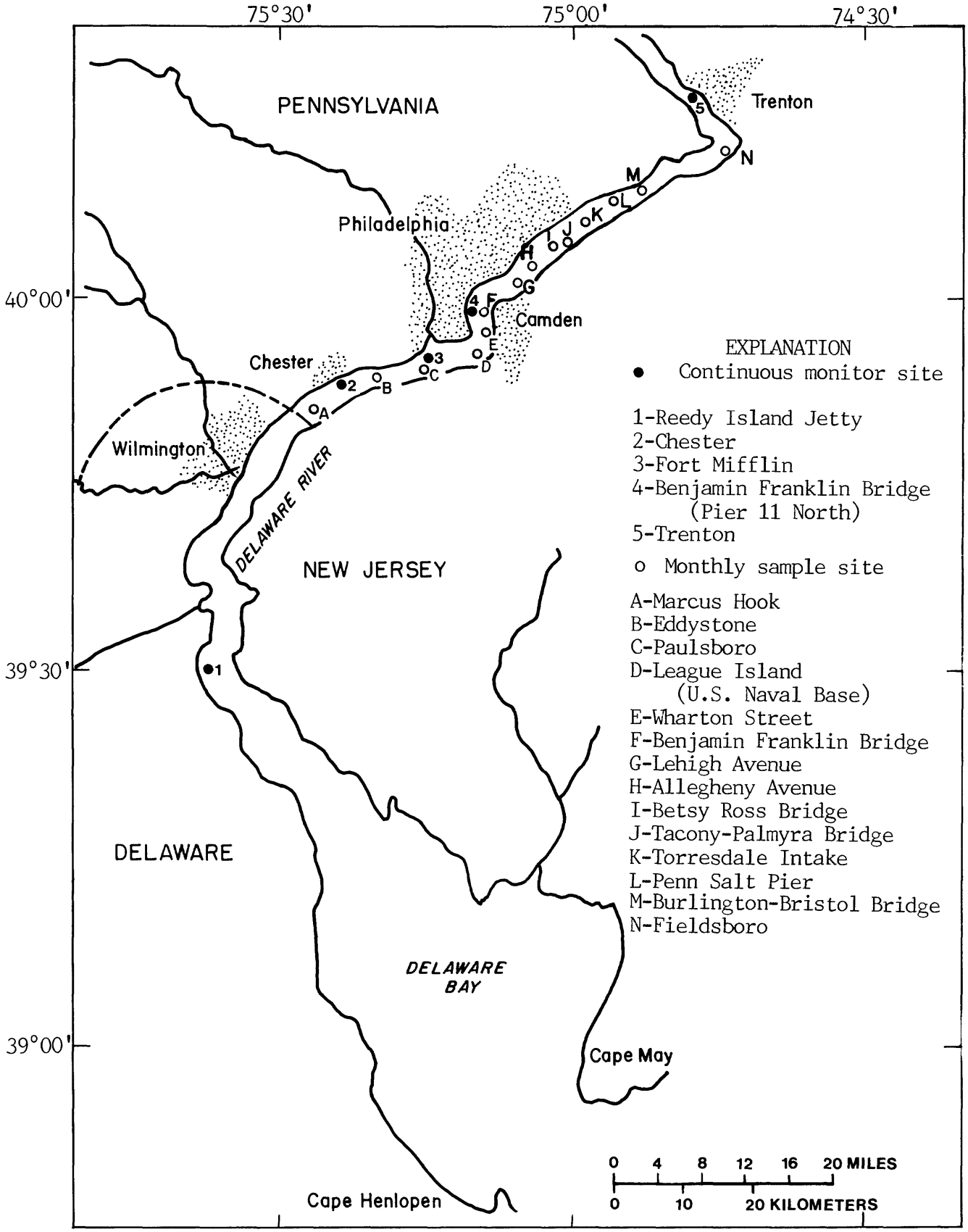


Figure 5.- Delaware River Estuary

Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

By Kirk E. White

INTRODUCTION

This section describes the water-quality monitoring program conducted by the U.S. Geological Survey in the Delaware Estuary during the 1987 report year. Also presented here are some of the data that were obtained by this program and a brief discussion of the significance of the data.

WATER-QUALITY MONITORING PROGRAM

Water quality of the Delaware River and Estuary was monitored between Trenton, N.J., and Reedy Island Jetty, Del.. Data were acquired continuously by electronic instruments at five monitor sites, one at Trenton, just upstream of the head of tidewater and at four sites in the estuary (fig. 5). The monitors at Chester, Pa., Fort Mifflin, Pa. and Benjamin Franklin Bridge were not operated from early December 1986 through the end of February 1987. At Fort Mifflin the water was monitored for two parameters: temperature and specific conductance. At the remaining sites, the water was monitored for four parameters: temperature, specific conductance, dissolved oxygen, and pH.

Additional data were obtained twice a month at 14 sites between Fieldsboro, N.J., and Marcus Hook, Pa. (fig. 5). At each of these sites, samples of water were collected at the center of the river channel. These samples were analyzed for temperature, chloride, alkalinity, biochemical oxygen demand, specific conductance, dissolved oxygen, and pH.

Data obtained from the continuous monitoring sites were processed by computer and stored for future reference by the U.S. Geological Survey. They were also distributed regularly to cooperators and published annually by the U.S. Geological Survey in "Water Resources Data for Pennsylvania, Volume 1, Delaware River Basin". Data from the twice a month sites were collected by the state of Delaware under the auspices of the Delaware River Basin Commission for the City of Philadelphia Water Department. These data can be obtained from the City of Philadelphia Water Department.

The above-described programs were carried out in cooperation with the City of Philadelphia Water Department, Delaware River Basin Commission, Delaware River Master, and other agencies of federal, state, and county governments.

ESTUARINE WATER-QUALITY DATA DURING 1987

The following is a summary and discussion of the data that were collected during the 1987 report year. Additional information is presented in the tables at the end of this section.

Streamflow

Streamflow is a vital factor which influences the water quality of the estuary. Increased streamflow usually results in better water quality by limiting salt-water intrusion and diluting the concentration of dissolved minerals, both of which contribute to a lower specific conductance and chloride level. Increased flow also aids in maintaining lower water temperature during warm weather and supporting higher dissolved-oxygen levels.

On the basis of streamflow records for the Delaware River at Trenton, mean monthly streamflow was lowest for the year during August (4,304 cfs) and highest for the year during April (29,460 cfs)(see table 8). The monthly mean streamflow was above the respective median for the period of record December, January, March, April, September, and November and below the median for the rest of the year.

Temperature

The significance of water temperature in regard to water quality in the estuary lies in its profound influence on various physical, chemical, and biological properties of the water. In general, increases in water temperature have deleterious effects on water quality by lowering the saturation level of dissolved oxygen and increasing biological activities.

The primary factors involved in controlling water temperature in the estuary are climatic; however, various uses of the water by man can also have significant effects.

Based on records from Benjamin Franklin Bridge (Pier 11 North) Philadelphia, Pa., mean monthly temperatures for the period March to November 1987 were below normal in March, May, September, October, and November and equaled or exceeded the norm for the remainder of the reporting period. The norm is based on historical temperature records from 1962 to 1986 (see fig. 6).

Specific Conductance and Chloride

Specific conductance is the ability of a solution to conduct electricity. Basically, it can be used to measure the amount of ionized material in solution and relates approximately to dissolved-solids content.

Specific conductance values in bodies of water usually reflect the geochemistry of the drainage basin; however, pollution and the intrusion of oceanic salts can also have considerable effects. Increasing streamflows reduce the concentration of dissolved solids, thus lowering specific conductance and chloride levels. Conversely, decreasing flows have the opposite effects.

In the Delaware Estuary, the intrusion of oceanic salts is important to those who must use the estuary as a water supply. For this reason, chloride concentration is of great interest. Water with chloride concentrations in excess of 250 mg/L (milligrams per liter) is usually considered undesirable for domestic use and water with concentrations in excess of 50 mg/L is unsatisfactory for some industrial uses.

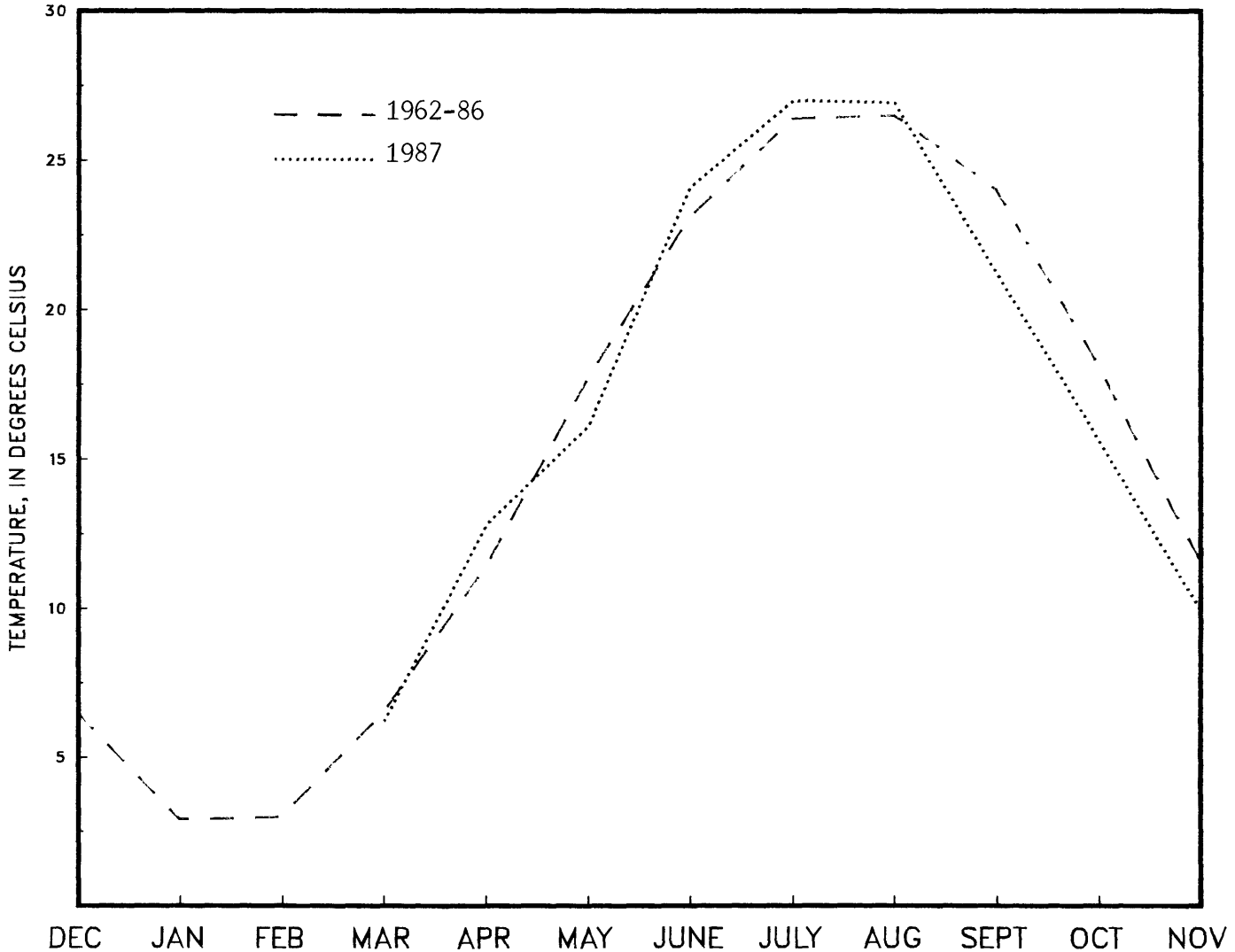


Figure 6.- Mean monthly temperatures of Delaware River at Benjamin Franklin Bridge, Philadelphia, Pennsylvania.

Table 17.- Daily maximum and minimum chloride concentrations, Delaware River at Fort Mifflin, Pa., in milligrams per liter
December 1, 1986 to November 30, 1987
[A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter);
max is maximum value; min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1							-	-	43	*	33	*	31	*	40	31	*	*	40	*	33	*	30	*
2							-	-	45	*	33	*	30	*	51	31	*	*	33	*	*	*	*	*
3							-	-	45	*	38	*	31	*	57	30	30	*	40	*	38	*	*	*
4							-	-	38	*	62	*	31	*	43	*	32	*	79	*	43	*	*	*
5							-	-	36	*	45	*	79	*	45	*	*	*	36	*	33	*	35	*
6							-	-	*	*	43	*	37	*	38	*	39	*	38	30	*	*	30	*
7							-	-	*	*	33	*	38	*	42	*	57	*	38	30	*	*	*	*
8							-	-	*	*	33	*	40	31	38	*	41	*	36	30	*	*	*	*
9							-	-	*	*	33	*	39	32	35	*	37	*	84	*	*	*	*	*
10							-	-	*	*	35	*	41	33	36	*	57	*	*	*	*	*	36	*
11							-	-	*	*	33	*	43	33	36	*	42	*	*	*	*	*	57	*
12							-	-	*	*	40	*	43	30	36	*	33	*	*	*	*	*	48	*
13							32	*	*	*	38	*	40	*	33	*	30	*	*	*	30	*	*	*
14							41	*	*	*	51	*	38	*	35	*	31	*	33	*	*	*	*	*
15							36	*	*	*	31	*	38	*	43	*	36	*	*	*	*	*	*	*
16							39	*	30	*	31	*	38	30	42	*	33	*	*	*	*	*	*	*
17							40	*	-	-	31	*	59	30	65	*	33	*	*	*	*	*	*	*
18							42	*	-	-	31	*	40	30	41	*	31	*	*	*	*	*	36	*
19							49	*	-	-	33	*	38	*	38	*	30	*	*	*	*	*	36	*
20							36	*	-	-	45	*	38	30	37	*	33	*	*	*	*	*	45	*
21							31	*	-	-	43	*	45	31	35	*	33	*	*	*	30	*	48	*
22							48	*	-	-	48	*	59	33	31	*	36	*	*	*	30	*	43	*
23							38	*	-	-	41	*	45	33	49	*	51	*	*	*	*	*	30	*
24							35	*	-	-	48	*	51	33	31	*	40	*	35	*	*	*	30	*
25							36	*	35	*	42	*	48	35	30	*	35	*	*	*	35	*	30	*
26							36	*	36	*	36	*	42	33	32	*	35	*	*	*	30	*	30	*
27							35	*	38	*	36	*	42	33	*	*	43	*	*	*	33	*	30	*
28							35	*	*	*	36	*	42	31	30	*	62	*	*	*	59	*	30	*
29							35	*	30	*	33	*	51	33	30	*	65	30	*	*	57	*	30	*
30							38	*	35	*	31	*	51	31	*	*	48	*	*	*	45	*	42	*
31							45	*			31	*			*	*	40	*			30	*		

Table 18.- Daily maximum and minimum chloride concentrations, Delaware River at Chester, Pa., in milligrams per liter December 1, 1986 to November 30, 1987. Collection and analysis by Scott Paper Company.
[A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter); max is maximum value; min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	36	*	*	*	52	42	63	58	32	*	36	*	40	35	76	60	60	37	140	54	*	*	39	32
2	34	*	33	*	50	43	58	53	32	*	40	*	44	37	75	51	60	38	175	60	30	*	42	31
3	*	*	*	*	60	40	50	46	32	*	36	*	48	37	64	30	56	39	150	70	30	*	42	32
4	30	*	*	*	60	52	60	45	34	*	34	30	49	37	63	42	65	39	160	64	34	*	37	30
5	*	*	*	*	61	50	55	41	34	*	31	*	43	36	52	39	80	40	136	70	32	*	38	32
6	*	*	*	*	58	46	48	42	33	*	*	*	44	37	46	42	66	43	148	62	38	*	60	32
7	*	*	*	*	58	47	52	37	*	*	34	*	49	38	57	45	100	41	220	78	30	*	55	34
8	34	*	*	*	58	48	44	36	*	*	35	*	46	37	70	46	95	45	280	74	30	*	45	30
9	30	*	*	*	52	49	42	38	*	*	40	30	43	35	60	43	74	45	157	66	*	*	40	32
10	*	*	30	*	52	49	42	37	*	*	36	30	45	38	55	41	82	46	55	44	34	*	37	*
11	*	*	32	*	56	48	39	33	*	*	36	31	46	42	55	44	76	43	48	32	*	*	36	32
12	32	*	30	*	60	50	37	32	*	*	35	*	50	40	60	44	65	44	48	35	39	*	38	30
13	30	*	32	*	54	50	39	31	*	*	36	*	50	41	57	44	65	54	48	32	32	*	42	32
14	*	*	32	*	55	50	42	*	*	*	33	*	49	39	55	38	76	55	39	*	31	30	44	30
15	30	*	35	*	56	50	35	30	*	*	38	31	55	40	54	40	90	45	36	*	33	*	38	33
16	30	*	34	31	55	50	37	*	*	*	36	32	59	40	48	42	78	40	*	*	32	*	36	32
17	30	*	33	*	58	51	41	*	*	*	40	33	70	70	60	40	95	45	*	*	34	*	40	30
18	30	*	32	*	56	52	38	31	*	*	38	30	80	36	46	38	96	52	*	*	32	*	40	34
19	33	*	36	32	58	44	36	33	*	*	38	30	110	58	42	31	122	60	*	*	35	30	40	35
20	35	*	45	31	61	51	36	*	*	*	40	32	160	70	45	30	120	62	*	*	31	*	40	32
21	32	*	45	33	56	51	37	32	*	*	42	33	135	65	43	33	160	45	*	*	32	*	38	35
22	37	*	42	34	58	50	32	*	30	*	36	34	110	50	46	38	118	62	*	*	34	30	40	35
23	34	*	39	35	57	48	31	30	30	*	36	31	110	55	53	40	130	60	*	*	33	30	40	32
24	33	*	39	35	57	54	31	*	30	*	35	32	130	60	48	34	150	68	*	*	38	32	40	34
25	33	*	36	32	58	52	31	*	35	*	41	32	105	65	48	30	190	55	32	*	42	31	41	34
26	30	*	38	33	57	52	32	*	30	*	35	30	110	60	44	33	170	55	*	*	53	30	38	33
27	31	*	37	34	61	54	34	*	32	*	35	*	100	50	43	35	180	60	*	*	61	31	40	35
28	30	*	45	37	65	58	33	*	32	*	39	30	94	48	43	33	230	80	30	*	38	30	40	35
29	*	*	44	35			42	*	31	*	41	34	96	54	47	35	220	115	30	*	37	33	46	39
30	*	*	45	38			35	*	34	*	42	35	70	57	50	37	180	75	30	*	38	*	42	35
31	*	*	48	40			31	*			41	36			51	40	200	70			37	35		

Table 19.- Daily maximum and minimum chloride concentrations, Delaware River at Reedy Island Jetty, Del., in milligrams per liter
December 1, 1986 to November 30, 1987
[A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter;
max is maximum value; min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	-	-	3560	547	-	-	5580	2940	2830	1280	-	-	4500	1890	5610	2260	5640	2580	6450	3650	3140	648	4280	1810
2	-	-	4180	1070	-	-	4030	2100	3500	1150	-	-	4530	1980	-	-	5640	3010	6720	3400	3890	973	4350	1770
3	-	-	2300	581	-	-	3240	1750	1790	677	-	-	4990	2200	-	-	5220	2870	6820	3180	2890	761	4090	1770
4	-	-	2200	378	-	-	3040	1290	3040	480	-	-	4880	2430	-	-	6140	2580	6910	3150	3030	569	4110	1780
5	-	-	-	-	-	-	3270	1070	1510	246	-	-	4740	2220	-	-	6550	2870	6770	3400	3830	660	4500	1880
6	-	-	-	-	-	-	3310	905	-	-	3190	784	5200	2320	-	-	6810	3110	6640	3490	4090	784	3960	1730
7	-	-	2680	547	-	-	2650	838	-	-	3580	784	6350	2250	-	-	7090	3090	6930	3470	3870	973	3420	1670
8	-	-	1770	265	4320	1360	2930	761	-	-	4150	1230	6280	2710	-	-	7090	3430	6620	3560	-	-	3590	1180
9	-	-	2490	502	3370	1060	3430	1230	-	-	4600	1350	6030	2300	-	-	6850	3390	6540	3140	-	-	3400	1130
10	-	-	3650	694	6300	2010	4480	1840	-	-	4680	1530	5970	2310	-	-	6870	2810	4920	2280	-	-	3920	1190
11	-	-	4060	1040	6390	2330	4630	2490	-	-	5000	1370	6070	1220	5710	2310	5530	2510	4940	1930	-	-	6290	2230
12	2230	290	-	-	5140	1790	5170	2270	-	-	4940	1320	6540	2760	5880	2380	5920	2540	4550	1980	-	-	5290	2090
13	1350	298	-	-	5110	1650	6290	2550	-	-	4270	1540	5800	2520	5630	2370	5540	2560	4140	1720	4090	1080	5810	2370
14	2600	409	-	-	5510	2000	6340	2590	-	-	4920	1590	6000	2540	5680	2420	4870	2270	3460	1380	4730	1770	5970	2020
15	2190	265	3680	1070	5240	2160	6610	2550	3280	524	4810	1610	5950	2650	4290	2120	4670	2190	2560	813	5270	1890	6320	2540
16	2750	299	3680	1090	-	-	5810	2470	2270	479	4040	1220	-	-	4330	1930	4520	2360	2270	671	4900	1840	5980	2580
17	3100	400	4030	1110	-	-	5190	2350	2240	412	4360	1540	-	-	4000	1740	5430	2260	2680	680	5540	2270	6320	2890
18	3310	694	3700	1090	5800	2470	5120	2310	1850	355	3690	1420	-	-	4150	1740	5190	2700	7440	840	6340	2580	5910	2980
19	1740	468	3650	1150	4800	2330	5530	2000	1790	322	4200	1570	-	-	4150	1740	5930	2840	4870	1510	6590	2730	5630	2230
20	3140	581	3460	851	4750	2370	4780	1740	1610	310	4530	1920	-	-	4940	1720	5850	2840	5000	1450	6080	2830	6220	2630
21	3470	648	3410	905	5020	2140	4960	1760	1680	299	4570	1960	-	-	5220	1670	6810	3000	4540	1310	6130	2940	5140	2450
22	3710	637	4240	798	5560	2160	4750	1810	1960	265	4060	1960	-	-	6170	1910	6840	3360	4790	1410	-	-	3270	3030
23	3610	716	-	-	5320	2680	5430	1720	1790	333	4350	1980	-	-	5830	2030	6230	2960	4210	798	-	-	-	-
24	3950	716	-	-	6130	2450	5830	2200	1920	378	5170	1950	-	-	5700	2170	6740	2910	3530	750	-	-	-	-
25	5050	851	-	-	5610	2650	5800	2340	2800	344	4850	2090	6340	2790	5900	2140	6860	3220	3110	739	-	-	-	-
26	2420	535	-	-	6120	2720	5380	2280	2690	558	4950	2050	5610	2230	5360	2000	6320	2100	3400	739	-	-	-	-
27	2590	434	-	-	6500	2750	4870	2050	-	-	4430	2020	4940	2210	5660	1990	6520	3360	2940	716	5630	2840	-	-
28	2840	423	-	-	5680	2800	4950	1910	-	-	4570	1950	4300	2060	6050	2420	6610	3590	3100	682	5640	2660	-	-
29	2960	400	-	-			4850	1890	-	-	4310	1920	4430	1750	5390	2470	6130	3740	3000	716	5560	2540	-	-
30	3120	423	-	-			3700	1920	-	-	4480	1890	4970	2000	5950	2520	-	-	3010	838	4920	2160	-	-
31	3110	423	-	-			4270	1670			4680	1950			5070	2690	6970	3560			4480	1850		

As sea water has a chloride concentration of approximately 19,000 mg/L the location of a body of water in relation to the sea can influence chloride levels in that body of water. For this reason, chloride concentrations in the Delaware Estuary generally increase with distance downstream toward the Delaware Bay and Atlantic Ocean.

Chloride concentration was not measured directly at Fort Mifflin, Pa., and Reedy Island Jetty, Del., but a correlation between specific conductance and chloride concentration has been developed based on analyses of water samples taken in the estuary. Chloride concentrations at those sites presented in tables 17 and 19 were derived from that relationship. The relationship is less reliable when chloride concentrations are lower than 30 mg/L because other ionized materials may be present in amounts large enough to affect the conductance-chloride relationship. Therefore, chloride concentrations derived from specific conductance are not given when the relationship indicates chloride concentrations of less than 30 mg/L. Chloride concentrations at Chester, Pa., (table 18) were furnished by Scott Paper Company.

At Fort Mifflin, the maximum daily chloride concentration equaled or exceeded 50 mg/L 8 percent of the time (see table 17). The maximum was 84 mg/L on September 9. At Chester, the minimum daily chloride concentration equaled or exceeded 50 mg/L 15 percent of the time and the maximum daily concentration was greater than 50 mg/L 32 percent of the time (see Table 18). Themaximumchlorideconcentrationequaled 280 mg/L on September 8, which was the only day that exceeded 250 mg/L during 1987. Minimum chloride concentrations at Reedy Island Jetty were in excess of 250 mg/L the entire year. During the period December through May, maximum chloride concentrations commonly ranged from 3,500 to 6,500 mg/L, whereas the common maximum chloride range for June through November was 6,000 to 7,000 mg/L (see table 19). The maximum at this site was 7,440 mg/L on September 18.

Chloride data from the continuous monitor site at Reedy Island Jetty and discharge data from Trenton, New Jersey, for the period of record between 1963 and 1987, were analyzed to determine temporal variations in chloride concentration and to illustrate the relationship of chloride to discharge in the Delaware River Estuary. Data from Fort Mifflin was not used for this analysis because it is suspected that the conductivity data is affected by tributary inflow. Chester chloride data were omitted because a different method of analysis was used.

For the chloride-discharge analysis, daily chloride concentrations were plotted against daily mean discharges. Data from the periods December 1, 1964 to November 30, 1965 and December 1, 1974 to November 30, 1975 were used. In 1965 the daily mean discharge for the Delaware River at Trenton was 57 percent (4,934 cfs) below the mean for the period (11,420 cfs). Precipitation at the National Oceanic and Atmospheric Administration station at Philadelphia Airport was 12.08 inches less than the 1951-80 normal of 41.42 inches. The 1975 daily mean discharge (16,661 cfs) was 46 percent above the mean. The precipitation for this year was 10.71 inches greater than normal. Based on the precipitation and discharge, 1965 and 1975 are dry and wet years, respectively. These two years represent the chloride-discharge relation for a wide range of discharges at Trenton.

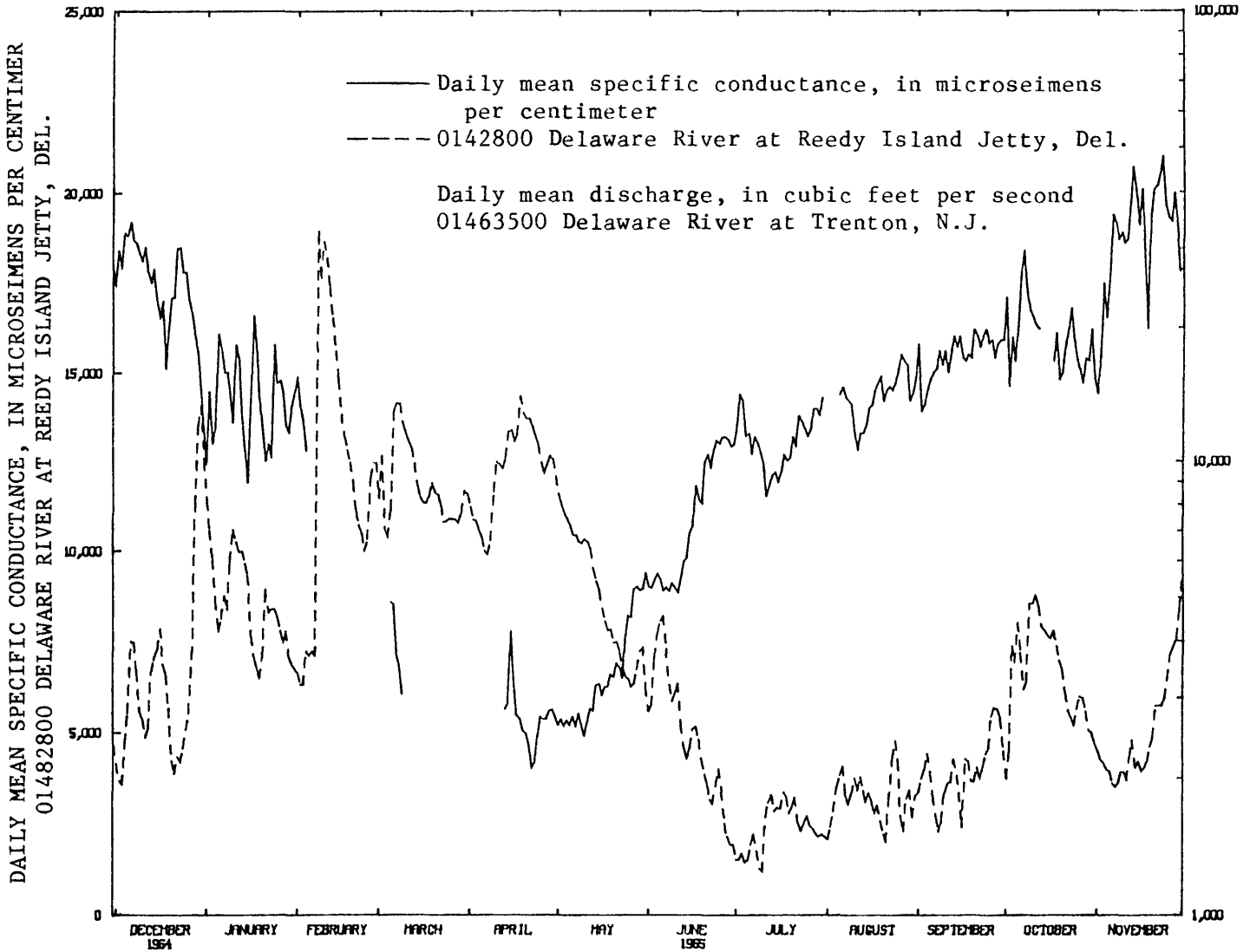


Figure 7. - Comparison of daily mean specific conductance of Delaware River at Reedy Island Jetty, Del. and daily mean discharge of Delaware River at Trenton, N.J. for 1965 report year.

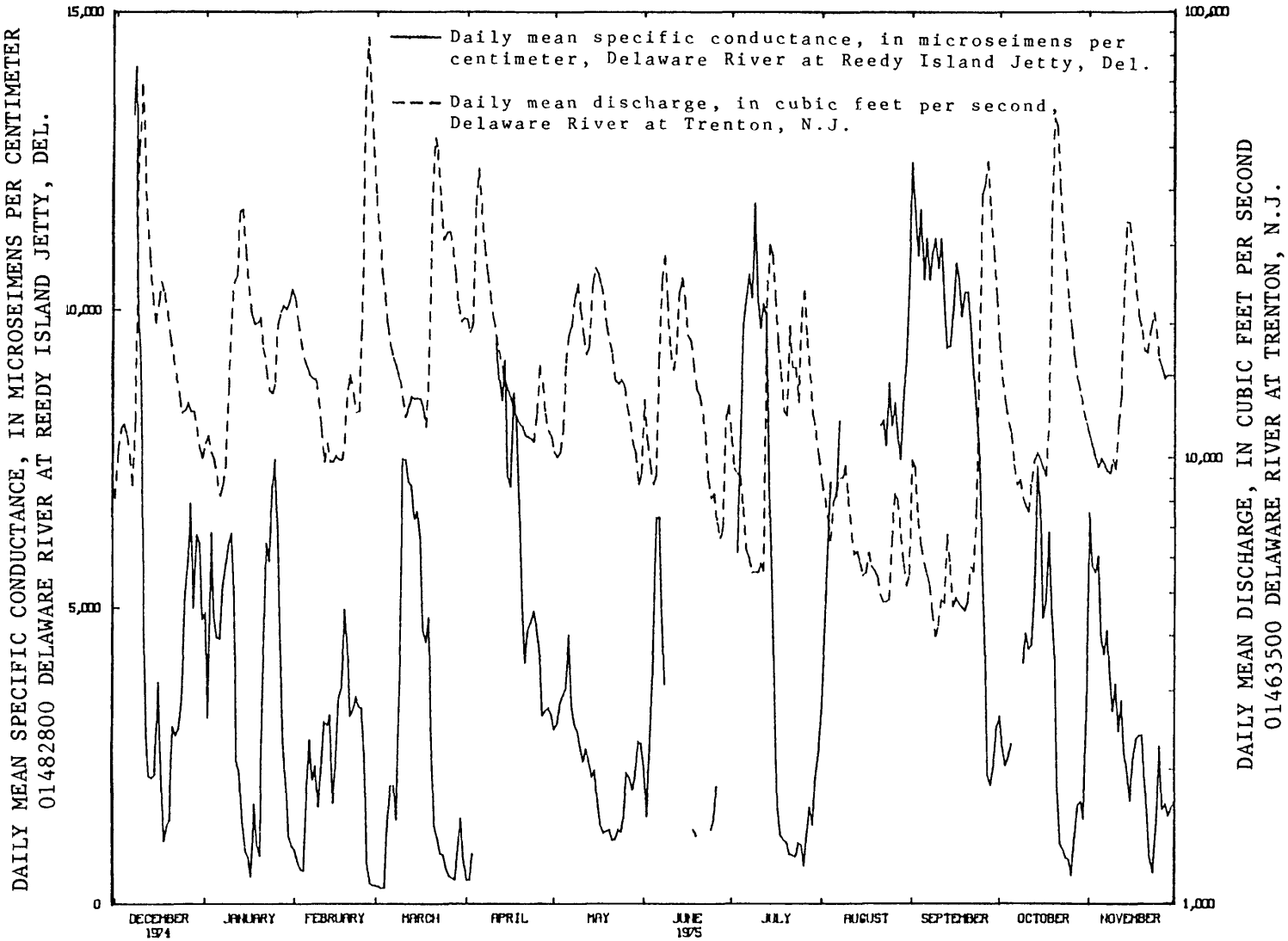


Figure 8.- Comparison of daily mean specific conductance of Delaware River at Reedy Island, Del. and daily mean discharge of Delaware River at Trenton, N.J. for 1975 report year.

The plot of chloride concentration against time shows no apparent trend. Data indicates that discharge is a major factor of chloride concentration. Attempts to remove discharge as a dominant factor such as the seasonal Kendall test are beyond the scope and time constraints of this report. As discharge increases chloride concentration decreases. This correlation is shown in figures 7 and 8 which illustrate the effect of discharge on specific conductance in the estuary. The solid line represents the specific conductance at Reedy Island Jetty and the dashed line represents the discharge of the Delaware River at Trenton. Since there is a linear relationship between specific conductance and chloride concentration, the effect of discharge on chloride would show an idential profile. The offset between discharge peaks at Trenton and chloride concentration at Reedy Island Jetty may be due to the distance between the two sites, about 80 miles. Other factors which may influence the chloride-discharge relationship are the addition of fresh water from downstream tributaries; the location of the salt front; tidal elevation; tidal range; changes in sea level; and wind direction and intensity.

Dissolved Oxygen

Dissolved oxygen is necessary in water for the respiration of aquatic organisms. It also plays a significant role in chemical reactions in aquatic environments. The major sources of dissolved oxygen in water are diffusion from the air and photosynthesis in aquatic plants. Dissolved-oxygen levels are limited by temperature, salinity, and the partial pressure of atmospheric oxygen.

Dissolved-oxygen levels in the estuary tend to be highest near Trenton and to decrease with distance downstream to a point near or somewhat downstream from the Benjamin Franklin Bridge where minimum values are usually reached.

During the past year, mean dissolved-oxygen concentration at the Benjamin Franklin Bridge was below 5 mg/L on June 3 through July 20, July 26 through September 14, and September 29 through October 29 (see table 20). The minimum daily mean was 1.8 on June 25. At Chester, the mean dissolved-oxygen concentration was below 5 mg/L from May 27 to September 12 (see table 21). The lowest daily mean was 1.6 mg/L on June 7 and July 11 and 13. The minimum hourly value was 1.2 mg/L on July 11. At Reedy Island Jetty, the minimum hourly value was 3.2 mg/L on July 2.

Figure 9 shows the frequency of hourly dissolved-oxygen concentration at Benjamin Franklin Bridge (Pier 11 North) and Chester during the critical summer period, July through September. During this period the dissolved-oxygen concentration was below 4 mg/L 55 percent of the time at Benjamin Franklin Bridge. Data for 1986 indicate that it was at or below 4 mg/L 77 percent of the time. Dissolved-oxygen concentration was below 4 mg/L 78 percent of the time at Chester in 1987 as compared with 87 percent of the time in 1986. These dissolved-oxygen data suggest an improved condition in 1987 as compared to 1986.

Table 20.- Dissolved oxygen, Delaware River at Benjamin Franklin Bridge at Philadelphia, Pa.
Daily mean dissolved oxygen in milligrams per liter
December 1, 1986 to November 30, 1987
A dash (-) indicates missing data.

Day	December	January	February	March	April	May	June	July	August	September	October	November
1				-	-	8.6	-	2.8	3.8	2.8	4.6	7.2
2				-	-	8.4	-	2.8	4.0	2.8	4.6	7.1
3				12.4	-	8.2	3.6	2.8	4.1	3.0	4.6	7.1
4				12.6	-	7.9	3.2	3.1	3.9	3.1	4.6	7.3
5				12.6	-	7.8	2.7	3.2	3.9	3.2	4.6	7.5
6				12.2	-	7.8	2.4	3.1	3.3	3.2	4.5	7.8
7				12.1	-	7.9	2.1	2.8	2.9	3.0	4.4	8.1
8				12.3	-	7.9	2.0	2.3	2.7	2.9	4.3	8.0
9				12.5	-	7.9	2.0	2.0	2.8	3.1	4.4	8.0
10				12.4	-	7.9	2.0	1.9	2.8	4.6	4.4	8.1
11				12.4	-	8.1	2.1	2.0	3.1	4.6	4.3	8.0
12				12.8	-	8.0	2.4	2.1	3.2	4.5	4.3	8.2
13				12.1	-	7.8	2.6	2.4	3.2	4.5	4.3	8.1
14				11.5	8.1	7.8	2.8	2.6	3.2	4.7	4.3	8.1
15				11.5	8.0	7.7	3.1	2.7	3.1	5.1	4.2	8.1
16				11.6	8.1	7.6	3.4	3.3	3.2	5.1	4.2	8.0
17				11.7	8.4	7.8	-	3.8	3.2	5.0	4.2	8.0
18				11.7	8.5	8.1	-	4.3	3.1	5.0	4.3	8.1
19				11.7	8.8	7.6	3.5	4.6	3.1	5.0	4.3	8.2
20				11.9	8.9	7.1	3.8	4.9	2.9	5.1	4.3	8.3
21				11.9	9.0	6.9	3.4	5.1	2.9	5.1	4.3	7.4
22				11.8	9.4	-	2.6	5.4	3.0	5.0	4.3	8.7
23				11.7	-	-	1.9	5.7	3.0	5.0	4.3	8.6
24				11.7	9.1	-	1.9	5.4	3.1	5.0	4.4	8.5
25				11.6	8.6	-	1.8	5.1	3.0	5.1	4.5	8.4
26				11.3	8.6	-	1.9	4.8	2.8	5.1	4.5	8.3
27				-	8.8	-	1.9	4.5	2.5	5.1	4.5	8.3
28				-	8.8	-	1.9	4.2	2.4	5.1	4.6	8.3
29				-	8.0	-	2.3	4.0	2.3	4.9	4.7	8.3
30				-	6.7	-	2.8	3.8	2.5	4.7	6.1	8.4
31				-		-		3.9	2.6		7.2	

Table 21.- Dissolved oxygen, Delaware River at Chester, Pa.
Daily mean dissolved oxygen in milligrams per liter
December 1, 1986 to November 30,1987
A dash (-) indicates missing data.

Day	December	January	February	March	April	May	June	July	August	September	October	November
1				-	8.1	6.9	3.2	2.7	2.5	2.1	5.7	5.7
2				-	8.0	6.7	3.0	2.7	2.6	2.0	6.0	5.6
3				11.2	7.8	6.4	2.9	2.3	2.7	2.1	6.2	5.6
4				11.3	7.7	6.3	2.7	2.2	2.7	2.1	6.4	5.7
5				11.5	7.4	6.1	2.2	2.2	2.6	2.4	6.3	5.8
6				11.6	7.7	5.8	1.7	2.3	2.5	2.7	6.2	6.4
7				11.7	8.0	5.7	1.6	2.5	2.4	3.0	6.3	7.0
8				11.5	8.2	5.7	1.9	2.4	2.5	3.3	6.2	7.1
9				11.3	8.3	5.7	2.2	2.0	2.4	3.6	6.2	7.0
10				11.3	8.5	5.9	2.3	1.8	2.3	3.5	6.1	7.2
11				11.3	8.6	6.0	2.6	1.6	2.2	3.8	5.9	7.7
12				11.3	8.4	6.1	3.1	1.7	2.2	4.6	5.9	8.0
13				11.4	8.3	6.2	3.0	1.6	2.4	5.2	6.1	8.2
14				11.5	7.9	6.6	2.8	1.7	2.5	5.2	6.3	8.3
15				11.4	7.6	6.7	2.9	1.9	2.4	5.5	6.3	8.2
16				11.4	7.6	6.7	2.7	1.8	2.5	6.0	6.1	8.0
17				11.3	8.0	7.2	2.8	1.8	2.4	6.2	6.0	8.0
18				11.3	8.0	7.4	2.9	2.1	2.4	6.2	5.9	8.2
19				11.2	7.8	6.7	3.0	2.3	2.3	6.2	5.8	8.1
20				11.1	7.6	6.4	2.9	2.3	2.3	6.2	5.7	8.0
21				11.1	7.6	6.5	2.5	2.4	2.3	6.2	5.7	8.3
22				11.1	7.4	6.4	2.2	2.4	2.3	6.2	5.9	8.7
23				11.1	7.3	6.3	1.9	2.4	2.4	6.3	6.2	8.8
24				10.9	7.1	5.9	2.5	2.4	2.3	6.4	6.2	8.7
25				10.7	7.1	5.5	2.5	2.5	2.4	6.1	6.2	8.7
26				9.8	7.1	5.1	2.6	2.2	2.3	6.0	6.2	8.6
27				9.0	7.0	4.6	2.5	2.0	2.3	6.0	6.3	8.7
28				8.8	6.9	4.3	2.3	2.1	2.2	5.8	6.3	8.9
29				8.6	6.8	4.0	2.7	2.2	2.2	5.7	6.0	9.2
30				8.5	6.9	3.7	3.1	2.4	2.1	5.6	5.8	9.0
31				8.3		3.5		2.5	2.1		5.8	

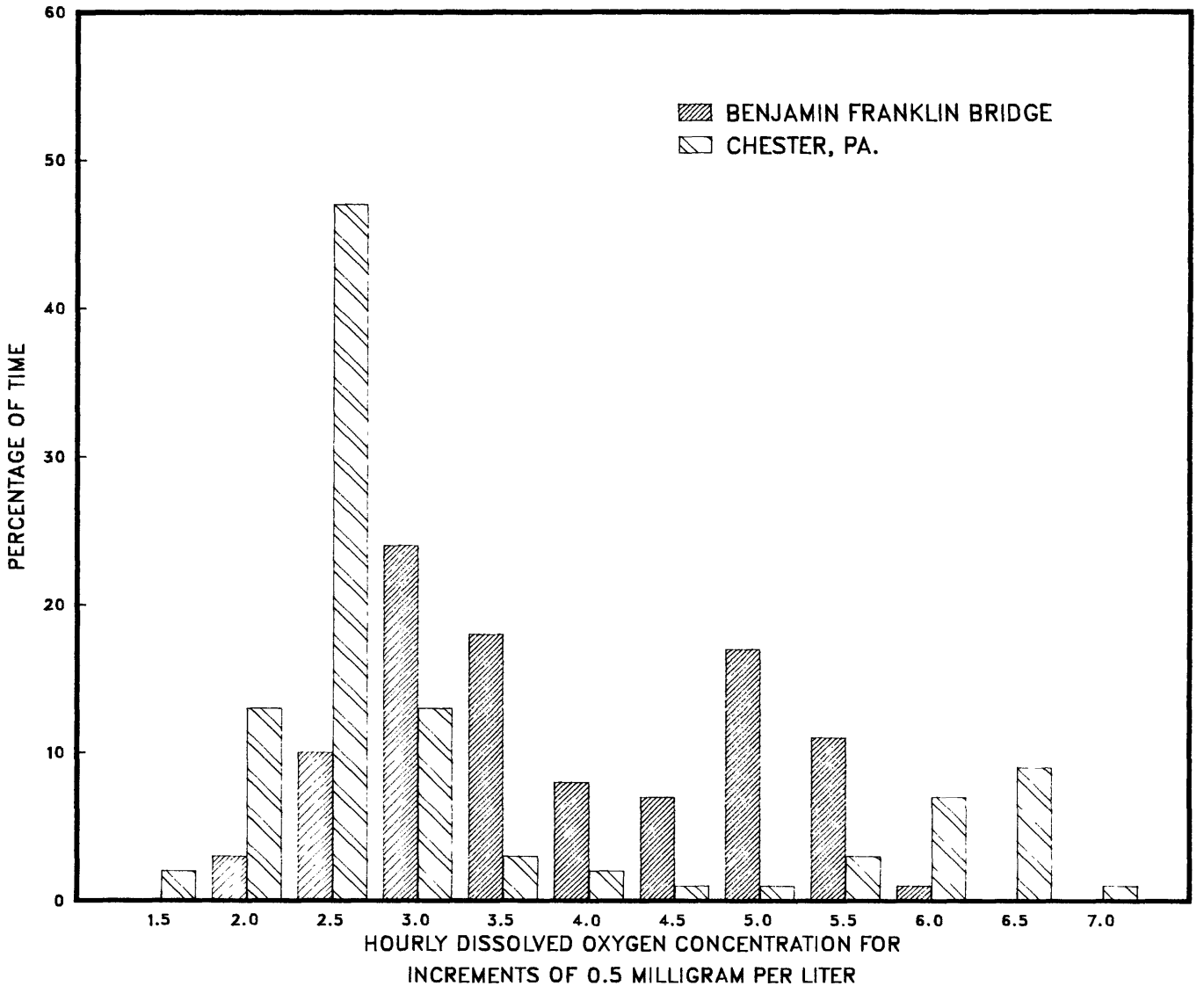


Figure 9.- Frequency of dissolved-oxygen concentrations at two stations in the Delaware River during July, August, and September 1987.

Hydrogen-Ion Concentration (pH)

Hydrogen-ion concentration (pH) is fundamentally a measure of acidity or alkalinity. Values of pH below 7 indicate acidity, whereas values above 7 indicate alkalinity. In natural waters, pH generally ranges from 6.0 to 8.5. The main factors controlling the pH of a body of water are usually the geochemistry of the drainage basin and external influences such as pollution. Photosynthetic activity can also have a considerable influence on pH values. Increased photosynthetic activity (algal bloom) produces higher pH values. All pH values at Benjamin Franklin Bridge, Chester, and Reedy Island Jetty were in a range of 5.6 to 8.5. The pH range for each station is: Reedy Island Jetty, 6.6 to 8.4; Chester, 5.9 to 7.7; Benjamin Franklin Bridge, 5.6 to 7.6. The pH in the estuary tends to be lowest near Trenton, N.J., and to increase downstream.