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

Report of The River Master Of the Delaware River

For the period
December 1,1997 - November 30, 1998

By Bruce E. Krejmas, William E. Harkness, and William J. Carswell, Jr.

With a section on Water Quality
By Hugh L. Darling

Open-File Report 00-431

Reston, Virginia

2000

U.S. Department of the Interior
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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
Length		
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
Area		
square mile (mi^2)	2.590	square kilometer
Volume		
million gallons (Mgal)	3,785	cubic meter
million gallons (Mgal)	1.547	cubic foot per second-day
billion gallons (Bgal)	3.785	cubic hectometer
cubic foot per second-day (ft^3/s·d)	0.002447	cubic hectometer
Flow rate		
million gallons per day (Mgal/d)	1.547	cubic foot per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
billion gallons per day (Bgal/d)	43.81	cubic meter per second
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Vertical datum: In this report, the term "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 the United States and Canada, formerly called Sea Level Datum of 1929.

SECTION I

RIVER MASTER LETTER OF TRANSMITTAL

and

SPECIAL REPORT

OFFICE OF THE DELAWARE RIVER MASTER
United States Geological Survey
433 National Center
Reston, Virginia 20192

November 22, 2000

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

The Honorable
Thomas R. Carper
Governor of Delaware

The Honorable
Christine Todd Whitman
Governor of New Jersey

The Honorable
George E. Pataki
Governor of New York

The Honorable
Thomas J. Ridge
Governor of Pennsylvania

The Honorable
Rudolph W. Giuliani
Mayor of the City of New York

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

Dear Sirs and Madam:

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 45th Annual Report of the River Master of the Delaware River for the 12-month period from December 1, 1997 to November 30, 1998. In this report, this period is referred to as the River Master report year or simply as the report year.

During the 1998 River Master report year, monthly precipitation in the upper Delaware River Basin ranged from 33 percent of the long-term average during August 1998 to 191 percent of the long-term average during June 1998. Total precipitation during the report year was 1.36 inches greater than the long-term average. Precipitation during the December to May period, when reservoirs typically refill, was 4.28 inches (121 percent) greater than the 57-year average.

On December 1, 1997, when the report year began, combined storage in the New York City reservoirs in the upper Delaware River Basin was 112.671 billion gallons (Bgal) or 41.6 percent of combined storage capacity. Median combined storage on December 1, computed on the basis of 30 years of record, is 172.146 Bgal. Operations on December 1, 1997 were being conducted as prescribed by the "Interstate Water Management Recommendations of the Parties to the Decree" (Delaware River Basin Commission Resolution 83-13). On January 16, 1998, conditions returned to normal, and operations resumed as prescribed by the Decree.

Precipitation during the first seven months of the report year was above normal in all months. Storage increased rapidly during January and continued to increase during winter until the reservoirs filled and then spilled in spring. Combined storage was at full capacity from April to mid-July, and then began the seasonal cycle of decline until the end of the report year. Precipitation remained above the long-term average through June, but precipitation was below average for the remainder of the report year.

The Delaware River Master Advisory Committee met at Milford, Pennsylvania on June 4, 1998, to discuss hydrologic conditions in the basin and operational procedures for the 1998 reservoir-release season. During the report year, the following individuals served as members of the Advisory Committee:

Delaware	Dr. Robert R. Jordan
New Jersey	Robert C. Shinn, Jr.
New York	N.G. Kaul
New York City	Joel A. Miele, Sr.
Pennsylvania	Irene B. Brooks

The River Master informed the Committee that, on the basis of information provided by New York City, the excess-release quantity to be released beginning June 15 was 7.381 Bgal. He stated that, using the formula contained in the Decree, beginning June 15, 1998, this water would be released at rates designed to maintain the flow of the Delaware River at Montague, N.J. at 100 cubic feet per second (ft^3/s) greater than the normal flow objective of 1,750 ft^3/s. The Parties to the Decree unanimously agreed that the excess-release quantity should be released as prescribed by the Decree.

Combined storage in the New York City Delaware River Basin reservoirs declined at above-normal rates throughout the summer as a result of below-normal precipitation and above-normal releases to meet the Montague flow objective. On October 8, 1998, the Parties to the Decree, the Delaware River Basin Commission, and the Delaware River Master agreed to suspend the release of the remaining excess-release quantity so that releases could be made from

New York City reservoirs to help meet the Trenton flow objective. On November 20, 1998, with storage levels continuing to decline and the likelihood of drought warning increasing in the New York City Delaware River system, the Parties to the Decree, the Delaware River Basin Commission, and the Delaware River Master agreed to several operational modifications intended to conserve water. The agreement called for reductions in New York City diversions to 680 million gallons per day (Mgal/d), and reduction of the Montague flow objective to 1,655 ft^3/s and the Trenton flow objective to 2,700 ft^3/s. In addition, the remainder of the excess release bank (903 $ft^3/s{\cdot}d$) was placed in a fishery protection bank for use if the basin entered drought warning. Copies of these agreements are included as Appendixes of this report.

On November 30, 1998, the end of the report year, combined storage in the New York City reservoirs was 120.291 Bgal or 44.4 percent of capacity, and Delaware River operations were being conducted at reduced levels.

During the report year, the River Master and staff participated in several water-supply related meetings of the Delaware River Basin Commission. Upon invitation of the representatives of the Parties to the Decree, the Deputy Delaware River Master met periodically with those representatives as an adviser to DRBC's Flow Management Technical Advisory Committee. Discussions focused mainly on proposals for managing reservoir releases and dealing with streamflow deficiencies.

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 Colleen Boshman. Heidi Soden joined the staff of the Milford office in March 1998, replacing Ms. Boshman.

During the year, the Milford office continued the weekly distribution of a summary hydrologic report. These weekly reports contained preliminary data on precipitation in the upper Delaware River basin, releases and spill 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 the Montague gaging station, and diversions by New Jersey. The reports were made available to the Delaware River Master Advisory Committee and to other parties interested in Delaware River operations. A monthly summary of hydrologic conditions, supplemented by an "outlook" of river flow for the upcoming month, also was provided to the Advisory Committee.

Section II of this report documents Delaware River operations during the report year. During the year, the City of New York diverted 186.910 Bgal from the basin and released 106.430 Bgal from Pepacton, Cannonsville, and Neversink Reservoirs to the Delaware River. The River Master directed releases from these reservoirs to the Delaware River totaling 75.259 Bgal.

Section III of this report describes water quality at various monitoring sites on the Delaware Estuary. It includes basic data on chemical properties and physical characteristics of the water along with a descriptive statistical summary of the data.

Throughout the year, diversions to supply water to New York City and releases designed to maintain the flow of the Delaware River at Montague were made as directed by the River Mas-

ter. Diversions by New York City from its reservoirs in the Delaware River basin did not exceed the limit stipulated by the Decree or the limits specified in the "Interstate Water Management Recommendations of the Parties to the Decree" (DRBC Resolution 83-13).

The River Master and staff are grateful for the continued excellent cooperation and support of the Parties to the Decree. Also, the efforts of the Pennsylvania Power & Light Company and Orange and Rockland Utilities, Inc. in informing the River Master of plans for power generation and furnishing data on reservoir releases are greatly appreciated.

A draft of this report was furnished to the River Master Advisory Committee members for review and comment.

Sincerely yours,

William J. Carswell, Jr., Ph.D.
Delaware River Master

SECTION II

REPORT ON DELAWARE RIVER OPERATIONS

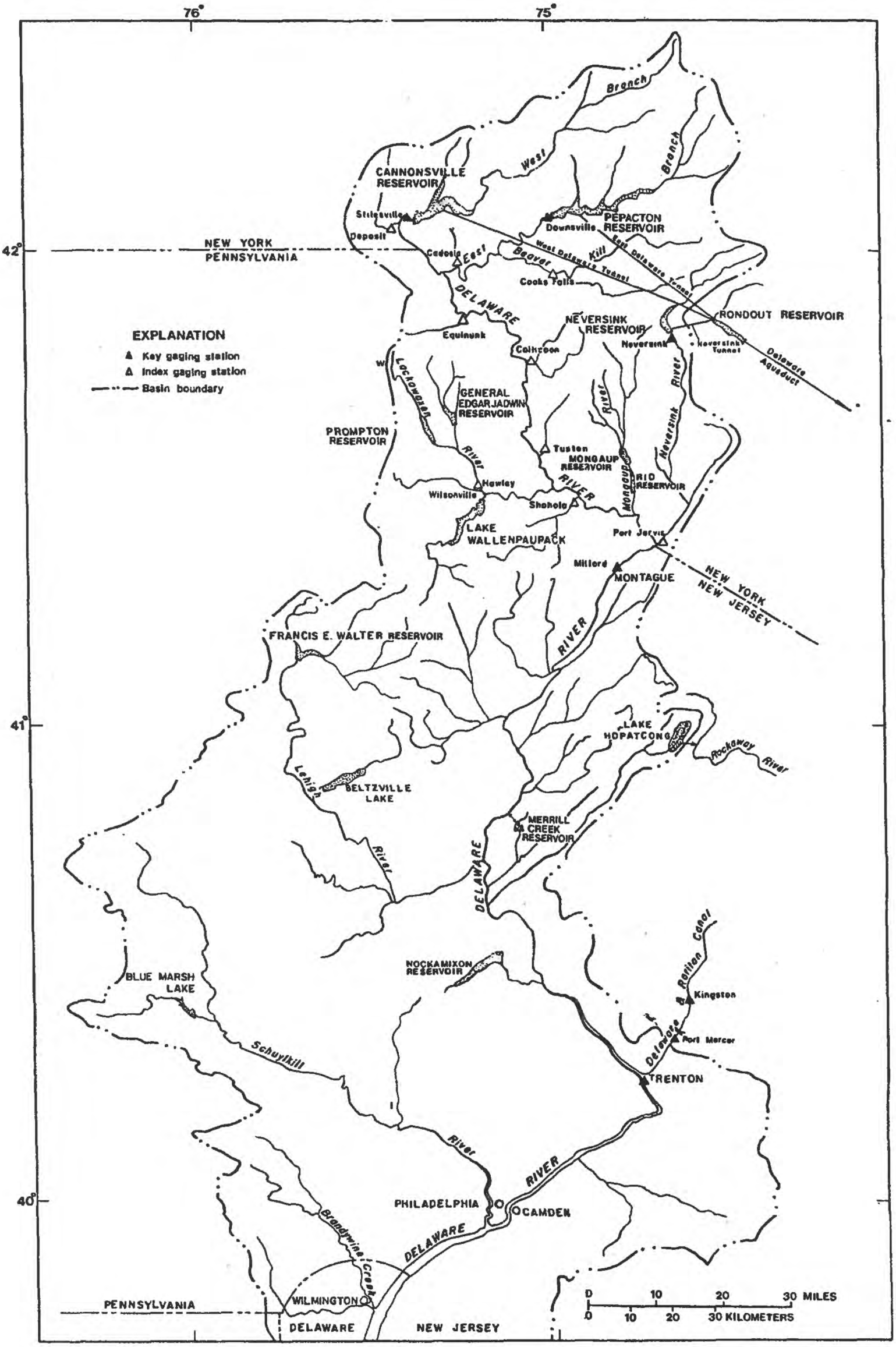

Figure 1.- Delaware River Basin above Wilmington, Delaware.

Section II

REPORT ON DELAWARE RIVER OPERATIONS

by Bruce E. Krejmas and William E. Harkness

ABSTRACT

A Decree of the United States Supreme Court in 1954 established the position of Delaware River Master. In addition, the Decree authorizes diversions of water from the Delaware River Basin (fig. 1) and requires compensating releases from certain New York City-owned reservoirs to be made under the supervision and direction of the River Master. The Decree stipulated that the River Master would furnish reports to the Court, not less frequently than annually. This is the 45th Annual Report of the River Master of the Delaware River. It covers the 1998 River Master report year, that is, the period from December 1, 1997 to November 30, 1998.

During the report year, precipitation in the upper Delaware River Basin was 1.36 inches greater than the long-term average. Reservoir storage in the upper basin was below normal on December 1, 1997 and the basin was in drought-warning status. Storage increased rapidly in January and the reservoirs continued to fill to above-spillway levels by spring. Storage declined steadily from mid-July to the end of the report year. Delaware River operations were conducted at reduced levels from November 20-30, 1998 in an attempt to delay or avert declaration of a drought warning.

Diversions from the Delaware River Basin by New York City and New Jersey were in compliance with the terms of the Decree or with the reduced limits imposed as a result of the drought warning. Reservoir releases were made as directed by the River Master at rates designed to meet the flow objective for the Delaware River at Montague, N.J. (hereafter called the Montague flow objective) on 119 days during the report year. Releases were made at experimental conservation rates--or rates designed to relieve thermal stress and protect the fishery in the streams below the reservoirs--on all other days.

During the report year, New York City and New Jersey complied fully with the terms of the Decree, and, during the drought-warning period, with the terms of the "Interstate Water Management Recommendations of the Parties to the Decree" (DRBC Resolution 83-13), other agreements among the Parties to the Decree, and with the directives of the River Master.

INTRODUCTION

An 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. The Decree stipulated that these diversions and releases were to be made under the supervision and direction of the Delaware River Master. The Decree also stipulated that reports on Delaware River operations be made to the Court not less frequently than annually. This report documents operations from December 1, 1997 to November 30, 1998, or the 1998 River Master report year.

Some hydrologic data presented in this report are records of streamflow and water quality for U.S. Geological Survey data-collection stations. These records were collected, computed, and furnished by the offices of the U.S. Geological Survey at Troy, New York; Malvern and Lemoyne, 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. Figure 1 shows the location of major streams and reservoirs, and selected streamflow-gaging stations in the Delaware River Basin.

ACKNOWLEDGMENTS

The River Master's daily operation records were prepared from hydrologic data collected chiefly on a day-to-day basis. Data for these records were collected and computed by the Office of the Delaware River Master or were furnished by the following agencies and utilities: Data for Pepacton, Cannonsville, and Neversink Reservoirs by the New York City Department of Environmental Protection, Bureau of Water Supply; for the Delaware and Raritan Canal by the New Jersey Water Supply Authority; for Lake Wallenpaupack by the Pennsylvania Power & Light Company; and for Rio Reservoir by Orange and Rockland Utilities, Inc. Precipitation data and quantitative precipitation forecasts were provided by the National Weather Service.

DEFINITION OF TERMS AND PROCEDURES

The following definitions apply to various terms and procedures used in the operations documented in this report. A table for converting inch-pound units to International System of Units (SI) is given on page *vi*.

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

Conservation releases. - Controlled releases from reservoirs designed to maintain specified flows in stream channels below the reservoirs.

Daily excess-release credits. - Daily credits and deficits during the seasonal period (see definition below) are computed as the arithmetic difference between the daily mean discharge of the Delaware River at Montague, N.J. and 1,750 ft^3/s. 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, however, with the following exception: during the seasonal period, credits also are applied for part or all of other releases from these reservoirs that contribute to the daily mean discharge at Montague between 1,750 ft^3/s and the applicable excess-release rate.

Directed releases. - Controlled releases from the New York City reservoirs in the upper Delaware River Basin, designed by the Delaware River Master to meet the Montague flow objective.

Diversions. - The transfer of water by New York City from Pepacton, Cannonsville, and Neversink Reservoirs in the upper Delaware River Basin through the East Delaware, West Delaware, and Neversink Tunnels, respectively, to the City's water-supply system. Also, the transfer of water by New Jersey from the Delaware River through the Delaware and Raritan Canal.

Excess quantity and seasonal period for its release. - As defined in the Decree, the excess quantity of water is equal to 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 Mgal/d stipulated by 1954 Decree) from all its sources of supply obtainable without pumping, except that the excess quantity shall not exceed 70 billion gallons. Each year, the "seasonal period" for release of the excess quantity begins on June 15. The flow objective for the period becomes effective at Montague on that date and remains in effect until the following March 15, or until the cumulative total of excess-release credits equals the seasonal quantity, whichever occurs first.

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

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

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

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

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.

Time of day. - Time of day is expressed in 24-hour Eastern Standard Time, which during the report year included a 23-hour day on April 5 and a 25-hour day on October 25.

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

PRECIPITATION

Precipitation in the Delaware River Basin above Montague totaled 44.59 inches for the 1998 report year and was 1.36 inches greater than the long-term (57-year) average. Monthly precipitation ranged from 33 percent of the long-term average in August 1998 to 191 percent of the average in June 1998. Table 1[1] presents data on monthly precipitation during the report year and long-term average precipitation. These data were computed from records collected by the National Weather Service; the New York City Department of Environmental Protection, Bureau of Water Supply; and the River Master, at 10 geographically distributed stations.

The seasonal period from December to May typically is when surface-water and groundwater reservoirs fill. During this period in 1997-98, average precipitation at the 10 stations was 24.51 inches, which was 121 percent of the 57-year average. During June to November, average precipitation at the 10 stations was 20.08 inches, which was 87 percent of the long-term average. The maximum monthly precipitation was 8.76 inches in June 1998, measured at Milford, Pennsylvania; the minimum monthly precipitation was 0.60 inches in August, measured at Downsville, New York.

OPERATIONS

December to May

Hydrologic conditions in the Delaware River Basin entered drought-warning status on October 27, 1997 and were in this status at the beginning of the report year. Operations on December 1, 1997 were being conducted as prescribed by the "Interstate Water Management Recommendations of the Parties to the Decree" (DRBC Resolution 83-13). The Montague flow objective was 1,655 ft^3/s and allowable diversions to New York City and New Jersey were 680 Mgal/d and 85 Mgal/d, respectively. Conservation releases from New York City reservoirs were being made at the basic levels shown in table 2.

In addition, on October 22, 1997, the Parties to the Decree, the DRBC, and the Delaware River Master established an emergency fishery protection program designed to protect the fishery during the drought-warning period. This program was modified on November 8, 1997. The program is described in more detail in the 1997 Report of the River Master of the Delaware River. A copy of the modified agreement in effect at the start of the 1998 River Master year is presented in Appendix A.

A total of 2,439 (ft^3/s).d was released to protect the fishery and 443 (ft^3/s).d was set aside in a fishery protection bank through reductions in releases to meet the Montague flow objective from October 27, 1997, when the agreement became effective, to February 24, 1998, when Cannonsville Reservoir filled to capacity and began spilling. The special releases and the reductions in release requirements are summarized in table 3.

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1. All numbered tables in Section II are grouped at the end of this section, beginning on page 32.

Hydrologic conditions returned to normal in mid-January and allowable diversions to New York City and New Jersey were restored to 800 and 100 Mgal/d, respectively, on January 13, 1998. The Montague flow objective was increased to 1,750 ft^3/s effective January 16, 1998. On January 24, 1998, conservation releases from New York City reservoirs were increased to the experimental release rates shown in table 2.

During the first half of the report year, total precipitation was 4.28 inches above average and monthly precipitation ranged from 106 percent of the long-term average in December 1997 to 133 percent in January 1998 (table 1). Runoff in the upper basin was in the normal range during December, February, and April and was above normal during January, March and May.

On December 1, 1997, when the 1998 report year began, Pepacton Reservoir contained 65.299 Bgal of water in storage above the point of maximum depletion, or 46.6 percent of the 140.190 Bgal storage capacity, Cannonsville Reservoir contained 31.489 Bgal, or 32.9 percent of the 95.706 Bgal storage capacity. Neversink Reservoir contained 15.883 Bgal, or 45.5 percent of the 34.941 Bgal storage capacity. Combined storage in these reservoirs on December 1 was 112.671 Bgal, or 41.6 percent of combined capacity. Daily storage contents in Pepacton, Cannonsville, and Neversink Reservoirs are shown in tables 4, 5, and 6, respectively, and combined storage is shown graphically in figure 2.

From December to May, inflow to the City's reservoirs generally exceeds draft rates and consequently, the amount of water in storage increases. The average inflow to Pepacton, Cannonsville, and Neversink Reservoirs for these six months during the 57-year period from December 1940 to May 1997 was 302.8 Bgal. During the corresponding six months of the current report year, inflow to the three reservoirs totaled 344.9 Bgal. Evaporation loss is not included in the computations.

Combined storage increased seasonably during December. Substantial precipitation in late December and early January, in combination with above-normal temperatures, resulted in large volumes of runoff and a rapid increase in storage during January. Combined storage continued to increase, although more gradually, during February and March. The three reservoirs were at or near full capacity during most of April and May.

Total storage in the three New York City reservoirs was 111.448 Bgal on November 30, 1997 and 268.722 Bgal on May 31, 1998, an increase of 157.274 Bgal or 58.1 percent of capacity. The maximum combined storage during the period from December to May was 276.722 Bgal on May 12, when all three reservoirs were spilling. Normally, maximum storage in the individual reservoirs occurs on different days. Maximum storage in Pepacton Reservoir during the December to May period was 142.360 Bgal on May 12; maximum storage in Cannonsville Reservoir was 100.776 Bgal on March 11; and maximum storage in Neversink Reservoir was 35.438 Bgal on May 11, 1998. Pepacton Reservoir spilled from April 5 to May 22. Cannonsville Reservoir spilled from February 23 to May 28, and Neversink Reservoir spilled from May 10 to 16. A total of 130.015 Bgal spilled from these reservoirs during the December to May period.

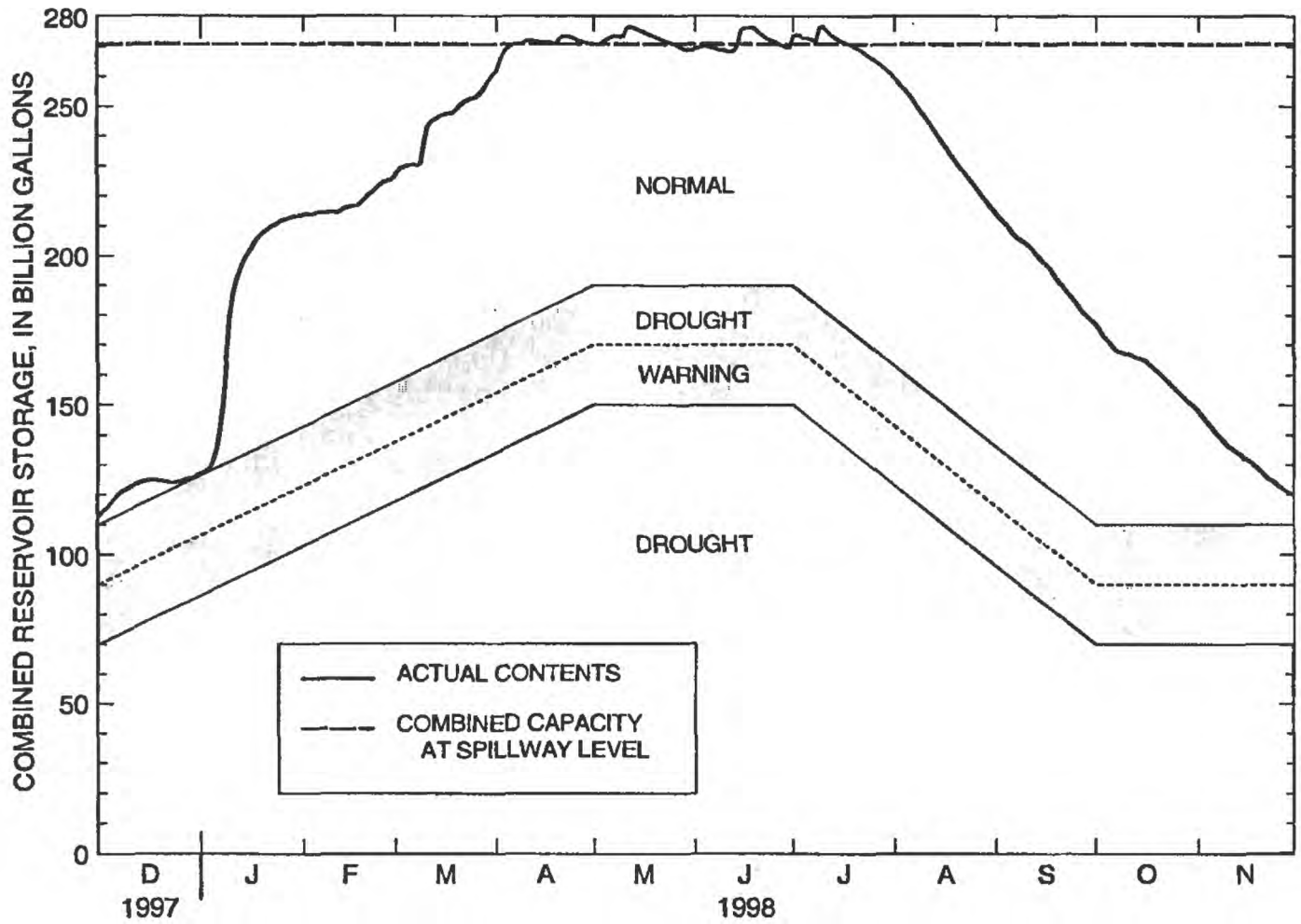

Figure 2. - Operating curves and actual contents for New York City reservoirs in the Delaware River basin, December 1, 1997 to November 30, 1998. (Sources: Operating curves from Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954; data on reservoir contents from New York City Bureau of Water Supply data).

On April 27, 1998, in response to a request by the Executive Director of the Delaware River Basin Commission, the Parties to the Decree agreed to an experimental release of bottom water from the outlet works of Cannonsville Reservoir, at rates ranging from 100 to 500 ft^3/s, whenever the spillage exceeded 1,000 ft^3/s for up to a two-week period. The objective of the release was to improve the quality of summer releases by releasing bottom water earlier in the season. For technical reasons, the Delaware River Master did not recommend implementation of the experimental-release program, but did not oppose the program given the unanimous consent of the Parties to the Decree. A copy of the experimental-release agreement is presented in Appendix B. The releases were made from July 1 to 14, 1998. New York City provided a report to the Parties to the Decree, summarizing the results of the program.

During the December to May period, diversions to Rondout Reservoir by New York City totaled 61.547 Bgal (338 Mgal/d). The forecasted discharge at Montague, exclusive of water released from the City reservoirs, was less than the flow objective on one day in December and a release was directed. The observed daily mean discharge at Montague did not decline below the flow objective at any time during the period, however.

June to November

Monthly precipitation from June to November was above average in June and below average from July to November. Total precipitation during the period was 20.08 inches or 2.92 inches less than the 57-year average (table 1).

Much-above average precipitation in June and early July resulted in the reservoirs filling to capacity and spilling. Pepacton Reservoir spilled from June 14 to 26 and from June 30 to July 17. Cannonsville Reservoir spilled from June 13 to July 20. Neversink Reservoir spilled from June 13 to 19 and on July 1 and 2. A total of 50.624 Bgal spilled from these reservoirs during June and July.

Releases were directed to meet the Montague flow objective on 118 days between June 1 and November 30, 1998, when the forecasted discharge at Montague, exclusive of water released from the New York City reservoirs, was less than the applicable flow objective (table 7). Releases at various conservation rates or at rates designed to protect the fishery were made at other times from June 1 to November 30. River Master records show that from May 28 to September 8, a total of 2,462 $(ft^3/s)\cdot d$ or 1.593 Bgal was released to help relieve thermal stress in the upper Delaware River Basin. New York City's computation of thermal releases, however, shows an additional 564 $(ft^3/s)\cdot d$ was released. This difference results from differences in computational methods used during times of spill.

From June 1 to June 14, the Montague flow objective was 1,750 ft^3/s. The forecasted flow, exclusive of releases from Pepacton, Cannonsville, and Neversink Reservoirs, did not decline below the flow objective, so no releases were directed.

The New York City Department of Environmental Protection, Bureau of Water Supply, furnished the River Master with the following data for the 1998 calendar year, as stipulated in the Decree:

1. The estimated continuous safe yield from all the City's sources, obtainable without pumping, is 1,665 Mgal/d, or a total during calendar year 1998 of 1.665 Bgal/d x 365 days = 607.725 Bgal.

2. The estimated consumption that the City must provide for, from all its sources of supply during calendar year 1998, is 591.582 + 7.250 = 598.832 Bgal.

On the basis 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 Bgal. The Montague flow objective during the excess release period beginning June 15, 1998 was computed as:

$$1{,}750\ ft^3/s + \frac{7.381\ \text{Bgal} \times 1{,}547\ (ft^3/s)/(\text{Bgal/d})}{120\ \text{days}} = 1{,}850\ ft^3/s$$

Data on consumption of water by the City of New York for each calendar year since 1950, from all sources of supply, are presented in table 8.

On June 15, 1998, the seasonal period for release of the excess quantity began, and the Montague flow objective was increased to 1,850 ft^3/s. From June 15 to October 8, as a result of below-normal runoff from precipitation, storage in lower Delaware River basin reservoirs--Blue

Marsh and Beltzville--declined rapidly. On October 8, 1998, in an effort to avert or delay entry into drought-warning status for the lower basin, the Parties to the Decree, the DRBC, and the River Master unanimously agreed to bank the remaining excess-release quantity. A copy of the agreement is presented in Appendix C. Water remaining in the excess-release bank would be used, if necessary, to provide lower basin drought assistance in accordance with procedures in section 2.5.6 A of DRBC Resolution 88-22 (Revised). The Montague flow objective reverted to 1,750 ft^3/s on October 12. A total of 5.892 Bgal of the 7.381 Bgal excess-release quantity was released and the remainder, 1.489 Bgal, was put in a bank to be used if needed for lower basin drought assistance. A total of 1,400 $(ft^3/s)\cdot d$ or 0.905 Bgal was released between October 24 and November 20 to provide lower basin drought assistance, as directed by DRBC. A summary of daily operations during the lower basin drought plan for the Delaware River at Montague and Trenton, N.J. is shown in table 9.

From July to September, precipitation was below normal, particularly in the lower basin. Precipitation was near normal in October but was below normal in November. On November 20, 1998, in anticipation of entry into drought-warning status, the Parties to the Decree and DRBC agreed to operational modifications pursuant to DRBC Resolution No. 83-13. The modified agreement mandated reductions in New York City's diversions from reservoirs in the Delaware River Basin to 680 Mgal/d. The Montague flow objective was reduced to 1,655 ft^3/s and the Trenton flow target was reduced to 2,700 ft^3/s. The remainder of the excess-release bank -- 903 $(ft^3/s)\cdot d$ or 0.584 Bgal -- was placed in a fishery protection bank for use during drought warning. The remaining water was to be used to enhance winter basic conservation releases by increasing releases to the levels of the summer basic conservation releases. A copy of the agreement authorizing this action is presented in Appendix D.

Between June 15, when release of the excess quantity began, and October 11, 1998, the forecasted flow at Montague, exclusive of releases from the New York City reservoirs, was less than the flow objective on 75 days and releases were directed. On 32 days during the June 15 to October 11 period, the observed flow was less than the applicable flow objective. On 24 of the 32 days, observed flows were within 10 percent of the flow objective and, on 8 days, flows were more than 10 percent below the flow objective. Between October 12 and November 30, 1998, the forecasted flow at Montague, exclusive of releases from New York City reservoirs, was less than the flow objective on 43 days and releases were directed.

The total discharge measured at Montague, the portion derived from uncontrolled runoff from the area below the reservoirs, the portion contributed by power reservoirs, and the portion contributed by Pepacton, Cannonsville, and Neversink Reservoirs are shown graphically on figure 3. In analyzing the water budget for Montague, uncontrolled runoff was computed as the residual of observed flow minus releases and spill from all reservoirs, and therefore was subject to all errors in observations, transit times, and routing of the various components of flow. The Rio conservation release of 100 ft^3/s is included in the uncontrolled-runoff component. The net effect of these uncertainties is incorporated in the derived hydrograph of uncontrolled runoff.

Diversions to Rondout Reservoir from June 1 to November 30, 1998 totaled 125.363 Bgal.

Summary of Operations

From December 1, 1997 to November 30, 1998, diversions from New York City reservoirs in the Delaware River Basin to Rondout Reservoir totaled 186.910 Bgal, and all releases from these reservoirs to the Delaware River totaled 106.430 Bgal. Directed releases to the Delaware River from these reservoirs totaled 76.145 Bgal.

During the year, maximum storage in Pepacton Reservoir was 142.734 Bgal on June 16; 100.776 Bgal in Cannonsville Reservoir on March 11;, and 35.578 Bgal in Neversink Reservoir on June 15, when the reservoirs were spilling. Maximum combined storage in the three reservoirs was 276.807 Bgal on July 10, 1998, and the combined spill was 180.639 Bgal.

During the year, minimum storage in Pepacton Reservoir was 65.299 Bgal (46.6 percent of capacity) on December 1, 1997; 22.237 Bgal (23.2 percent of capacity) in Cannonsville Reservoir on November 30; and 12.386 Bgal (35.4 percent of capacity) in Neversink Reservoir on November 30. Minimum combined storage in the three reservoirs was 112.671 Bgal on December 1, 1997.

On November 30, 1998, the end of the report year, combined storage in the three reservoirs was 120.291 Bgal or 44.4 percent of combined capacity. During the year, the net change in combined storage was 8.843 Bgal, or an increase in contents of 3.3 percent.

The distribution of combined storage for the three reservoirs on the first day of the month, for the reference period June 1967 to November 1997, is shown in figure 4. Storage was below median in December, January, February, May, June and October. Storage was above median in March, April, July, August, September and November, and also was above the 75th percentile in July and August.

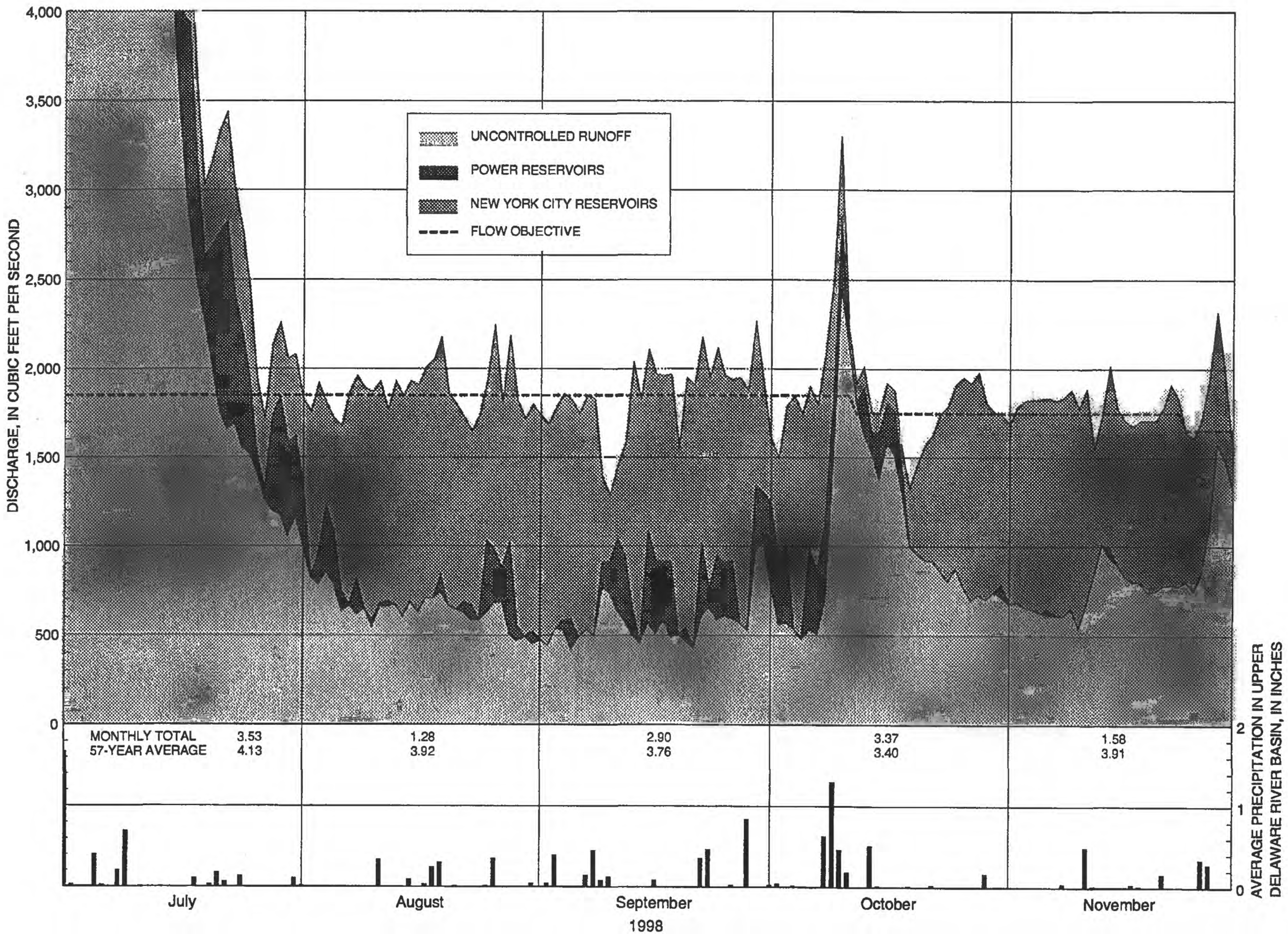

Figure 3.--Components of flow, Delaware River at Montague, N.J., July 1 to November 30, 1998.

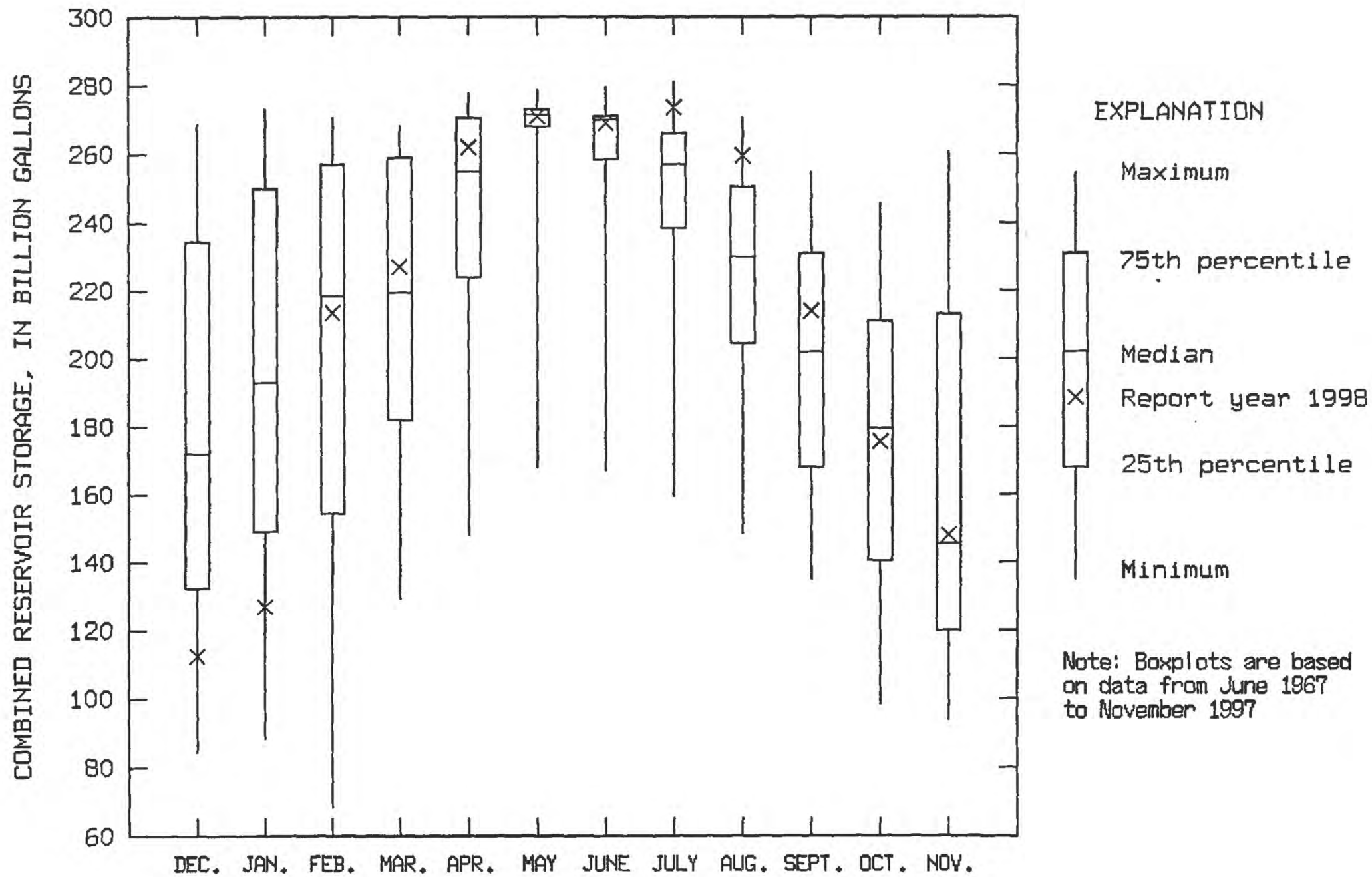

Figure 4.- Combined storage in Pepacton, Cannonsville, and Neversink Reservoirs on the first day of the month, December 1997 to November 1998 (this report year), and summary statistics for the period of record, June 1967 to November 1997.

SUPPLEMENTAL RELEASES FROM WALLENPAUPACK POWERPLANT

An agreement between Pennsylvania Power & Light Company and New York City provides for supplemental releases from the 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 ft^3/s for more than three consecutive days. No supplemental releases were requested during the report year.

COMPONENTS OF FLOW, DELAWARE RIVER AT MONTAGUE, N.J.

The data and computations of the various components of flow form the basic operational records used by the River Master to carry out specific responsibilities related to the Montague formula. The operational record has two parts: forecasted flow at Montague, exclusive of controlled releases from New York City's reservoirs (table 10), and segregation of components of daily mean flow at Montague (table 11).

The following components may be present in the flow of the Delaware River at Montague:

1. Controlled releases from Lake Wallenpaupack on Wallenpaupack Creek, for the production of hydroelectric power.
2. Controlled releases from Rio Reservoir on Mongaup River, for the production of hydroelectric power.
3. Runoff from the uncontrolled area above Montague, including spill from New York City reservoirs.
4. Controlled releases from Pepacton, Cannonsville, and Neversink Reservoirs of New York City.

The releases from New York City's reservoirs necessary to maintain the Montague objective were computed from the forecasted flow at Montague, exclusive of controlled releases from the reservoirs.

TIME OF TRAVEL

Following are average times for the effective travel of water from the various sources of controlled supply to Montague. These times were used for flow routing during the 1998 report year:

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

The travel times were computed from reservoir and powerplant operational data and historical gaging-station records. They are generally suitable for use in the operations of the River Master. Occasionally, however, notable exceptions are observed. For example, when a large release from Cannonsville Reservoir follows a small release, a substantial portion of the water fills the channel en route, and the remainder may arrive at Montague as much as 18 hours later. During winter, the development of ice cover, together with low streamflow, gradually increases the resistance to flow, resulting in increased travel times. Because ice-affected travel times increase gradually over several days, and releases generally were not being directed to meet the Montague objective during periods of ice cover, no adjustments were made to compensate for increased travel times during these periods.

SEGREGATION OF FLOW AT MONTAGUE

Table 11 presents the River Master daily operational record of reservoir releases and segregation of flow among the various components contributing to the flow of the Delaware River at Montague. The data are arranged to conform to the downstream movement of water from the various sources to Montague. Summation of data along individual lines in the table is equivalent to routing the various flow contributions to Montague, using the average travel times given previously. Uncontrolled runoff was computed as a residual by subtracting the flow contributions of all other sources from the observed discharge at Montague.

COMPUTATION OF DIRECTED RELEASES

During the report year, the River Master used the following information for daily operations: (1) discharges computed from recorded or reported stream gage heights, for various 24-hour periods, without real-time information on any changes in stage-discharge relations; (2) daily discharge from New York City's three reservoirs, measured with venturi meters; (3) rainfall reports for the previous 24 hours; (4) actual powerplant releases 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 various sources. Although variable uncertainty is inherent in estimating future conditions, these data must nevertheless be used in the daily designs and direction of releases.

The travel time of water from Pepacton Reservoir to Montague (60 hours) is greater than the travel time of water from any other reservoir. Releases from Cannonsville and Neversink Reservoirs were timed to arrive at Montague concurrently with releases from Pepacton Reservoir. To allow for differences in travel times, daily directed releases were scheduled to begin from Pepacton at 1200 hours, from Cannonsville at 2400 hours, and from Neversink at 1500 hours the following day.

Releases from the City's reservoirs required to maintain the specified flow at Montague were computed from estimates of releases from Lake Wallenpaupack and Rio Reservoir and forecasts of uncontrolled runoff at Montague. To account for the travel times from these sources to Montague, the computation requires that estimates of the following components of flow be made two or more days in advance: (1) release of water from Lake Wallenpaupack; (2) release of water from Rio Reservoir; and (3) uncontrolled runoff at Montague. Table 10 shows the River Master daily operational record for computing daily directed release requirements during periods of low flow.

The electric utilities furnished advance estimates of power generation and releases. Because the hydroelectric plants were used chiefly for meeting peak-power demands, advance estimates were subject to various modifying factors including the vagaries of weather on electricity demand. In addition, because the power companies are members of regional power pools, demand for power outside of the local service area may unexpectedly affect generation schedules. As a result, at times, the actual use of water for power generation differed considerably from the advance estimates that were used in the design of reservoir releases.

For computational purposes during periods of low flow, estimates of uncontrolled runoff at Montague were treated as two components: (1) current runoff and (2) forecasted increase in runoff from precipitation. Estimates for these components are given in table 10.

During ice-free conditions, current runoff was computed using a routing and recession procedure based on discharges at 0800 hours at the following USGS gaging stations:

Station Name	Drainage Area (mi^2)
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

During the winter period, the advance estimate of uncontrolled runoff (current conditions) was made on the basis of flows at a reduced network of streamflow-gaging stations and the recession curve for computed uncontrolled flow at Montague.

The forecasted runoff from precipitation is shown in table 10 under the heading "Weather Adjustment." Throughout the low-flow periods, the National Weather Service office at Binghamton, N.Y., furnished quantitative forecasts of average precipitation and air temperatures, for the drainage area above Montague, for each day of the three-day design period. During winter, runoff was estimated on the basis of the current status of snow and ice, along with forecasted precipitation and temperature. During other periods, the forecasted precipitation was used to estimate runoff.

The forecasted flow at Montague, exclusive of releases from New York City's reservoirs (table 10), is computed as the sum of forecasted releases from power reservoirs, estimated uncontrolled runoff including conservation releases from Rio Reservoir, and weather adjustments. If the computed flow was less than the desired flow at Montague, then the deficiency was made up by directed releases from the City's reservoirs.

When significantly revised forecasts of precipitation or powerplant releases became available, the releases required from the reservoirs were recomputed. Typically, this procedure resulted in a reduced release requirement for New York City reservoirs for that day and, consequently, water was conserved. Table 10 gives only the final figures for releases from New York City reservoirs.

ANALYSIS OF FORECASTS

Forecasts of streamflow at Montague, developed on the basis of anticipated contributions from the several components (excluding releases from New York City's reservoirs), differed on most days from observed flow. Occasionally, variations in the components were partially compensating and observed flows were in good agreement with forecasted flows.

The forecasted flow of the Delaware River at Montague, exclusive of releases from New York City reservoirs, was less than the applicable flow objective most days from July 26 to November 30, 1998. The following tabulation compares estimates of the various contributions to flow at Montague with actual operations during the period.

Releases and Runoff	Estimates [$(ft^3/s)\cdot d$]	Actual operations [$(ft^3/s)\cdot d$]
Directed releases from New York City reservoirs	[a] 117,768	[b] 117,740
Power releases		
Lake Wallenpaupack	15,611	13,374
Rio Reservoir	2,193	2,171
Runoff from uncontrolled area	97,576	102,016

[a] Directed release as designed.
[b] Actual release in response to direction.

From July 26 to November 30, releases from New York City reservoirs were slightly less than the corresponding directed releases. Releases from Lake Wallenpaupack were 14 percent less than forecasted amounts, and releases from Rio Reservoir were 1.0 percent less than forecast amounts. Observed runoff from the uncontrolled area was 4.6 percent greater than forecasted runoff.

On the basis of observed discharges at Montague, exact forecasting of releases required from the City's reservoirs during the report year would have totaled 114,952 $(ft^3/s)\cdot d$. Directed releases totaled 117,825 $(ft^3/s)\cdot d$, or 2.5 percent more than required for exact forecasting.

Comparison of hydrographs of forecasted runoff and actual runoff (fig. 5) from the uncontrolled area indicates that although the forecasting procedures tended to underestimate runoff during high precipitation events, the forecasts generally were adequate. Numerical adjustments were made when needed to compensate for errors in the forecasts, but because of travel times, the effects of the adjustments on flows at Montague are not evident until several days after the design date.

Analysis of the precipitation forecasts shows that the total precipitation amount forecasted for the three-day design periods is fairly accurate, but often the timing of storms may be either earlier or later than forecasted. The accuracy of the runoff forecasts is affected greatly by the timing of precipitation events. In addition, if the actual storm track differs from the forecasted track, the amount and timing of runoff can be significantly different than predicted.

DIVERSIONS TO NEW YORK CITY WATER SUPPLY

The 1954 Amended Decree authorizes New York City to divert water from the Delaware River Basin at a rate not to exceed 800 Mgal/d. The Decree also specifies that the rate of diversions shall be computed as the aggregate total diversion beginning on June 1 of each year divided by the number of days elapsed since the preceding May 31.

Table 12 gives diversions during the report year from Pepacton, Cannonsville, and Neversink Reservoirs to the New York City water-supply system (Rondout Reservoir). The table includes a running account of the average rates of combined diversions from the three reservoirs, computed as prescribed by the Decree or the "Interstate Water Management Recommendations of the Parties to the Decree (DRBC Resolution 83-13)." The following tabulation shows allowable maximum diversion rates and actual diversions for various periods during the report year.

Effective dates	Allowable diversions (Mgal/d)	Actual diversions (Mgal/d)
October 27, 1997 to January 12, 1998	680	363
January 13 to May 31, 1998	800	358
June 1 to November 20, 1998	800	691
November 21 to November 30, 1998	680	585

During the year, a total of 186.901 Bgal of water was diverted to the New York City water-supply system. The allowable diversion was 292.931 Bgal.

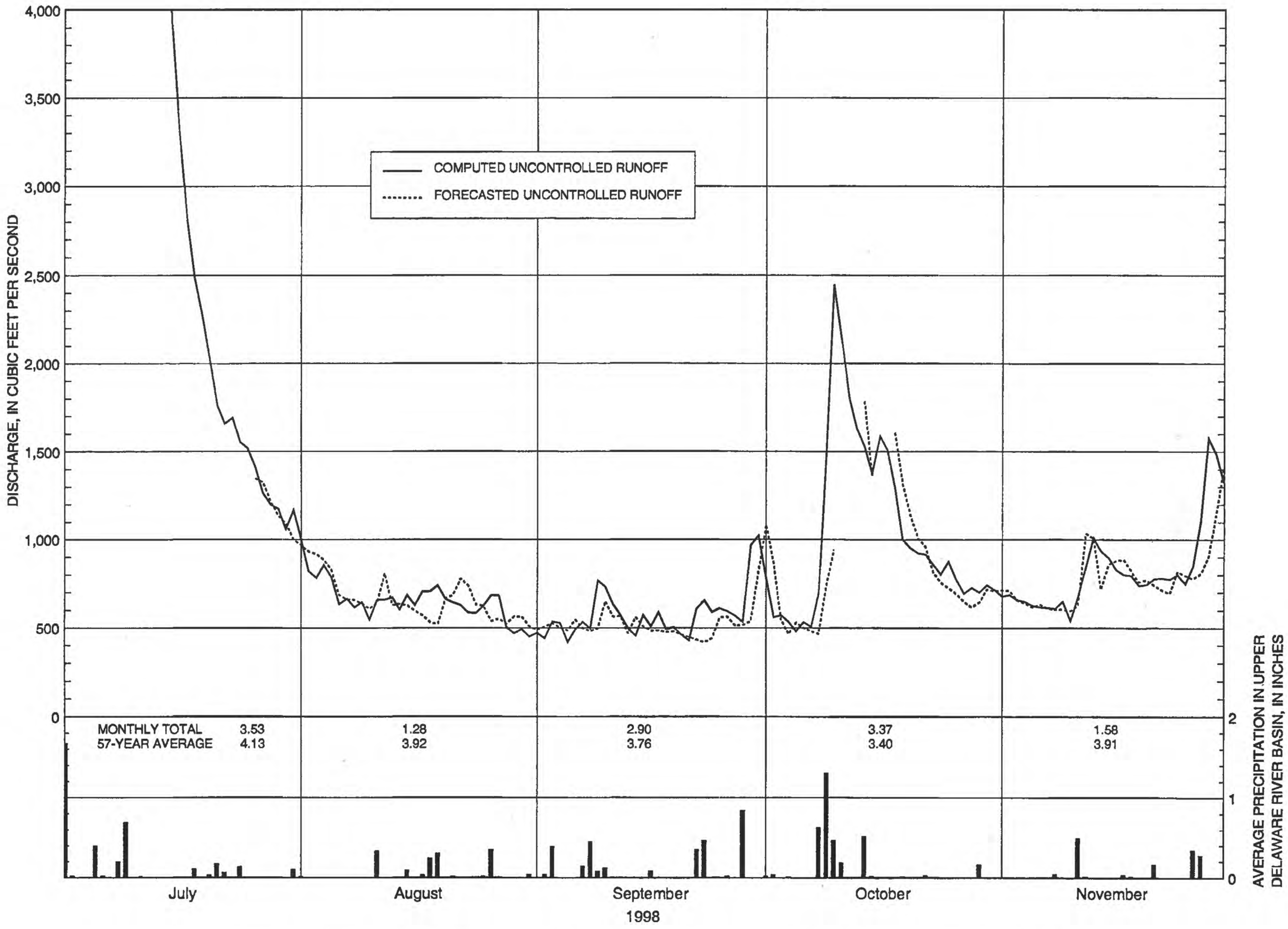

Figure 5.--Uncontrolled runoff component, Delaware River at Montague, N.J., July 1 to November 30, 1998.

STORAGE IN NEW YORK CITY RESERVOIRS

The following tabulation summarizes the "point of maximum depletion" and other pertinent levels and contents of Pepacton, Cannonsville, and Neversink Reservoirs. This information was provided by the (former) New York City Board of Water Supply.

Level	Pepacton Reservoir		Cannonsville Reservoir		Neversink Reservoir	
	Elevation (ft.)	Contents (Bgal)	Elevation (ft.)	Contents (Bgal)	Elevation (ft.)	Contents (Bgal)
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 4, 5, and 6 show storage in Pepacton, Cannonsville, and Neversink Reservoirs, respectively, above the "point of maximum depletion" or minimum full-operating level.

On December 1, 1997, combined storage in the three reservoirs was 112.671 Bgal, or 41.6 percent of combined capacity. As discussed previously, storage increased from below normal to normal during the winter period. Pepacton Reservoir spilled from April 5 to May 22, June 14 to 26, and June 30 to July 17, 1998. A total of 57.695 Bgal spilled during these periods. Cannonsville Reservoir spilled a total of 114.691 Bgal from February 23 to May 28, and from June 13 to July 20, 1998. Neversink Reservoir spilled a total of 8.253 Bgal from May 10 to 16, June 13 to 19, and July 1, 2, 1998. Combined storage reached a maximum for the year on July 10, 1998, when Pepacton and Cannonsville Reservoirs were spilling.

The seasonal decline in storage began in mid-July, much later than normal. Storage declined to 120.291 Bgal, or 44.4 percent of combined capacity on November 30, 1998.

COMPARISON OF RIVER MASTER OPERATIONS DATA WITH OTHER STREAMFLOW RECORDS

River Master operations essentially are day-to-day operations, which by necessity use preliminary data on streamflow. In this section, records used in River Master operations are compared to final data published for U.S. Geological Survey streamflow-gaging stations. The data on releases were reported in million gallons per day (Mgal/d) and converted to cubic feet per second (ft^3/s) for use in the comparisons.

Releases from New York City Reservoirs

River Master operations data on controlled releases from Pepacton, Cannonsville, and Neversink Reservoirs to the Delaware River were furnished by New York City. These data were obtained from calibrated instruments connected to venturi meters installed in the outlet conduits of the reservoirs.

The U.S. Geological Survey gaging station on East Branch Delaware River at Downsville, N.Y. is 0.5 mile downstream from Pepacton Reservoir Dam (fig. 1). Discharge measured at this station includes releases from Pepacton Reservoir and a small amount of seepage and any runoff that enters the channel between the dam and the gage site. The drainage area is 371 mi^2 at the dam and 372 mi^2 at the gaging station.

The following tabulation compares releases from Pepacton Reservoir (table 11), reported by New York City, to the final records for the USGS gaging station on East Branch Delaware River at Downsville, N.Y. (table 13), for the flow objective shown.

Flow objective (ft^3/s)	6	19	45	70	95
NYC-measured flow (ft^3/s)	6.2	18.6	45.3	69.6	95.0
USGS-measured flow (ft^3/s)	6.6	18.0	44.4	66.6	92.7
Percent difference	-6.1	+3.3	+2.0	+4.5	+2.5

The differences at all flow rates are small and measured rates compare favorably. The calibration of instruments connected to the venturi meters was adjusted periodically by New York City to improve the accuracy of the readings.

The U.S. Geological Survey gaging station on West Branch Delaware River at Stilesville, N.Y. is 1.4 miles downstream from Cannonsville Dam (fig. 1). Discharge measured at this station includes releases from Cannonsville Reservoir and runoff from 2 mi^2 of drainage area between the dam and the gage site. The drainage area is 454 mi^2 at the dam and 456 mi^2 at the gaging station.

The following tabulation compares releases from Cannonsville Reservoir (table 11), reported by New York City, to the final records for the USGS gaging station on West Branch Delaware River at Stilesville, N.Y. (table 14), for the flow objective shown.

Flow objective (ft^3/s)	8	23	45	160	250-400	700-1,000	>1,000
NYC-measured flow (ft^3/s)	7.7	22.8	44.4	161	317	873	1,115
USGS-measured flow (ft^3/s)	16.8	26.8	52.6	208	290	796	1,021
Percent difference	-54	-15	-16	-23	+9.3	+9.7	+9.2

The gaging-station records are considered good at flows greater than 100 ft^3/s and fair at flows less than 100 ft^3/s. The records include runoff from precipitation on the area between the dam and the gaging station and seepage near the base of the dam. On January 21, 1998, the seepage was measured at 3.9 ft^3/s, which was greater than rates estimated in previous years. The differences in flow between reservoir-release records and USGS gaging-station records continue to be monitored by the River Master's office, in cooperation with New York City and the USGS District office at Troy, N.Y. To further investigate the differences, two discharge measurements were made during the report year, just below the Cannonsville release outlet. By measuring flow at this location, most of the runoff contribution from the intervening area between the outlet and the gaging station is eliminated, but seepage near the base of the dam is included. The first measurement differed from New York City release records by -9.8 percent (unadjusted) and +7.3 percent when adjusted for the seepage of 3.9 ft^3/s for the 23 ft^3/s flow objective. The second measurement, at 254 ft^3/s, did not differ from the release records.

The U.S. Geological Survey gaging station on Neversink River at Neversink, N.Y. is 1,650 feet downstream from Neversink Dam (fig. 1). Discharge measured at this station includes releases from Neversink Reservoir and, during storms, a small amount of runoff that originates between the dam and gage site. The drainage area is 92.5 mi^2 at the dam and is 92.6 mi^2 at the gaging station.

The following tabulation compares releases from Neversink Reservoir (table 11), reported by New York City, to the final records for the USGS gaging station on Neversink River at Neversink, N.Y. (table 15), for the flow objective shown.

Flow objective (ft^3/s)	5	15	25	53	74	90-110
NYC-measured flow (ft^3/s)	4.6	15.4	24.8	52.4	74.1	97.5
USGS-measured flow (ft^3/s)	7.0	15.4	24.9	50.9	68.0	90.2
Percent difference	-34.3	0	-0.4	+2.9	+9.0	+8.1

The flow objectives are the basic and experimental conservation release rates except for the two highest release rates, which represent elevated rates of release for thermal protection during the report year. The River Master's office made eight discharge measurements, six during the year and one just before and one just after the year, to further investigate the differences between reservoir-release records and USGS gaging-station records. These measurements yielded results similar to the data in the tabulation at flows of 5 ft^3/s, 15 ft^3/s, 25 ft^3/s and 53 ft^3/s.

Releases from Lake Wallenpaupack

Records of daily discharge through the Wallenpaupack powerplant were furnished by the Pennsylvania Power & Light Company and published by the U.S. Geological Survey as Wallenpaupack Creek at Wilsonville, Pa. (table 16). These discharges represent the flow through the turbines of the powerplant and were computed on a midnight-to-midnight basis. For River Master operations, flows were computed on a 24-hour basis beginning at 0800 hours to compensate for the travel time to Montague (table 11).

From December 1997 through November 1998, the River Master's record agrees with the published U.S. Geological Survey record except for some small variations which result mainly from differences in time frame and rounding of computations. On some days, however, unexplained differences are present in the records. Overall, the records agree to within 0.18 percent for the year.

Delaware River at Montague, N.J.

The River Master's operation record for the Delaware River at Montague, N.J. (table 11) showed 0.17 percent less discharge for the year than the published U.S. Geological Survey record for the gaging station at that site (table 17). Daily values for the two records were in good agreement.

Diversion Tunnels

Records of diversions through the East Delaware, West Delaware, and Neversink Tunnels (fig. 1) were furnished by the City of New York. These records were obtained from the City's calibrated instruments connected to venturi meters installed in the tunnel conduits. The measured flows were transmitted electronically, on a 15-second interval, to the New York City Department of Environmental Protection computer at the Rondout Effluent Chamber. On five-minute intervals, release and diversion quantities for the preceding five-minute period are computed on the basis of the instantaneous rate-of-flow data from each instrument. These five-minute quantities are summed to compute daily total flows, which were reported to the River Master's office on a daily basis. On a weekly basis the diversion values were checked against the flow meter totalizer readings and were corrected when necessary. Periodic current-meter measurements were made by the River Master's office to verify the reported diversions. The measurements were made in the outlet channels below the tunnels.

The East Delaware Tunnel is used to divert water from Pepacton Reservoir to Rondout Reservoir. Conditions in the outlet channel of the East Delaware Tunnel were unfavorable for flow measurements throughout the report year because of high water levels in Rondout Reservoir. Comparison of diversion data provided by New York City with discharges obtained from recorded gage heights and the rating curve for the weir at the outlet channel of the East Delaware Tunnel shows that the diversions reported by the City were within acceptable limits.

The generating plant at the downstream end of the East Delaware Tunnel operated most days of the report year. When the powerplant was not in operation, some water leaked through the wicket gates and was not recorded on the totalizer. Current-meter measurements made in previous years and in 1998 show that the rate of leakage is fairly constant at about 8.0 Mgal/d. Because the powerplant was not in operation for the equivalent of 133 days during the 1998 report year, the unmeasured leakage totaled about 1.1 Bgal. On the basis of measurements obtained in 1998 and previous years, the record of diversions through the East Delaware Tunnel was substantially correct.

The West Delaware Tunnel is used to divert water from Cannonsville Reservoir to Rondout Reservoir. One current-meter measurement of flow in the West Delaware Tunnel outlet channel was made during the year. This measurement suggested that the venturi instruments gave

larger results, namely, +5.1 percent for the totalizer and +5.8 percent for the rate-of-flow indicator. Inspections of the channel below the outlet, when valves were closed, detected only negligible leakage.

A hydroelectric powerplant uses water diverted through the West Delaware Tunnel, but the plant operates only when diversions are less than 300 Mgal/d. When the powerplant is not operating, the valves on the pipelines to the plant are closed, and there is no leakage through the system. The results of the measurements and inspections made during the report year and previous years indicate that the reported record of diversions through the West Delaware Tunnel was substantially correct.

The Neversink Tunnel is used to divert water from Neversink Reservoir to Rondout Reservoir. One current-meter measurement of flow from Neversink Tunnel was made during the report year. This measurement, and one measurement made at the end of the 1997 report year, showed that on average, results from the venturi instruments and totalizer were 6.4 percent larger, and results from the instruments and rate-of-flow indicator were 5.7 percent larger, than the current-meter measurements.

A hydroelectric plant uses water diverted through the Neversink Tunnel. When the powerplant is not operating and the main valve on the diversion tunnel is open, leakage develops that is not recorded on the venturi instruments. On the basis of previous measurements, the average rate of leakage was about 14.0 ft^3/s (9.0 Mgal/d). When the powerplant was operating, the leakage was included in the recorded flow. No leakage occurs when the main valve on the tunnel is closed.

During the 1998 report year, the powerplant operated part of the day on most days and was not operated the equivalent of 225 days. Using the average leakage rate and records of powerplant operation, slightly more than 2.0 Bgal of water was diverted but not recorded.

DIVERSIONS BY NEW JERSEY

The Amended Decree authorizes New Jersey to divert water from the Delaware River or its tributaries in New Jersey, to areas outside the Delaware River Basin, without compensating releases. These diversions may not exceed 100 Mgal/d (154.7 ft^3/s) as a monthly average, and the diversion on any day may not exceed 120 Mgal/d (185.6 ft^3/s). The U.S. Geological Survey streamflow-gaging station on Delaware and Raritan Canal at Port Mercer, New Jersey (fig. 1) is used as the official control point for measuring the diversions by New Jersey (table 18).

The following tabulation lists the allowable diversion by New Jersey, the period it was in effect, and the maximum monthly diversion during the report year:

Effective dates	Allowable monthly average diversion Mgal/d	Maximum monthly average diversion (Mgal/d)	Month of maximum average diversion
Dec. 1, 1997 to Nov. 30, 1998	100	103	October 1998

The maximum daily diversion was 107 Mgal on October 22, 23, 25-30, 1998. The actual October 1998 average diversion by New Jersey, measured at Port Mercer, was slightly greater than the limit stipulated by the Decree. During October 1998, streamflow data collected at the Port Mercer gaging station indicated that the New Jersey diversion was within the legal limit. Recomputation of the October flow data in November 1998, however, resulted in a monthly average diversion of 103 Mgal/d. Because of the post-October timing of the recomputation, New Jersey is considered to have complied with the terms of the Decree during October 1998 and all other months of the River Master year.

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

From December 1, 1997 to January 15, 1998, operations of the Delaware River Master were conducted as prescribed by the "Interstate Water Management Recommendations of the Parties to the Decree (DRBC Resolution 83-13)," which were designed to alleviate drought-warning conditions in the basin. From January 16 to November 23, 1998; operations were conducted as stipulated by the Decree and from November 24 to 30, 1998 as specified by unanimous agreement of the Parties to the Decree.

Diversions from the Delaware River Basin to the New York City water-supply system were less than those authorized by the Decree and the "Interstate Water Management Recommendations of the Parties to the Decree."

Under compensating releases of the Montague Formula, New York City released water from its reservoirs at rates designed by the River Master to maintain the applicable flow objectives at Montague. During the report year, New York City complied fully with the directives of the River Master.

Diversions from the Delaware River Basin by New Jersey were within limits prescribed by the Decree. New Jersey complied fully with the requests of the River Master.

Table 1. Precipitation in the Delaware River basin above Montague, N.J.
[All values, except percentages, in inches]

Month	December 1940 to November 1997 Monthly Average	December 1997 to November 1998			
		Amount	Percentage of average	Excess (+) or deficit (-)	
				Month	Cumulative
December	3.40	3.59	106	+0.19	+0.19
January	2.95	3.92	133	+.97	+1.16
February	2.65	2.95	111	+.30	+1.46
March	3.29	3.94	120	+.65	+2.11
April	3.77	4.67	124	+.90	+3.01
May	4.17	5.44	130	+1.27	+4.28
June	3.88	7.42	191	+3.54	+7.82
July	4.13	3.53	85	-.60	+7.22
August	3.92	1.28	33	-2.64	+4.58
September	3.76	2.90	77	-.86	+3.72
October	3.40	3.37	99	-.03	+3.69
November	3.91	1.58	40	-2.33	+1.36
12 months	43.23	44.59	103	+1.36	

Table 2. Conservation release rates for New York City reservoirs in the Delaware River Basin
[All values in cubic feet per second]

Reservoir	Operative dates	Conservation release rates		
		Basic	Augmented	Experimental
Pepacton	January 1 to March 31	6	50	45
	April 1-7	6	70	45
	April 8-30	19	70	45
	May 1-31	19	70	70
	June 1 to August 31	19	70	95
	September 1-30	19	70	70
	October 1-31	19	70	45
	November 1 to December 31	6	50	45
Cannonsville	January 1 to March 31	8	33	45
	April 1-15	8	45	45
	April 16 to May 31	23	45	45
	June 1-14	23	45	160
	June 15 to August 15	23	325	160
	August 16 to September 15	23	45	160
	September 16 to October 31	23	45	45
	November 1-30	23	33	45
	December 1-31	8	33	45
Neversink	January 1 to March 31	5	25	25
	April 1-7	5	45	25
	April 8-30	15	45	25
	May 1 to September 30	15	45	53
	October 1-31	15	45	25
	November 1 to December 31	5	25	25

Table 3. Summary of releases during administration of emergency fishery protection program

[All values in cubic feet per second (ft^3/s) except Cumulative Fishery in cubic feet per second-days ($ft^3/s \cdot d$)

Design Date 1997	Daily mean flow at Trenton on previous day	Montague Date 1997	Directed Releases				Pepacton Reservoir				Cannonsville Reservoir				Neversink Reservoir				Cumulative Fishery	
			Defi-ciency	Bal. Adj.	Fishery reduction	Directed	Directed	Conser-vation	Fishery release	Total	Directed	Conser-vation	Fishery release	Total	Directed	Conser-vation	Fishery release	Total	Reduc-tions	Releases
Nov. 28	6,760	Dec. 1	0	-50	0	0	0	6	13	19	0	26	0	26	0	5	10	15	400	644
29	6,260	2	0	-50	0	0	0	6	13	19	0	26	0	26	0	5	10	15	400	667
30	6,120	3	0	-50	0	0	0	6	13	19	0	14	12	26	0	5	10	15	400	702
Dec. 1	6,430	4	0	-50	0	0	0	6	13	19	0	13	15	28	0	5	10	15	400	740
2	6,380	5	0	-50	0	0	0	6	13	19	0	13	15	28	0	5	10	15	400	778
3	8,010	6	0	-50	0	0	0	6	13	19	0	13	15	28	0	5	10	15	400	816
4	10,800	7	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	854
5	9,630	8	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	892
6	8,570	9	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	930
7	8,080	10	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	968
8	7,940	11	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,006
9	7,590	12	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,044
10	6,940	13	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,082
11	6,790	14	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,120
12	6,850	15	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,158
13	6,220	16	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,196
14	5,900	17	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,234
15	6,020	18	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,272
16	5,400	19	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,310
17	5,130	20	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	0	5	400	1,338
18	4,930	21	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	400	1,376
19	4,770	22	150	-50	43	57	19	0	0	19	23	0	0	23	15	0	0	15	443	1,376
20	5,040	23	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,414
21	4,570	24	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,452
22	4,540	25	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,490
23	4,440	26	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,528
24	4,540	27	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,566
25	4,820	28	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,603
26	6,410	29	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,640
27	8,640	30	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,677
28	8,510	31	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	1,715

Table 3. Summary of releases during administration of emergency fishery protection program (Continued)

[All values in cubic feet per second (ft^3/s) except Cumulative Fishery in cubic feet per second-days ($ft^3/s \cdot d$)

Design Date	Daily mean flow at Trenton on previous day	Montague Date	Directed Releases				Pepacton Reservoir				Cannonsville Reservoir				Neversink Reservoir				Cumulative Fishery	
1997/98		1997/98	Defi-ciency	Bal. Adj.	Fishery reduction	Directed	Directed	Conser-vation	Fishery release	Total	Directed	Conser-vation	Fishery release	Total	Directed	Conser-vation	Fishery release	Total	Reduc-tions	Releases
Dec. 29	8,890	Jan. 1	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,752
30	9,180	2	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,789
31	14,000	3	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,826
Jan. 1	12,700	4	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,863
2	10,500	5	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,900
3	8,550	6	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,937
4	7,510	7	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	1,974
5	8,390	8	0	-50	0	0	0	6	13	19	0	8	14	22	0	5	10	15	443	2,011
6	8,270	9	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	10	15	443	2,049
7	10,300	10	0	-50	0	0	0	6	13	19	0	8	15	23	0	5	9	14	443	2,086
8	18,300	11	0	-50	0	0	0	6	13	19	0	8	7	15	0	5	0	5	443	2,106
9	29,100	12	0	-50	0	0	0	6	0	6	0	8	0	8	0	5	0	5	443	2,106
10	49,400	13	0	-50	0	0	0	6	0	6	0	8	0	8	0	5	0	5	443	2,106
11	60,200	14	0	-50	0	0	0	6	0	6	0	8	0	8	0	5	0	5	443	2,106
12	45,900	15	0	-50	0	0	0	6	0	6	0	8	0	8	0	5	0	5	443	2,106
13	32,400	16	0	-50	0	0	0	6	0	6	0	8	0	8	0	5	1	6	443	2,107
14	24,500	17	0	-50	0	0	0	6	0	6	0	8	9	17	0	5	10	15	443	2,126
15	20,300	17	0	-50	0	0	0	6	13	19	0	10	15	25	0	5	10	15	443	2,164
16	17,800	19	0	-50	0	0	0	6	13	19	0	10	15	25	0	5	10	15	443	2,202
17	18,600	20	0	-50	0	0	0	6	13	19	0	10	15	25	0	5	10	15	443	2,240
18	19,100	21	0	-50	0	0	0	6	13	19	0	10	15	25	0	5	10	15	443	2,278
19	20,100	22	0	-50	0	0	0	6	13	19	0	11	15	26	0	5	10	15	443	2,316
20	18,000	23	0	-50	0	0	0	6	13	19	0	8	12	20	0	5	10	15	443	2,351
21	16,400	24	0	-50	0	0	0	6	13	19	0	11	15	26	0	5	10	15	443	2,389
22	15,000	25	0	-50	0	0	0	6	13	19	0	11	15	26	0	12	7	19	443	2,424
23	13,600	26	0	-50	0	0	0	12	10	22	0	32	5	37	0	25	0	25	443	2,439
24	15,000	27	0	-50	0	0	The emergency fishery protection program became effective on October 27, 1997. The first release made under this program was designed on November 28, 1997 and arrived at Montague on December 1, 1997. The program of experimental conservation releases was restored at 8:00 a.m. on January 24, 1998, when combined storage in the New York City Delaware River Basin Reservoirs remained more than 25 billion gallons above the drought-warning zone for 15 consecutive days. Fishery releases were suspended at that time but the potential for reduction in directed releases existed until February 24, 1998, when Cannonsville Reservoir filled to capacity and began spilling.															443	2,439
25	23,800	28	0	-50	0	0													443	2,439
26	19,200	29	0	-50	0	0													443	2,439
27	17,400	30	0	-50	0	0													443	2,439
28	15,500	31	0	-50	0	0													443	2,439

Table 4. Storage in Pepacton Reservoir, N.Y. for year ending November 30, 1998
[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 hours)

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	65,299	69,399	102,085	105,352	132,701	140,653	139,804	140,801	134,986	120,735	107,492	96,552
2	65,653	69,599	102,070	106,116	134,931	140,523	139,785	140,950	134,534	120,378	106,916	96,204
3	65,958	69,864	101,867	106,724	136,981	140,634	139,895	140,987	133,959	120,004	106,292	95,932
4	66,289	70,256	101,883	107,172	138,314	140,765	139,914	140,653	133,635	119,597	106,004	95,523
5	66,831	71,312	101,945	107,460	139,472	141,190	139,767	140,505	133,204	119,019	105,494	95,207
6	67,423	72,717	101,789	107,621	140,338	141,320	139,656	140,394	132755	118,529	105,018	94,695
7	67,933	75,652	101,680	108,007	140,950	141,506	139,491	140,320	132,379	118,107	104,510	94,321
8	68,320	79,236	101,727	107,975	141,320	141,468	139,289	140,375	131,809	117,669	104,240	93,886
9	68,432	84,383	101,820	108,524	141,338	141,506	139,050	142,062	131,398	117,232	104,082	93,452
10	68,532	90,379	101,617	111,955	141,727	141,598	139,068	141,987	130,919	116,897	103,782	92,976
11	68,581	93,422	101,320	115,110	141,617	142,174	138,866	141,561	130,475	116,478	103,547	92,679
12	68,656	95,418	101,258	117,031	141,598	142,360	138,774	141,172	130,014	116,076	103,215	92,279
13	68,656	96,780	101,382	118,327	141,543	142,155	138,866	140,950	129,554	115,592	102,790	92,086
14	68,656	97,877	101,351	119,461	141,524	141,931	139,859	140,708	129,130	115,160	102,523	92,012
15	68,556	98,705	101,133	120,429	141,431	141,746	142,584	140,523	128,602	114,694	102,210	91,041
16	68,544	99,366	101,242	120,992	141,449	141,654	142,734	140,338	128,128	114,313	101,976	90,952
17	68,544	100,140	100,978	121,694	141,468	141,506	142,528	140,246	127,846	113,865	101,351	90,672
18	68,432	100,652	100,838	121,985	141,079	141,375	142,472	140,061	127,372	113,371	101,039	90,321
19	68,357	101,086	101,101	122,327	140,987	141,005	142,192	139,840	126,971	112,942	100,559	89,913
20	68,320	101,320	101,273	123,015	141,580	140,838	141,820	139,472	126,464	112,398	100,373	89,505
21	68,195	101,538	101,758	123,600	141,654	140,560	141,524	139,234	125,975	112,053	99,939	89,170
22	68,096	101,789	102,101	124,395	141,524	140,357	141,320	138,940	125,574	111,497	99,536	88,648
23	67,971	101,773	102,601	124,811	141,524	140,116	140,987	138,572	125,140	111,186	99,197	88,316
24	68,071	101,961	103,090	125,557	141,449	139,895	140,801	138,277	124,603	110,631	98,782	87,926
25	68,195	102,132	103,515	125,975	141,153	139,767	140,671	137,875	124,257	110,160	98,598	87,667
26	68,320	102,227	103,893	126,464	140,876	139,491	140,486	137,510	123,722	109,738	98,275	87,352
27	68,432	102,227	104,288	127,058	140,820	139,179	140,024	137,036	123,308	109,234	97,923	86,995
28	68,569	102,258	104,653	127,934	140,690	139,216	139,969	136,654	122,688	108,846	97,679	86,508
29	68,769	102,242	- - -	129,377	140,597	139,234	139,712	136,290	122,207	108,427	97,389	86,037
30	68,769	102,227	- - -	130,617	140,597	139,326	139,656	135,892	121,745	107,943	97,130	85,668
31	69,222	102,101	- - -	131,791	- - -	139,381	- - -	135,475	121,300	- - -	96,902	- - -
Change	+4,252	+32,879	+2,552	+27,138	+8,806	-1,216	+275	-4,181	-14,175	-13,357	-11,041	-11,234
Equiv. Mgal/d	+137.2	+1,061	+91.1	+875.4	+293.5	-39.2	+9.2	-134.9	-457.3	-445.2	-356.2	-374.5
Equiv. ft^3/s	+212	+1,641	+141	+1,354	+454	-60.7	+14.2	-209	-707	-689	-551	-579

Change for year +20,698 Mgal — Equiv. for year +56.7 Mgal/d — Equiv. for year +87.7 ft^3/s

Table 5. Storage in Cannonsville Reservoir, N.Y. for year ending November 30, 1998
[Storage in millions of gallons above elevation 1,040.00 ft. Add 2,584 million gallons for total contents above sill 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 hours)

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	31,489	40,745	86,337	97,218	98,909	97,621	95,219	97,830	91,233	65,930	50,134	36,915
2	32,398	40,882	86,684	97,814	99,376	97,621	95,295	98,104	90,549	65,217	49,679	36,023
3	32,880	41,123	86,886	98,233	99,376	97,621	95,463	97,959	89,986	64,644	48,759	35,142
4	33,477	41,680	87132	98,265	99,327	97,943	95,660	97,524	89,393	63,931	48,125	34,310
5	34,151	42,962	87,406	98,249	98,989	98,039	95,645	97,557	88,617	63,294	47,636	33,447
6	34,775	45,223	87,551	98,039	98,812	98,023	95,508	97,557	87,927	62,505	47,102	32,592
7	35,241	48,248	87,739	97,895	98,555	98,023	95,417	97,154	86,872	61,995	46,568	31,879
8	35,766	51,977	87,927	97,669	98,297	98,007	95,295	96,993	86,005	61,944	46,424	31,174
9	36,231	58,827	88,191	97,685	98,249	97,911	95,189	99,585	85,022	61,766	46,457	30,562
10	36,598	65,408	88,328	99,392	98,506	98,056	95,113	100,100	84,241	61,753	46,490	29,913
11	37,034	69,437	88,572	100,776	98,603	98,603	94,991	99,295	83,432	61,269	46,768	29,663
12	37,410	71,821	88,876	100,212	98,506	98,973	94,930	98,619	82,391	60,768	46,791	29,153
13	37,728	73,424	89,636	99,520	98,329	98,989	95,113	97,991	81,452	59,902	46,902	28,625
14	38,064	74,837	90,214	98,989	98,217	98,828	95,947	97,476	80,391	59,364	47,147	28,260
15	38,360	75,984	90,625	98,651	98,072	98,603	97,202	97,170	79,603	58,839	47,291	27,800
16	38,580	76,951	90,959	98,410	98,007	98,410	98,120	96,897	78,636	58,375	47,258	27,366
17	38,727	78,291	91,401	98,120	97,911	98,039	98,490	96,591	77,697	57,899	47,136	26,847
18	38,801	79,244	91,873	97,911	97,846	97,927	98,748	96,414	76,716	56,971	46,891	26,464
19	38,864	79,963	92,664	97,830	97,637	97,782	98,925	96,173	75,929	56,129	46,490	25,911
20	38,917	80,820	93,501	97,943	98,201	97,557	98,410	95,803	74,989	55,396	45,946	25,307
21	38,959	81,495	94,276	98,394	98,844	97,476	98,007	95,600	74,188	54,848	45,301	24,719
22	38,938	82,102	94,854	98,571	98,941	97,379	97,701	95,219	73,424	54,217	44,645	24,187
23	38,938	82,724	95,493	98,490	98,909	97,283	97,412	94,991	72,470	53,587	43,988	23,900
24	38,938	83,186	96,157	98,362	98,619	97,202	97,090	94,504	71,795	53,062	43,162	23,861
25	38,980	83,778	96,704	98,136	98,458	97,041	96,897	94,246	70,814	52,479	42,310	23,118
26	39,116	84,241	96,848	98,088	98,265	97,090	96,575	93,881	70,192	51,663	41,501	22,631
27	39,432	84,661	96,832	98,426	98,120	96,704	96,285	93,622	69,212	51,009	40,588	22,268
28	39,610	85,036	96,913	98,732	98,023	95,963	96,044	93,227	68,457	50,729	39,821	22,229
29	39,852	85,398	---	99,022	97,878	95,508	95,819	92,831	67,848	50,519	39,137	22,252
30	39,989	85,672	---	99,006	97,782	95,311	95,915	92,436	67,114	50,449	38,486	22,237
31	40,336	86,019	---	98,925	---	95,006	---	91,994	66,516	---	37,807	---
Change	+9,496	+45,683	+10,894	+2,012	-1,143	-2,776	+909	-3,921	-25,478	-16,067	-12,642	-15,570
Equiv. Mgal/d	+3,06.3	+1,474	+389.1	+64.9	-38.1	-89.5	+30.3	-126.5	-821.9	-535.6	-407.8	-519.0
Equiv. ft^3/s	+474	+2,280	+602	+100	-58.9	-139	+46.9	-196	-1,271	-829	-631	-803
Change for year -8,603 Mgal					Equiv. for year -23.6 Mgal/d					Equiv. for year -36.5 ft^3/s		

Table 6. Storage in Neversink Reservoir, N.Y. for year ending November 30, 1998
[Storage in millions of gallons above elevation 1,319.00 ft. Add 525 million gallons for total contents above sill of outlet tunnel, elevation 1,314.00 ft. Storage at spillway level is 34,941 million gallons]
(River Master daily operations record; gage reading at 0800 hours)

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	15,883	17,079	25,300	24,267	30,364	32,624	34,448	34,705	33,163	27,528	19,217	14,517
2	16,086	17,155	25,238	24,360	30,970	32,624	34,508	34,981	33,043	27,313	18,913	14,393
3	16,231	17,264	25,122	24,437	31,299	32,742	34,616	34,779	32,929	27,150	18,575	14,296
4	16,361	17,332	25,023	24,405	31,438	33,024	34,562	34,774	32,786	26,945	18,243	14,206
5	16,537	17,674	24,936	24,568	31,522	33,360	34,503	34,749	32,628	26,714	17,956	14,086
6	16,648	17,900	24,957	24,686	31,518	33,746	34,428	34,700	32,496	26,490	17,650	13,991
7	16,759	18,398	24,908	24,666	31,532	34,032	34,443	34,670	32,245	26,274	17,336	13,877
8	16,854	19,694	24,826	24,662	31,527	34,042	34,453	34,621	32,047	26,081	17,039	13,780
9	16,938	22,498	24,707	24,731	31,522	33,983	34,483	34,665	31,818	25,883	16,934	13,686
10	17,042	23,765	24,649	26,215	31,695	33,959	34,508	34,720	31,634	25,625	16,712	13,580
11	17,206	24,364	24,560	27,154	31,832	35,438	34,503	34,655	31,443	25,416	16,611	13,508
12	17,213	24,580	24,515	27,404	31,882	35,389	34,572	34,635	31,257	25,205	16,368	13,553
13	17,298	24,916	24,617	27,477	31,860	35,209	34,720	34,562	31,030	24,965	16,126	13,520
14	17,384	25,167	24,585	27,597	31,911	35,214	35,041	34,503	30,859	24,748	15,867	13,439
15	17,456	25,354	24,494	27,740	32,019	35,125	35,578	34,428	30,666	24,548	15,722	13,364
16	17,514	25,437	24,453	27,831	32,155	35,031	35,379	34,335	30,465	24,308	15,447	13,391
17	17,525	25,608	24,368	27,875	32,283	34,931	35,309	34,257	30,429	24,088	15,222	13,340
18	17,466	25,662	24,360	27,813	32,283	34,779	35,224	34,199	30,055	23,846	14,933	13,239
19	17,395	25,712	24,490	27,870	32,217	34,803	35,194	34,209	29,964	23,525	14,693	13,123
20	17,346	25,708	24,474	28,045	32,472	34,759	34,941	34,238	29,737	23,199	14,668	13,144
21	17,254	25,691	24,445	28,263	32,757	34,631	34,734	34,219	29,549	22,909	14,546	12,971
22	17,151	25,642	24,356	28,464	32,885	34,513	34,503	34,155	29,311	22,583	14,568	12,906
23	17,103	25,650	24,267	28,614	32,991	34,379	34,340	33,993	29,155	22,303	14,574	12,752
24	17,059	25,542	24,189	28,609	32,991	34,272	34,345	33,906	28,981	21,977	14,574	12,784
25	17,039	25,595	24,132	28,655	32,914	34,184	34,345	33,838	28,839	21,676	14,586	12,816
26	17,127	25,549	24,144	28,650	32,838	34,106	34,335	33,756	28,694	21,264	14,602	12,540
27	17,079	25,500	24,144	28,716	32,810	34,130	34,248	33,669	28,548	20,871	14,605	12,514
28	17,079	25,424	24,197	28,888	32,738	34,165	34,214	33,577	28,377	20,502	14,624	12,476
29	16,982	25,374	- - -	29,347	32,719	34,238	34,155	33,504	28,180	20,064	14,634	12,424
30	16,941	25,391	- - -	29,814	32,671	34,281	34,150	33,393	27,953	19,649	14,611	12,386
31	17,148	25,354	- - -	30,100	- - -	34,335	- - -	33,288	27,749	- - -	14,611	- - -
Change	+1,510	+8,206	-1,157	+5,903	+2,571	+1,664	-185	-862	-5,539	-8,100	-5,038	-2,225
Equiv. Mgal/d	+48.7	+264.7	-41.3	+190.4	+85.7	+53.7	-6.2	-27.8	-178.7	-270.0	-162.5	-74.2
Equiv. ft^3/s	+75.4	+410	-63.9	+295	+133	+83.0	-9.5	-43.0	-276	-418	-251	-115
Change for year -3,252 Mgal					Equiv. for year -8.9 Mgal/d					Equiv. for year -13.8 ft^3/s		

Table 7. Design rates for Delaware River at Montague, N.J. gaging station, December 1, 1997 to November 30, 1998
[Rates in cubic feet per second]

Effective dates	Montague Design Rate
December 1, 1997 to January 15, 1998	1,655
January 16 to June 14, 1998	1,750
June 15 to October 11, 1998	1,850
October 12 to November 23, 1998	1,750
November 24 - 30, 1998	1,655

Table 8. Consumption of Water by New York City - 1950 to 1998
Data furnished by New York City, Department of Environmental Protection
Bureau of Water Supply
[Mgal/d, million gallons per day; Bgal, billion gallons]

Year	Average daily consumption			Annual Consumption (Bgal)
	City Proper (Mgal/d)	Outside Communities (Mgal/d)	Total (Mgal/d)	
1950	953.3	29.1	982.4	358.576
51	1,041.9	28.1	1,070.0	390.550
52	1,087.0	32.7	1,119.7	409.810
53	1,093.9	44.6	1,138.5	415.552
54	1,063.4	46.3	1,109.7	405.040
1955	1,109.9	45.3	1,155.2	421.648
56	1,111.3	48.9	1,160.2	424.633
57	1,169.0	57.2	1,226.2	447.563
58	1,152.9	49.6	1,202.5	438.912
59	1,204.3	60.3	1,264.6	461.579
1960	1,199.4	58.9	1,258.3	460.529
61	1,221.0	64.0	1,285.0	469.022
62	1,207.6	68.8	1,276.4	465.896
63	1,218.0	76.7	1,294.7	472.582
64	1,189.2	79.4	1,268.6	464.295
1965	1,052.1	71.2	1,123.3	409.995
66	1,044.9	73.2	1,118.1	408.128
67	1,135.3	71.0	1,206.3	440.302
68	1,242.0	78.2	1,320.2	483.175
69	1,328.7	80.1	1,408.8	514.229
1970	1,400.3	90.4	1,490.7	544.116
71	1,423.6	87.9	1,511.5	551.695
72	1,412.4	83.0	1,495.4	547.340
73	1,448.9	95.4	1,544.3	563.681
74	1,441.8	96.3	1,538.1	561.409
1975	1,415.0	92.1	1,507.1	550.093
76	1,435.0	95.8	1,530.8	560.264
77	1,483.0	104.7	1,587.7	579.510
78	1,479.4	103.0	1,582.4	577.566
79	1,513.0	104.6	1,617.6	590.426
1980	1,506.3	110.1	1,616.3	591.582
81	1,309.5	100.0	1,409.5	514.475
82	1,383.0	104.8	1,487.8	543.060
83	1,424.2	112.6	1,536.8	561.010
84	1,465.2	113.9	1,579.1	577.963
1985	1,325.4	106.5	1,431.9	522.656
86	1,351.1	115.2	1,466.3	535.200
87	1,447.1	119.8	1,566.9	571.885
88	1,484.3	125.6	1,609.9	589.090
89	1,402.0	113.4	1,515.4	553.158
1990	1,424.4	122.4	1,546.8	564.577
91	1,469.9	123.6	1,593.5	581.628
92	1,368.7	113.9	1,482.6	542.632
93	1,368.9	118.8	1,487.7	543.011
94	1,357.8	119.2	1,477.0	539.105
1995	1,326.1	123.1	1,449.2	528.958
96	1,283.5	120.2	1,403.7	512.351
97	1,201.3	123.5	1,324.8	483.552
98	1,220.0	124.7	1,344.7	490.816

Table 9. Summary of daily operations during administration of Lower Basin Drought Plan for the Delaware River at Montague and Trenton, N.J.
[All values in cubic feet per second except quantity remaining in excess release bank is in cubic feet per second days]

Design date 1998	Supply exclusive of NYC release	Deficiency	Balancing adjustment	Release directed for Montague flow objective	DRBC request for Trenton flow objective	Total directed release	Montague date 1998	Montague flow	Trenton flow (2 days later)	Excess release bank	
										Amount released	Quantity remaining
Oct. 13	1,652	98	-100	0	0	0	Oct. 16	1,920	4,220	0	2,303
14	2,001	0	-100	0	0	0	17	1,880	4,080	0	2,303
15	1,675	75	-100	0	0	0	18	1,550	3,330	0	2,303
16	1,318	432	-100	332	0	332	19	1,330	3,020	0	2,303
17	1,141	609	-100	509	0	509	20	1,460	2,920	0	2,303
18	1,006	744	-100	644	0	644	21	1,570	2,930	0	2,303
19	958	792	-80	712	0	712	22	1,630	2,980	0	2,303
20	816	934	-38	896	0	896	23	1,750	3,090	0	2,303
21	756	994	-9	985	0	985	24	1,790	3,120	0	2,303
22	725	1,025	+9	1,034	0	1,034	25	1,910	3,180	0	2,303
23	691	1,059	+21	1,080	100	1,180	26	1,950	3,230	100	2,203
24	647	1,103	+21	1,124	100	1,224	27	1,920	3,210	100	2,103
25	616	1,134	+17	1,151	100	1,251	28	1,980	3,290	100	2,003
26	644	1,106	+1	1,107	0	1,107	29	1,810	3,130	0	2,003
27	718	1,032	-9	1,023	0	1,023	30	1,760	3,000	0	2,003
28	770	970	-16	954	0	954	31	1,740	2,930	0	2,003

Table 9. Summary of daily operations during administration of Lower Basin Drought Plan for the Delaware River at Montague and Trenton, N.J. (Continued)
[All values in cubic feet per second except quantity remaining in excess release bank is in cubic feet per second days]

Design date 1998	Supply exclusive of NYC release	Deficiency	Balancing adjustment	Release directed for Montague flow objective	DRBC request for Trenton flow objective	Total directed release	Montague date 1998	Montague flow	Trenton flow (2 days later)	Excess release bank	
										Amount released	Quantity remaining
Oct. 29	714	1,036	-29	1,007	0	1,007	Nov. 1	1,690	2,840	0	2,003
30	710	1,040	-35	1,005	100	1,105	2	1,790	2,880	100	1,903
31	656	1,094	-36	1,058	100	1,158	3	1,820	2,900	100	1,803
Nov. 1	639	1,111	-35	1,076	100	1,176	4	1,830	2,880	100	1,703
2	617	1,133	-29	1,104	100	1,204	5	1,830	2,960	100	1,603
3	634	1,116	-23	1,093	100	1,193	6	1,840	3,260	100	1,503
4	611	1,139	-20	1,119	100	1,219	7	1,820	3,090	100	1,403
5	604	1,146	-18	1,128	100	1,228	8	1,840	2,830	100	1,303
6	605	1,145	-16	1,129	100	1,229	9	1,880	2,980	100	1,203
7	599	1,151	-15	1,136	100	1,236	10	1,780	3,250	100	1,103
8	628	1,122	-12	1,110	100	1,210	11	1,890	3,370	100	1,003
9	1,034	716	-11	705	0	705	12	1,550	2,920	0	1,003
10	1,007	743	-14	729	0	729	13	1,740	2,990	0	1,003
11	718	1,032	-7	1,025	0	1,025	14	2,000	3,180	0	1,003
12	861	889	-11	878	0	878	15	1,780	2,940	0	1,003
13	881	869	+9	878	0	878	16	1,710	2,830	0	1,003
14	885	865	+10	875	0	875	17	1,680	2,750	0	1,003
15	822	928	-17	911	0	911	18	1,710	2,810	0	1,003
16	761	989	-20	969	0	969	19	1,710	2,830	0	1,003
17	771	979	-16	963	0	963	20	1,710	2,830	0	1,003
18	740	1,010	-9	1,001	0	1,001	21	1,780	2,840	0	1,003
19	714	1,036	-5	1,031	100	1,131	22	1,910	2,950	100	903
20	693	1,057	-1	1,056	0	1,056	23	1,830	2,890	0	903
21	819	836	+3	839	0	839	24	1,640	2,810	0	903
22	797	858	0	858	0	858	25	1,610	3,550	0	903
23	779	876	-6	870	0	870	26	1,720	3,950	0	903
24	806	849	-14	835	0	835	27	1,940	3,720	0	903
25	899	756	-13	743	0	743	28	2,320	3,930	0	903
26	1,143	512	-8	504	0	504	29	1,990	3,480	0	903
27	1,408	247	-15	232	0	232	30	1,560	2,980	0	903

Table 10. New York City Reservoir release design data
(River Master daily operation record)
[ft^3/s, cubic feet per second; $(ft^3/s)\cdot d$, cubic feet per second days]

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague, NJ exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Current condition ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Montague Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative $(ft^3/s)\cdot d$	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment ft^3/s
1997/1998	1	2	3	4		5	6	7	8	9	10	11	12	13	14
MONTAGUE DESIGN RATE = 1,655 ft^3/s -- DECEMBER 1, 1997 TO JANUARY 15, 1998															
The estimated discharge at Montague was greater than the Montague design rate Dec. 1, 1997 to Dec. 21, 1998															
Dec. 19	0	0	1,505	0	Dec. 22	1,505	150	-50	100	57	2,756	0	2,151	605	-50
The estimated discharge at Montague was greater than the Montague design rate Dec. 23, 1997 to Jan. 15, 1998															
MONTAGUE DESIGN RATE = 1,750 ft^3/s -- JANUARY 16, 1998 TO JUNE 14, 1998															
The estimated discharge at Montague was greater than the Montague design rate Jan. 16, 1998 to June 14, 1998															
MONTAGUE DESIGN RATE = 1,850 ft^3/s -- JUNE 15, 1998 TO OCTOBER 11, 1998															
The estimated discharge at Montague was greater than the Montague design rate June 15, 1998 to July 25, 1998															
July 23	0	71	1,320	28	July 26	1,419	431	0	431	431	431	348	348	83	-8
24	0	170	1,325	0	27	1,495	355	0	355	355	786	531	879	-93	+9
25	417	355	1,215	0	28	1,987	0	0	0	0	786	111	990	-204	+20
26	417	355	1,137	0	29	1,909	0	0	0	0	786	8	998	-212	+21
27	417	177	1,066	26	30	1,686	164	-8	156	156	942	263	1,261	-319	+32
28	417	0	999	0	31	1,416	434	+9	443	443	1,385	230	1,491	-106	+11

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 quantitative precipitation 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. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7 from Table 10.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 10), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15, 1998 to November 30, 1998.

Table 10. New York City Reservoir release design data - Continued
(River Master daily operation record)
[ft^3/s, cubic feet per second; $(ft^3/s)\cdot d$, cubic feet per second days]

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague, NJ exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Current condition ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Montague Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative $(ft^3/s)\cdot d$	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment ft^3/s
1998	1	2	3	4		5	6	7	8	9	10	11	12	13	14
July 29	417	0	969	0	Aug. 1	1,386	464	+20	484	485	1,870	505	1,996	-126	+13
30	0	0	930	0	2	930	920	+21	941	940	2,810	1,030	3,026	-216	+22
31	0	0	916	0	3	916	934	+32	966	967	3,777	897	3,923	-146	+15
Aug. 1	257	142	884	0	4	1,283	567	+11	578	581	4,358	621	4,544	-186	+19
2	257	142	827	0	5	1,226	624	+13	637	640	4,998	770	5,314	-316	+32
3	257	0	686	0	6	943	907	+22	929	926	5,924	1,096	6,410	-486	+49
4	0	0	661	0	7	661	1,189	+15	1,204	1,205	7,129	1,185	7,595	-466	+47
5	0	71	657	0	8	728	1,122	+19	1,141	1,142	8,271	1,032	8,627	-356	+36
6	0	0	637	0	9	637	1,213	+32	1,245	1,244	9,515	1,204	9,831	-316	+32
7	0	0	608	0	10	608	1,242	+49	1,291	1,291	10,806	1,271	11,102	-296	+30
8	0	0	616	27	11	643	1,207	+47	1,254	1,254	12,060	1,174	12,276	-216	+22
9	0	0	591	217	12	808	1,042	+36	1,078	1,078	13,138	1,158	13,434	-296	+30
10	0	0	583	46	13	629	1,221	+32	1,253	1,258	14,396	1,178	14,612	-216	+22
11	0	0	632	3	14	635	1,215	+30	1,245	1,245	15,641	1,245	15,857	-216	+22
12	0	0	628	0	15	628	1,222	+22	1,244	1,244	16,885	1,164	17,021	-136	+14
13	0	0	597	0	16	597	1,253	+30	1,283	1,282	18,167	1,222	18,243	-76	+8
14	0	0	571	0	17	571	1,279	+22	1,301	1,304	19,471	1,144	19,387	+84	-8
15	0	0	531	0	18	531	1,319	+22	1,341	1,343	20,814	1,143	20,530	284	-28
16	0	0	522	0	19	522	1,328	+14	1,342	1,342	22,156	1,012	21,542	614	-61
17	0	0	642	23	20	665	1,185	+8	1,193	1,196	23,352	1,186	22,728	624	-62
18	0	0	680	6	21	686	1,164	-8	1,156	1,156	24,508	1,206	23,934	574	-57
19	0	0	779	0	22	779	1,071	-28	1,043	1,046	25,554	1,166	25,100	454	-45
20	0	71	739	0	23	810	1,040	-61	979	979	26,533	1,179	26,279	254	-25
21	0	0	632	0	24	632	1,218	-62	1,156	1,156	27,689	1,266	27,545	144	-14
22	257	0	603	21	25	881	969	-57	912	913	28,602	823	20,368	234	-23
23	0	0	532	6	26	538	1,312	-45	1,267	1,268	29,870	868	29,236	634	-63
24	197	142	529	23	27	896	959	-25	934	934	30,804	974	30,210	594	-59
25	0	142	512	12	28	666	1,184	-14	1,170	1,166	31,970	826	31,036	934	-93
26	0	0	564	0	29	564	1,286	-23	1,263	1,264	33,234	1,294	32,330	904	-90
27	0	0	542	21	30	563	1,287	-63	1,224	1,228	34,462	1,358	33,688	774	-77
28	0	0	509	0	31	509	1,341	-59	1,282	1,280	35,742	1,330	35,018	724	-72

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase iu runoff based on quantitative precipitation 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. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7 from Table 10.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 10), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Table 10. New York City Reservoir release design data - Continued
(River Master daily operation record)
[ft^3/s, cubic feet per second; $(ft^3/s)\cdot d$, cubic feet per second days]

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague, NJ exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Current condition ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Montague Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative $(ft^3/s)\cdot d$	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment ft^3/s
1998	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Aug. 29	0	0	480	8	Sept. 1	488	1,362	-93	1,269	1,269	37,011	1,379	36,397	614	-61
30	0	0	497	11	2	508	1,342	-90	1,252	1,250	38,261	1,410	37,807	454	-45
31	0	0	511	15	3	526	1,324	-77	1,247	1,244	39,505	1,314	39,121	384	-38
Sept. 1	0	0	482	20	4	502	1,348	-72	1,276	1,279	40,784	1,269	40,390	394	-39
2	0	71	469	16	5	556	1,294	-61	1,233	1,237	42,021	1,257	41,647	374	-37
3	0	0	546	0	6	546	1,304	-45	1,259	1,260	43,281	1,360	43,007	274	-27
4	0	0	498	0	7	498	1,352	-38	1,314	1,316	44,597	1,316	44,323	274	-27
5	0	0	481	0	8	481	1,369	-39	1,330	1,334	45,931	1,354	45,677	254	-25
6	840	0	448	49	9	1,337	513	-37	476	476	46,407	936	46,613	-206	+21
7	840	0	452	198	10	1,490	360	-27	333	333	46,740	941	47,554	-814	+81
8	840	0	550	14	11	1,404	446	-27	419	418	47,158	808	48,362	-1,204	+100
9	621	0	526	43	12	1,190	660	-25	635	635	47,793	905	49,267	-1,474	+100
10	0	0	456	12	13	468	1,382	+21	1,403	1,399	49,192	1,209	50,476	-1,284	+100
11	0	0	561	0	14	561	1,289	+81	1,370	1,371	50,563	1,391	51,867	-1,304	+100
12	417	0	504	6	15	927	923	+100	1,023	1,024	51,587	764	52,631	-1,044	+100
13	417	0	484	0	16	901	949	+100	1,049	1,049	52,636	929	53,560	-924	+92
14	417	0	463	21	17	901	949	+100	1,049	1,047	53,683	937	54,497	-814	+81
15	417	0	462	15	18	894	956	+100	1,056	1,056	54,739	936	55,433	-694	+69
16	417	0	474	6	19	897	953	+100	1,053	1,056	55,795	1,346	56,779	-984	+98
17	0	71	462	0	20	533	1,317	+92	1,409	1,410	57,205	1,310	58,089	-884	+88
18	0	0	439	10	21	449	1,401	+81	1,482	1,482	58,687	1,422	59,511	-824	+82
19	321	0	427	5	22	753	1,097	+69	1,166	1,162	59,849	832	60,343	-494	+49
20	321	0	412	5	23	738	1,112	+98	1,210	1,192	61,041	1,092	61,435	-394	+39
21	321	0	423	17	24	761	1,089	+88	1,177	1,171	62,212	901	62,336	-124	+12
22	321	0	428	130	25	879	971	+82	1,053	1,053	63,265	943	63,279	-14	+1
23	321	0	562	0	26	883	967	+49	1,016	1,020	64,285	930	64,209	76	-8
24	0	0	511	0	27	511	1,339	+39	1,378	1,381	65,666	1,281	65,490	176	-18
25	0	0	489	27	28	516	1,334	+12	1,346	1,347	67,013	1,317	66,807	206	-21
26	385	0	470	66	29	921	929	+1	930	931	67,944	511	67,318	626	-63
27	385	0	468	352	30	1,205	645	-8	637	637	68,581	547	67,865	716	-72

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 quantitative precipitation 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. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7 from Table 10.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 10), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Table 10. New York City Reservoir release design data - Continued
(River Master daily operation record)
[ft^3/s, cubic feet per second; $(ft^3/s)\cdot d$, cubic feet per second days]

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague, NJ exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Current condition ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Montague Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative $(ft^3/s)\cdot d$	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment ft^3/s
1998	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Sept. 28	385	0	1,066	18	Oct. 1	1,469	381	-18	363	365	68,946	605	68,470	476	-48
29	385	0	782	76	2	1,243	607	-21	586	588	69,534	938	69,408	126	-13
30	385	71	547	0	3	1,003	847	-63	784	788	70,322	848	70,256	66	-7
Oct. 1	0	0	463	0	4	463	1,387	-72	1,315	1,315	71,637	1,315	71,571	66	-7
2	0	0	530	0	5	530	1,320	-48	1,272	1,270	72,907	1,370	72,941	-34	+3
3	418	0	500	0	6	918	932	-13	919	919	73,826	869	73,810	16	-2
4	418	0	481	0	7	899	951	-7	944	943	74,769	993	74,803	-34	+3
5	418	0	464	0	8	882	968	-7	961	963	75,732	723	75,526	206	-21
6	418	0	463	277	9	1,158	692	+3	695	692	76,424	52	75,578	846	-85
7	418	0	459	482	10	1,359	491	-2	489	489	76,913	0	75,578	1,335	-100
8	0	0	536	1,604	11	2,140	0	+3	0	0	76,913	0	75,578	1,335	-100
MONTAGUE DESIGN RATE = 1,750 ft^3/s -- OCTOBER 12, 1998 TO NOVEMBER 23, 1998															
The estimated discharge at Montague was greater than the Montague design rate Oct. 12 to 13, 1998															
Oct. 11	291	0	1,750	35	Oct. 14	2,076	0	-100	0	0	76,913	103	75,681	1,232	-100
12	291	0	1,338	22	15	1,651	99	-100	0	0	76,913	113	75,794	1,119	-100
The estimated discharge at Montague was greater than the Montague design rate Oct. 16 to 17, 1998															
Oct. 15	0	71	1,574	30	Oct. 18	1,675	75	-100	0	0	76,913	316	76,110	803	-80
16	0	0	1,318	0	19	1,318	432	-100	332	328	77,241	748	76,858	383	-38
17	0	0	1,127	14	20	1,141	609	-100	509	506	77,747	796	77,654	93	-9
18	0	0	1,006	0	21	1,006	744	-100	644	647	78,394	827	78,481	-87	+9
19	0	0	958	0	22	958	792	-80	712	714	79,108	834	79,315	-207	+21
20	0	0	816	0	23	816	934	-38	896	891	79,999	891	80,206	-207	+21
21	0	0	756	0	24	756	994	-9	985	987	80,986	947	81,153	-167	+17
22	0	0	725	0	25	725	1,025	+9	1,034	1,035	82,021	875	82,028	-7	+1
23	0	0	691	0	26	691	1,059	+21	1,080	1,078	83,099	978	83,006	93	-9
24	0	0	647	0	27	647	1,103	+21	1,124	1,125	84,224	1,055	84,061	163	-16
25	0	0	616	0	28	616	1,134	+17	1,151	1,152	85,376	1,022	85,083	293	-29
26	0	0	644	0	29	644	1,106	+1	1,107	1,108	86,484	1,048	86,131	353	-35
27	0	0	694	24	30	718	1,032	-9	1,023	1,017	87,501	1,007	87,138	363	-36
28	0	71	674	35	31	780	970	-16	954	958	88,459	968	88,106	353	-35

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 quantitauve precipitation 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. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7 from Table 10.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 10), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Table 10. New York City Reservoir release design data - Continued
(River Master daily operation record)
[ft^3/s, cubic feet per second; $(ft^3/s)\cdot d$, cubic feet per second days]

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague, NJ exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack	Powerplant release forecasts: Rio Reservoir	Uncontrolled runoff: Current condition	Uncontrolled runoff: Weather adjustment	Montague Date	Discharge	Indicated deficiency	Balancing adjustment	Directed release	Computation of balancing adjustment: Adjusted directed release: Daily	Adjusted directed release: Cumulative	Actual deficiency: Daily	Actual deficiency: Cumulative	Cumulative difference	Balancing adjustment
	ft^3/s	ft^3/s	ft^3/s	ft^3/s		ft^3/s	ft^3/s	ft^3/s	ft^3/s	ft^3/s	$(ft^3/s)\cdot d$	ft^3/s	$(ft^3/s)\cdot d$	$(ft^3/s)\cdot d$	ft^3/s
1998	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Oct. 29	0	0	714	0	Nov. 1	714	1,036	-29	1,007	1,011	89,490	1,071	89,177	293	-29
30	0	0	695	15	2	710	1,040	-35	1,005	1,003	90,473	1,063	90,240	233	-23
31	0	0	656	0	3	656	1,094	-36	1,058	1,062	91,535	1,092	91,332	203	-20
Nov. 1	0	0	639	0	4	639	1,111	-35	1,076	1,081	92,616	1,101	92,433	183	-18
2	0	0	617	0	5	617	1,133	-29	1,104	1,104	93,720	1,124	93,557	163	-16
3	0	0	634	0	6	634	1,116	-23	1,093	1,092	94,812	1,102	94,659	153	-15
4	0	0	611	0	7	611	1,139	-20	1,119	1,105	95,917	1,135	95,794	123	-12
5	0	0	604	0	8	604	1,146	-18	1,128	1,130	97,047	1,140	96,934	113	-11
6	0	0	605	0	9	605	1,145	-16	1,129	1,129	98,176	1,099	98,033	143	-14
7	0	0	592	7	10	599	1,151	-15	1,136	1,138	99,314	1,208	99,241	73	-7
8	0	0	593	35	11	628	1,122	-12	1,110	1,110	100,424	1,070	100,311	113	-11
9	0	0	588	446	12	1,034	716	-11	705	709	101,133	909	101,220	-87	+9
10	0	0	577	430	13	1,007	743	-14	729	730	101,863	740	101,960	-97	+10
11	0	0	718	0	14	718	1,032	-7	1,025	1,024	102,887	754	102,714	173	-17
12	0	0	861	0	15	861	889	-11	878	882	103,769	852	103,566	203	-20
13	0	0	828	53	16	881	869	+9	878	879	104,648	919	104,485	163	-16
14	0	0	859	26	17	885	865	+10	875	878	105,526	948	105,433	93	-9
15	0	0	802	20	18	822	928	-17	911	912	106,438	952	106,385	53	-5
16	0	0	761	0	19	761	989	-20	969	969	107,407	1,009	107,394	13	-1
17	0	0	764	7	20	771	979	-16	963	963	108,370	1,003	108,397	-27	+3
18	0	0	740	0	21	740	1,010	-9	1,001	1,001	109,371	971	109,368	3	0
19	0	0	714	0	22	714	1,036	-5	1,031	1,027	110,398	967	110,335	63	-6
20	0	0	672	21	23	693	1,057	-1	1,056	1,055	111,453	975	111,310	143	-14
MONTAGUE DESIGN RATE = 1,655 ft3/s -- NOVEMBER 24 - 30, 1998															
Nov. 21	0	0	811	8	Nov. 24	819	836	+3	839	839	112,292	854	112,164	128	-13
22	0	0	797	0	25	797	858	0	858	859	113,151	904	113,068	83	-8
23	0	0	779	0	26	779	876	-6	870	871	114,022	806	113,874	148	-15
24	0	0	763	43	27	806	849	-14	835	836	114,858	551	114,425	433	-43
25	0	0	731	168	28	899	756	-13	743	744	115,602	79	114,504	1,098	-100
26	0	0	795	348	29	1,143	512	-8	504	504	116,106	169	114,673	1,433	-100
27	0	0	1,408	0	30	1,408	247	-15	232	234	116,340	329	115,002	1,338	-100

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Col. 4 - Computed increase in runoff based on quantitative precipitation 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. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7 from Table 10.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 10), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Caunonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1997	1	2	3	4		5	6		7	8	9	10	11	12	13
Nov. 28	0	19	26	15	Nov. 30	0	117	Dec. 1	0	60	117	4,963	5,140		
29	0	19	26	15	Dec. 1	0	234	2	0	60	234	6,286	6,580		
30	0	19	26	15	2	0	354	3	0	60	354	4,976	5,390		
Dec. 1	0	19	28	15	3	0	433	4	0	62	433	4,135	4,630		
2	0	19	28	15	4	0	390	5	0	62	390	3,918	4,370		
3	0	19	28	15	5	0	394	6	0	62	394	4,034	4,490		
4	0	19	23	15	6	0	358	7	0	57	358	3,575	3,990		
5	0	19	23	15	7	0	333	8	0	57	333	3,240	3,630		
6	0	19	23	15	8	64	511	9	0	57	575	2,928	3,560		
7	0	19	23	15	9	107	226	10	0	57	333	2,720	3,110		
8	0	19	23	15	10	99	0	11	0	57	99	2,744	2,900		
9	0	19	23	15	11	0	181	12	0	57	181	2,702	2,940		
10	0	19	23	15	12	43	174	13	0	57	217	2,476	2,750		
11	0	19	23	15	13	0	0	14	0	57	0	2,403	2,460		
12	0	19	23	15	14	0	0	15	0	57	0	2,193	2,250		
13	0	19	23	15	15	0	252	16	0	57	252	1,861	2,170		
14	0	19	23	15	16	0	500	17	0	57	500	1,893	2,450		
15	0	19	23	15	17	0	184	18	0	57	184	1,989	2,230		
16	0	19	23	15	18	0	0	19	0	57	0	2,013	2,070		
17	0	19	23	5	19	0	103	20	0	47	103	1,980	2,130		
18	0	19	23	15	20	0	64	21	0	57	64	1,999	2,120		
19	57	19	23	15	21	116	0	22	57	0	116	1,677	1,850		
20	0	19	23	15	22	227	124	23	0	57	351	1,692	2,100		
21	0	19	23	15	23	119	152	24	0	57	271	1,782	2,110		
22	0	19	23	15	24	0	71	25	0	57	71	2,182	2,310		
23	0	19	23	15	25	0	0	26	0	57	0	3,023	3,080		
24	0	19	23	15	26	0	103	27	0	57	103	3,600	3,760		
25	0	19	22	15	27	0	131	28	0	56	131	3,523	3,710		
26	0	19	22	15	28	114	241	29	0	56	355	3,179	3,590		
27	0	19	22	15	29	224	496	30	0	56	720	3,344	4,120		
28	0	19	23	15	30	226	106	31	0	57	332	3,681	4,070		
Total	57	589	734	455		1,339	6,232		57	1,721	7,571	92,711	102,060		

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 direction (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.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1997/98	1	2	3	4		5	6		7	8	9	10	11	12	13
Dec. 29		19	22	15	Dec. 31	450	0	Jan. 1		56	450	3,344	3,850		
30		19	22	15	Jan. 1	183	0	2		56	183	2,561	2,800		
31		19	22	15	2	602	0	3		56	602	2,942	3,600		
Jan. 1		19	22	15	3	0	88	4		56	88	3,336	3,480		
2		19	22	15	4	109	237	5		56	346	5,828	6,230		
3		19	22	15	5	799	450	6		56	1,249	9,595	10,900		
4		19	22	15	6	805	241	7		56	1,046	14,698	15,800		
5		19	22	15	7	794	787	8		56	1,581	21,963	23,600		
6		19	23	15	8	882	872	9		57	1,754	37,289	39,100		
7		19	23	14	9	1,056	851	10		56	1,907	29,337	31,300		
8		19	15	5	10	694	851	11		39	1,545	18,116	19,700		
9		6	8	5	11	459	897	12		19	1,356	12,325	13,700		
10		6	8	5	12	624	886	13		19	1,510	9,571	11,100		
11		6	8	5	13	807	886	14		19	1,693	7,838	9,550		
12		6	8	5	14	924	713	15		19	1,637	6,364	8,020		
13		6	8	6	15	1,689	507	16		20	2,196	6,564	8,780		
14		6	17	15	16	1,038	415	17		38	1,453	9,409	10,900		
15		19	25	15	17	920	394	18		59	1,314	7,887	9,260		
16		19	25	15	18	913	.252	19		59	1,165	6,776	8,000		
17		19	25	15	19	750	528	20		59	1,278	5,763	7,100		
18		19	25	15	20	662	752	21		59	1,414	5,177	6,650		
19		19	26	15	21	563	454	22		60	1,017	4,713	5,790		
20		19	20	15	22	825	443	23		54	1,268	4,218	5,540		
21		19	26	15	23	525	489	24		60	1,014	4,586	5,660		
22		19	26	19	24	581	465	25		64	1,046	5,070	6,180		
23		22	37	25	25	671	297	26		84	968	4,498	5,550		
24		46	43	25	26	778	181	27		114	959	4,077	5,150		
25		46	43	25	27	824	358	28		114	1,182	3,654	4,950		
26		46	43	25	28	749	124	29		114	873	3,783	4,770		
27		45	43	25	29	772	426	30		113	1,198	3,449	4,760		
28		45	43	25	30	668	181	31		113	849	3,198	4,160		
Total	0	647	744	469		22,116	14,025		0	1,860	36,141	267,929	305,930		

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 direction (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.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Jan. 29		45	43	25	Jan. 31	0	181	Feb. 1		113	181	3,126	3,420		
30		45	43	25	Feb. 1	143	199	2		113	342	2,995	3,450		
31		45	43	25	2	666	461	3		113	1,127	2,770	4,010		
Feb. 1		45	43	25	3	706	319	4		113	1,025	2,942	4,080		
2		45	43	25	4	721	340	5		113	1,061	2,926	4,100		
3		45	43	25	5	650	344	6		113	994	3,083	4,190		
4		45	43	25	6	615	297	7		113	912	2,815	3,840		
5		45	43	25	7	0	53	8		113	53	2,744	2,910		
6		37	45	25	8	130	184	9		107	314	2,599	3,020		
7		36	45	25	9	739	376	10		106	1,115	2,439	3,660		
8		37	45	25	10	815	163	11		107	978	2,395	3,480		
9		45	45	25	11	762	418	12		115	1,180	3,855	5,150		
10		46	45	25	12	823	142	13		116	965	7,439	8,520		
11		46	45	25	13	657	131	14		116	788	7,066	7,970		
12		46	45	25	14	79	70	15		116	149	5,285	5,550		
13		46	45	25	15	153	213	16		116	366	4,678	5,160		
14		46	45	25	16	998	330	17		116	1,328	4,386	5,830		
15		46	45	25	17	752	400	18		116	1,152	5,072	6,340		
16		46	45	26	18	760	273	19		117	1,033	7,370	8,520		
17		46	45	25	19	821	308	20		116	1,129	9,055	10,300		
18		46	45	25	20	704	234	21		116	938	8,056	9,110		
19		45	45	25	21	0	262	22		115	262	7,233	7,610		
20		46	45	25	22	119	319	23		116	438	6,626	7,180		
21		46	45	25	23	801	578	24		116	1,379	6,805	8,300		
22		46	45	25	24	1,213	375	25		116	1,588	7,926	9,630		
23		46	45	25	25	846	294	26		116	1,140	7,964	9,220		
24		46	45	25	26	824	369	27		116	1,193	7,731	9,040		
25		46	45	25	27	741	351	28		116	1,092	7,342	8,550		
Total	0	1,250	1,244	701		16,238	7,984		0	3,195	24,222	144,723	172,140		

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 direction (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.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled		Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other			Total	Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Feb. 26		45	45	25	Feb. 28	0	440	Mar. 1		115	440	10,145	10,700		
27		46	45	25	Mar. 1	142	730	2		116	872	14,112	15,100		
28		46	45	25	2	1,172	543	3		116	1,715	12,769	14,600		
Mar. 1		46	45	25	3	1,104	0	4		116	1,104	11,280	12,500		
2		45	45	25	4	1,101	0	5		115	1,101	9,884	11,100		
3		45	45	25	5	1,045	0	6		115	1,045	8,670	9,830		
4		45	45	25	6	1,155	0	7		115	1,155	7,660	8,930		
5		45	45	25	7	1,145	0	8		115	1,145	6,960	8,220		
6		45	45	25	8	1,075	0	9		115	1,075	9,510	10,700		
7		45	45	25	9	1,066	319	10		115	1,385	26,400	27,900		
8		45	45	25	10	1,141	823	11		115	1,964	27,121	29,200		
9		45	45	25	11	1,276	844	12		115	2,120	18,265	20,500		
10		45	45	25	12	1,165	773	13		115	1,938	13,747	15,800		
11		45	45	25	13	1,338	691	14		115	2,029	11,156	13,300		
12		45	56	25	14	1,248	521	15		126	1,769	9,705	11,600		
13		45	45	25	15	1,241	543	16		115	1,784	8,401	10,300		
14		45	45	25	16	1,266	372	17		115	1,638	7,287	9,040		
15		45	45	25	17	1,219	645	18		115	1,864	6,711	8,690		
16		46	45	25	18	1,299	752	19		116	2,051	7,763	9,930		
17		46	45	25	19	1,225	766	20		116	1,991	8,993	11,100		
18		46	45	25	20	1,280	454	21		116	1,734	9,250	11,100		
19		45	48	25	21	1,253	450	22		118	1,703	10,979	12,800		
20		45	45	25	22	1,244	500	23		115	1,744	9,941	11,800		
21		46	45	25	23	1,253	578	24		116	1,831	8,753	10,700		
22		46	45	25	24	1,302	525	25		116	1,827	8,057	10,000		
23		46	45	25	25	900	372	26		116	1,272	7,752	9,140		
24		46	45	25	26	914	316	27		116	1,230	9,654	11,000		
25		46	67	25	27	1,191	348	28		138	1,539	11,223	12,900		
26		46	45	25	28	1,147	400	29		116	1,547	11,337	13,000		
27		46	45	25	29	1,151	461	30		116	1,612	10,672	12,400		
28		46	45	25	30	1,132	514	31		116	1,646	9,438	11,200		
Total	0	1,409	1,431	775		34,190	13,680		0	3,615	47,870	343,595	395,080		

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 direction (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.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Mar. 29		46	45	25	Mar. 31	1,144	564	Apr. 1		116	1,708	8,676	10,500		
30		46	45	25	Apr. 1	1,136	699	2		116	1,835	13,749	15,700		
31		46	45	25	2	1,094	518	3		116	1,612	13,372	15,100		
Apr. 1		46	45	26	3	906	319	4		117	1,225	11,058	12,400		
2		45	45	26	4	657	411	5		116	1,068	9,516	10,700		
3		46	43	25	5	555	209	6		114	764	8,272	9,150		
4		45	45	25	6	536	42	7		115	578	7,547	8,240		
5		46	45	25	7	699	248	8		116	947	6,897	7,960		
6		46	45	25	8	704	301	9		116	1,005	7,329	8,450		
7		46	45	25	9	883	635	10		116	1,518	15,666	17,300		
8		46	45	25	10	718	737	11		116	1,455	15,429	17,000		
9		46	45	25	11	0	578	12		116	578	12,106	12,800		
10		46	45	25	12	80	298	13		116	378	10,606	11,100		
11		46	45	25	13	640	401	14		116	1,041	8,943	10,100		
12		46	45	25	14	539	486	15		116	1,025	8,339	9,480		
13		46	45	25	15	612	454	16		116	1,066	7,828	9,010		
14		46	45	25	16	653	284	17		116	937	7,127	8,180		
15		46	45	25	17	533	220	18		116	753	6,651	7,520		
16		46	45	25	18	0	209	19		116	209	6,445	6,770		
17		46	45	25	19	76	784	20		116	860	13,024	14,000		
18		46	45	25	20	775	610	21		116	1,385	17,199	18,700		
19		46	45	25	21	940	613	22		116	1,553	13,731	15,400		
20		46	45	25	22	1,707	461	23		116	2,168	11,416	13,700		
21		46	45	25	23	1,735	581	24		116	2,316	9,968	12,400		
22		46	45	25	24	1,149	227	25		116	1,376	8,388	9,880		
23		48	45	25	25	0	117	26		118	117	7,825	8,060		
24		46	45	25	26	194	546	27		116	740	8,354	9,210		
25		48	45	25	27	1,001	404	28		118	1,405	7,377	8,900		
26		48	45	25	28	933	447	29		118	1,380	6,452	7,950		
27		48	45	25	29	964	539	30		118	1,503	5,649	7,270		
Total	0	1,386	1,348	752		21,563	12,942		0	3,486	34,505	294,939	332,930		

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 direction 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.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled		Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amonnt				Date			Date	Directed	Other			Total	Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Apr. 28		48	45	25	Apr. 30	1,012	426	May 1		118	1,438	5,134	6,690		
29		48	45	32	May 1	735	326	2		125	1,061	5,144	6,330		
30		51	45	51	2	0	245	3		147	245	6,438	6,830		
May 1		70	45	51	3	153	241	4		166	394	10,040	10,600		
2		70	45	51	4	804	691	5		166	1,495	9,839	11,500		
3		70	45	51	5	716	546	6		166	1,262	10,272	11,700		
4		70	45	51	6	827	528	7		166	1,355	10,579	12,100		
5		70	45	53	7	939	606	8		168	1,545	9,687	11,400		
6		70	45	53	8	606	624	9		168	1,230	9,202	10,600		
7		70	45	53	9	0	606	10		168	606	14,026	14,800		
8		70	45	53	10	101	833	11		168	934	29,198	30,300		
9		70	45	53	11	996	851	12		168	1,847	30,085	32,100		
10		70	45	53	12	1,554	819	13		168	2,373	22,459	25,000		
11		70	45	53	13	1,712	837	14		168	2,549	16,383	19,100		
12		70	45	53	14	1,222	833	15		168	2,055	12,977	15,200		
13		70	45	53	15	711	731	16		168	1,442	10,390	12,000		
14		70	45	53	16	0	496	17		168	496	9,196	9,860		
15		70	45	53	17	112	472	18		168	584	8,058	8,810		
16		68	45	53	18	745	408	19		166	1,153	6,771	8,090		
17		70	45	53	19	737	482	20		168	1,219	5,663	7,050		
18		70	45	53	20	864	610	21		168	1,474	4,678	6,320		
19		70	45	53	21	556	369	22		168	925	4,037	5,130		
20		68	45	53	22	473	140	23		166	613	3,501	4,280		
21		70	45	53	23	0	96	24		168	96	3,236	3,500		
22		70	45	53	24	0	0	25		168	0	3,012	3,180		
23		70	45	53	25	35	0	26		168	35	3,617	3,820		
24		70	45	53	26	558	422	27		168	980	3,162	4,310		
25		70	45	53	27	452	330	28		168	782	2,680	3,630		
26		71	45	53	28	441	404	29		169	845	2,286	3,300		
27		71	125	68	29	422	145	30		264	567	2,179	3,010		
28		76	271	53	30	0	223	31		400	223	2,287	2,910		
Total	0	2,111	1,701	1,599		17,483	14,340		0	5,411	31,823	276,216	313,450		

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 direction (Col. 1).
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
May 29		71	124	53	May 31	42	415	June 1		248	457	5,945	6,650		
30		70	104	53	June 1	430	131	2		227	561	4,972	5,760		
31		73	107	53	2	561	46	3		233	607	7,100	7,940		
June 1		93	161	53	3	423	216	4		307	639	6,684	7,630		
2		93	161	53	4	491	131	5		307	622	4,711	5,640		
3		93	161	53	5	408	124	6		307	532	3,581	4,420		
4		94	161	53	6	0	88	7		308	88	3,054	3,450		
5		94	161	53	7	115	0	8		308	115	2,757	3,180		
6		94	161	51	8	606	0	9		306	606	2,418	3,330		
7		94	161	53	9	877	92	10		308	969	2,193	3,470		
8		94	161	53	10	1,130	106	11		308	1,236	2,076	3,620		
9		94	161	53	11	1,172	259	12		308	1,431	2,411	4,150		
10		94	161	51	12	727	227	13		306	954	6,660	7,920		
11		94	161	53	13	643	376	14		308	1,019	13,373	14,700		
12		93	161	53	14	967	532	15		307	1,499	18,394	20,200	0	0
13		93	161	53	15	1,109	688	16		307	1,797	21,796	23,900	0	0
14		94	161	53	16	1,058	670	17		308	1,728	19,364	21,400	0	0
15		94	164	53	17	1,043	776	18		311	1,819	18,570	20,700	0	0
16		94	162	53	18	984	776	19		309	1,760	15,731	17,800	0	0
17		96	162	53	19	861	713	20		311	1,574	12,415	14,300	0	0
18		96	271	71	20	641	400	21		438	1,041	10,721	12,200	0	0
19		456	500	71	21	662	354	22		1,027	1,016	7,727	9,770	0	0
20		571	360	71	22	1,085	394	23		1,002	1,479	6,359	8,840	0	0
21		340	207	71	23	1,180	241	24		618	1,421	5,471	7,510	0	0
22		167	207	73	24	1,259	358	25		447	1,617	4,676	6,740	0	0
23		141	207	74	25	1,142	414	26		422	1,556	3,952	5,930	0	0
24		139	288	74	26	742	234	27		501	976	3,293	4,770	0	0
25		138	334	74	27	564	145	28		546	709	2,895	4,150	0	0
26		114	334	53	28	509	106	29		501	615	2,604	3,720	0	0
27		97	334	53	29	479	348	30		484	827	2,959	4,270	0	0
Total	0	4,068	6,119	1,741		21,910	9,360		0	11,928	31,270	224,862	268,060		

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 direction (Col. 1).
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
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Col. 11 = 24 hours of calendar day shown.

Col. 12 = Col. 11 - Col. 8 - 1,750 ft^3/s 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, 1998 = 11,418 $(ft^3/s)\cdot d$.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
June 28	0	94	334	67	June 30	356	833	July 1	0	495	1,189	16,216	17,900	0	0
29	0	107	260	53	July 1	523	872	2	0	420	1,395	12,985	14,800	0	0
30	0	94	292	53	2	462	862	3	0	439	1,324	9,637	11,400	0	0
July 1	0	94	459	56	3	442	851	4	0	609	1,293	7,358	9,260	0	0
2	0	97	512	70	4	358	348	5	0	679	706	6,275	7,660	0	0
3	0	127	405	70	5	305	504	6	0	602	809	6,279	7,690	0	0
4	0	125	308	67	6	418	220	7	0	500	638	5,302	6,440	0	0
5	0	125	283	53	7	435	181	8	0	461	616	4,343	5,420	0	0
6	0	94	254	53	8	381	199	9	0	401	580	7,049	8,030	0	0
7	0	94	254	53	9	444	323	10	0	401	767	12,232	13,400	0	0
8	0	94	390	53	10	351	206	11	0	537	557	10,406	11,500	0	0
9	0	94	506	53	11	334	67	12	0	653	401	8,016	9,070	0	0
10	0	94	504	53	12	328	170	13	0	651	498	6,361	7,510	0	0
11	0	94	504	53	13	457	596	14	0	651	1,053	4,966	6,670	0	0
12	0	96	504	80	14	354	404	15	0	680	758	3,942	5,380	0	0
13	0	93	393	107	15	418	270	16	0	593	688	3,309	4,590	0	0
14	0	93	300	93	16	537	574	17	0	486	1,111	2,823	4,420	0	0
15	0	91	280	68	17	416	266	18	0	439	682	2,489	3,610	0	0
16	0	91	258	56	18	347	0	19	0	405	347	2,278	3,030	0	0
17	0	91	291	90	19	319	340	20	0	472	659	2,029	3,160	0	0
18	0	91	367	110	20	493	504	21	0	568	997	1,765	3,330	0	0
19	0	104	398	110	21	578	592	22	0	612	1,170	1,658	3,440	0	0
20	0	105	396	110	22	339	387	23	0	611	726	1,693	3,030	0	0
21	0	105	381	82	23	459	209	24	0	568	668	1,554	2,790	0	0
22	0	93	351	77	24	430	0	25	0	521	430	1,519	2,470	0	0
23	431	91	303	54	25	0	89	26	431	17	89	1,413	1,950	183	183
24	355	93	254	54	26	2	53	27	355	46	55	1,264	1,720	-30	153
25	0	93	254	54	27	346	195	28	0	401	541	1,198	2,140	100	253
26	0	93	268	57	28	495	170	29	0	418	665	1,177	2,260	8	261
27	156	93	312	68	29	454	74	30	156	317	528	1,059	2,060	100	361
28	443	93	314	53	30	434	18	31	443	17	452	1,168	2,080	313	674
Total	1,385	3,036	10,889	2,130		12,015	10,377		1,385	14,670	22,392	149,763	188,210		

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 begiuniug 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 iu response to direction (Col. 1).
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 12 = Col. 11 - Col. 8 - 1,750 ft^3/s 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, 1998 = 11,418 $(ft^3/s)\cdot d$.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
July 29	484	93	339	53	July 31	345	0	Aug. 1	485		345	1,000	1,830	80	754
30	941	93	794	53	Aug. 1	0	0	2	940		0	820	1,760	10	764
31	966	93	821	53	2	0	170	3	967		170	783	1,920	170	934
Aug. 1	578	93	435	53	3	247	127	4	581		374	855	1,810	60	994
2	637	93	490	57	4	223	71	5	640		294	786	1,720	-30	964
3	929	91	758	77	5	0	120	6	926		120	634	1,680	-70	894
4	1,204	91	1,023	91	6	0	0	7	1,205		0	665	1,870	120	1,014
5	1,141	93	959	90	7	131	71	8	1,142		202	616	1,960	210	1,224
6	1,245	93	1,063	88	8	0	0	9	1,244		0	646	1,890	140	1,364
7	1,291	94	1,123	74	9	0	32	10	1,291		32	547	1,870	120	1,484
8	1,254	94	1,086	74	10	10	7	11	1,254		17	659	1,930	180	1,664
9	1,078	94	910	74	11	0	32	12	1,078		32	660	1,770	20	1,684
10	1,253	93	1,112	53	12	0	0	13	1,258		0	672	1,930	180	1,864
11	1,245	94	1,098	53	13	0	0	14	1,245		0	605	1,850	100	1,964
12	1,244	94	1,097	53	14	0	0	15	1,244		0	686	1,930	180	2,144
13	1,283	94	1,135	53	15	0	0	16	1,282		0	628	1,910	160	2,304
14	1,301	94	1,157	53	16	0	0	17	1,304		0	706	2,010	260	2,564
15	1,341	94	1,196	53	17	0	0	18	1,343		0	707	2,050	300	2,864
16	1,342	96	1,193	53	18	97	0	19	1,342		97	741	2,180	430	3,294
17	1,193	96	1,047	53	19	0	0	20	1,196		0	664	1,860	110	3,404
18	1,156	96	1,009	51	20	0	0	21	1,156		0	644	1,800	50	3,454
19	1,043	96	897	53	21	56	0	22	1,046		56	628	1,730	-20	3,434
20	979	94	832	53	22	0	85	23	979		85	586	1,650	-100	3,334
21	1,156	94	1,009	53	23	0	0	24	1,156		0	584	1,740	-10	3,324
22	912	94	766	53	24	358	43	25	913		401	626	1,940	190	3,514
23	1,267	94	1,120	54	25	298	0	26	1,268		298	684	2,250	500	4,014
24	934	94	787	53	26	192	0	27	934		192	684	1,810	60	4,074
25	1,170	94	998	74	27	434	85	28	1,166		519	505	2,190	440	4,514
26	1,263	94	1,080	90	28	88	0	29	1,264		88	468	1,820	70	4,584
27	1,224	94	1,044	90	29	0	0	30	1,228		0	492	1,720	-30	4,554
28	1,282	94	1,112	74	30	0	70	31	1,280		70	450	1,800	50	4,604
Total	34,336	2,908	29,490	1,959		2,479	913		34,357	0	3,392	20,431	58,180		

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 direction (Col. 1).
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 13 - Season limit of cumulative credit beginning June 15, 1997 = 11,418 $(ft^3/s)\cdot d$.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague								
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio, Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Aug. 29	1,269	94	1,101	74	Aug. 31	0	0	Sept. 1	1,269	0	0	471	1,740	-10	4,594
30	1,252	94	1,103	53	Sept. 1	0	0	2	1,250	0	0	440	1,690	-60	4,534
31	1,247	90	1,101	53	2	0	0	3	1,244	0	0	536	1,780	30	4,564
Sept. 1	1,276	70	1,156	53	3	0	53	4	1,279	0	53	528	1,860	110	4,674
2	1,233	70	1,114	53	4	0	174	5	1,237	0	174	419	1,830	80	4,754
3	1,259	70	1,137	53	5	0	0	6	1,260	0	0	490	1,750	0	4,754
4	1,314	70	1,193	53	6	0	0	7	1,316	0	0	534	1,850	100	4,854
5	1,330	70	1,211	53	7	0	0	8	1,334	0	0	496	1,830	80	4,934
6	476	70	353	53	8	111	35	9	476	0	146	768	1,390	-360	4,574
7	333	70	258	53	9	175	0	10	333	48	175	734	1,290	-460	4,114
8	419	70	297	51	10	407	0	11	418	0	407	635	1,460	-290	3,824
9	635	70	511	54	11	372	0	12	635	0	372	573	1,580	-170	3,654
10	1,403	68	1,278	53	12	0	142	13	1,399	0	142	499	2,040	290	3,944
11	1,370	68	1,250	53	13	0	4	14	1,371	0	4	455	1,830	80	4,024
12	1,023	68	903	53	14	495	18	15	1,024	0	513	573	2,110	360	4,384
13	1,049	68	907	74	15	412	0	16	1,049	0	412	509	1,970	220	4,604
14	1,049	70	903	74	16	325	0	17	1,047	0	325	588	1,960	210	4,814
15	1,056	70	933	53	17	422	0	18	1,056	0	422	492	1,970	220	5,034
16	1,053	70	933	53	18	0	0	19	1,056	0	0	504	1,560	-190	4,844
17	1,409	70	1,287	53	19	0	78	20	1,410	0	78	462	1,950	200	5,044
18	1,482	70	1,361	51	20	0	0	21	1,482	0	0	428	1,910	160	5,204
19	1,166	70	1,041	51	21	408	0	22	1,162	0	408	610	2,180	430	5,634
20	1,210	70	1,071	51	22	103	0	23	1,192	0	103	655	1,950	200	5,834
21	1,177	70	1,050	51	23	360	0	24	1,171	0	360	589	2,120	370	6,204
22	1,053	70	930	53	24	296	0	25	1,053	0	296	611	1,960	210	6,414
23	1,016	70	897	53	25	326	0	26	1,020	0	326	594	1,940	190	6,604
24	1,378	70	1,258	53	26	0	0	27	1,381	0	0	569	1,950	200	6,804
25	1,346	70	1,224	53	27	0	0	28	1,347	0	0	533	1,880	130	6,934
26	930	70	808	53	28	370	0	29	931	0	370	969	2,270	520	7,454
27	637	68	518	51	29	279	0	30	637	0	279	1,024	1,940	190	7,644
Total	32,850	2,158	30,729	1,642		4,861	504		32,839	48	5,365	17,288	55,540		

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.
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Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to direction (Col. 1).
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Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Sept. 28	363	70	244	51	Sept. 30	460	0	Oct. 1	365	0	460	785	1,610	-140	7,504
29	586	70	475	43	Oct. 1	351	0	2	588	0	351	561	1,500	-250	7,254
30	784	65	698	25	2	352	78	3	788	0	430	572	1,790	40	7,294
Oct. 1	1,315	45	1,245	25	3	0	0	4	1,315	0	0	535	1,850	100	7,394
2	1,272	45	1,200	25	4	0	0	5	1,270	0	0	480	1,750	0	7,394
3	919	45	849	25	5	448	0	6	919	0	448	533	1,900	150	7,544
4	944	45	873	25	6	351	0	7	943	0	351	506	1,800	50	7,594
5	961	45	893	25	7	432	0	8	963	0	432	695	2,090	340	7,934
6	695	45	622	25	8	291	0	9	692	0	291	1,507	2,490	692	8,626
7	489	45	419	25	9	365	0	10	489	0	365	2,446	3,300	489	9,115
8	0	45	43	25	10	0	0	11	0	113	0	2,137	2,250	0	9,115
9	0	45	45	25	11	0	0	12	0	115	0	1,805	1,920		
10	0	46	45	25	12	264	0	13	0	116	264	1,630	2,010		
11	0	43	45	25	13	119	0	14	0	113	119	1,528	1,760		
12	0	43	45	25	14	262	0	15	0	113	262	1,375	1,750		
13	0	43	46	25	15	219	0	16	0	114	219	1,587	1,920		
14	0	45	46	25	16	257	0	17	0	116	257	1,507	1,880		
15	0	45	46	25	17	39	99	18	0	116	138	1,296	1,550		
16	332	45	258	25	18	0	0	19	328	0	0	1,002	1,330		
17	509	45	436	25	19	0	0	20	506	0	0	954	1,460		
18	644	45	577	25	20	0	0	21	647	0	0	923	1,570		
19	712	45	644	25	21	0	0	22	714	0	0	916	1,630		
20	896	45	821	25	22	0	0	23	891	0	0	859	1,750		
21	985	45	917	25	23	0	0	24	987	0	0	803	1,790		
22	1,034	45	965	25	24	0	0	25	1,035	0	0	875	1,910		
23	*1,180	45	1,108	25	25	0	0	26	1,178	0	0	772	1,950		
24	*1,224	46	1,154	25	26	0	0	27	1,225	0	0	695	1,920		
25	*1,251	45	1,182	25	27	0	0	28	1,252	0	0	728	1,980		
26	1,107	45	1,038	25	28	0	0	29	1,108	0	0	702	1,810		
27	1,023	45	947	25	29	0	0	30	1,017	0	0	743	1,760		
28	954	45	888	25	30	0	67	31	958	0	67	715	1,740		
Total	20,179	1,461	18,814	819		4,210	244		20,178	916	4,454	32,172	57,720		

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.

*Includes 100 ft^3/s for Delaware River at Trenton, N.J. flow target.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to direction (Col. 1).
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
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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, 1998 = 11,418 $(ft^3/s)\cdot d$.
Excess-release quantity suspended Oct. 12, 1998.

Table 11. Controlled releases from reservoirs in the upper Delaware River basin (Continued) and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
[Mean discharge in cubic feet per second for 24 hours]

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1998	1	2	3	4		5	6		7	8	9	10	11	12	13
Oct. 29	1,007	45	941	25	Oct. 31	0	0	Nov. 1	1,011		0	679	1,690		
30	*1,105	45	1,033	25	Nov. 1	0	0	2	1,103		0	687	1,790		
31	*1,158	45	1,092	25	2	0	0	3	1,162		0	658	1,820		
Nov. 1	*1,176	45	1,111	25	3	0	0	4	1,181		0	649	1,830		
2	*1,204	45	1,134	25	4	0	0	5	1,204		0	626	1,830		
3	*1,193	45	1,122	25	5	30	0	6	1,192		30	618	1,840		
4	*1,219	45	1,035	25	6	0	0	7	1,205		0	615	1,820		
5	*1,228	45	1,160	25	7	0	0	8	1,230		0	610	1,840		
6	*1,229	45	1,159	25	8	0	0	9	1,229		0	651	1,880		
7	*1,236	45	1,168	25	9	0	0	10	1,238		0	542	1,780		
8	*1,210	45	1,140	25	10	3	0	11	1,210		3	677	1,890		
9	705	45	639	25	11	0	0	12	709		0	841	1,550		
10	729	43	662	25	12	0	0	13	730		0	1,010	1,740		
11	1,025	43	956	25	13	60	0	14	1,024		60	936	2,000		
12	878	45	812	25	14	0	0	15	882		0	898	1,780		
13	878	45	809	25	15	0	0	16	879		0	831	1,710		
14	875	45	808	25	16	0	0	17	878		0	802	1,680		
15	911	45	842	25	17	0	0	18	912		0	798	1,710		
16	969	45	899	25	18	0	0	19	969		0	741	1,710		
17	963	45	893	25	19	0	0	20	963		0	747	1,710		
18	1,001	45	931	25	20	0	0	21	1,001		0	779	1,780		
19	*1,131	45	1,057	25	21	0	0	22	1,127		0	783	1,910		
20	1,056	45	985	25	22	0	0	23	1,055		0	775	1,830		
21	839	45	769	25	23	0	0	24	839		0	801	1,640		
22	858	45	789	25	24	0	0	25	859		0	751	1,610		
23	870	45	801	25	25	0	0	26	871		0	849	1,720		
24	835	45	766	25	26	0	0	27	836		0	1,104	1,940		
25	743	45	674	25	27	0	0	28	744		0	1,576	2,320		
26	504	43	436	25	28	0	0	29	504		0	1,486	1,990		
27	232	43	166	25	29	0	0	30	234		0	1,326	1,560		
Total	28,967	1,342	26,889	750		93	0		28,981	0	93	24,846	53,920		

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.

*Includes 100 ft^3/s for Delaware River at Trenton, N.J. flow target.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in responce to direction (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 ft^3/s 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, 1998 = 11,418 $(ft^3/s)\cdot d$.
Excess-release quantity suspended Oct. 12, 1998.

Table 12. 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 1997	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Oct. 27, 1997 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Oct. 27, 1997 or Jan. 13, 1998 to date
Dec. 1	451	0	0	471	Jan. 1	0	0	0	409
2	299	28	0	467	2	0	0	0	403
3	280	0	0	462	3	0	0	0	397
4	0	0	0	450	4	0	0	0	391
5	0	0	0	439	5	280	0	109	391
6	0	0	0	428	6	150	0	93	389
7	0	0	0	418	7	156	0	100	387
8	316	0	0	416	8	0	0	0	382
9	301	0	0	413	9	0	0	0	377
10	300	0	0	411	10	0	0	0	372
11	276	0	0	408	11	0	0	0	367
12	317	0	0	406	12	0	0	0	363
13	291	0	0	403	13	0	0	0	0
14	292	0	0	401	14	0	0	0	0
15	304	0	0	399	15	302	0	89	130
16	301	98	76	401	16	295	0	157	211
17	300	188	137	405	17	297	0	155	259
18	299	199	136	409	18	295	0	145	289
19	300	199	144	414	19	302	0	155	313
20	282	199	139	417	20	297	0	154	330
21	319	199	138	422	21	301	0	150	344
22	301	199	144	426	22	298	0	151	354
23	128	198	99	426	23	299	0	153	363
24	150	199	103	426	24	272	0	147	368
25	154	199	83	426	25	316	0	162	376
26	152	199	125	427	26	317	0	158	383
27	151	199	99	427	27	300	0	163	389
28	147	199	120	428	28	299	0	166	393
29	144	128	110	427	29	301	0	136	396
30	0	50	0	421	30	300	0	150	399
31	0	0	0	415	31	295	0	113	399
Total	6,555	2,680	1,653			5,672	0	2,806	

Table 12. 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 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Jan. 13, 1998 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Jan. 13, 1998 to date
Feb. 1	302	0	159	403	Mar. 1	0	193	102	406
2	282	0	148	404	2	220	192	100	408
3	203	0	147	401	3	297	192	199	414
4	196	0	175	400	4	300	191	0	415
5	194	0	141	397	5	298	191	6	417
6	191	0	150	395	6	284	191	201	422
7	196	0	147	393	7	299	191	104	425
8	195	0	130	391	8	300	190	99	428
9	418	0	149	397	9	310	0	101	428
10	450	0	146	404	10	201	0	1	424
11	450	0	148	410	11	0	0	142	419
12	450	0	147	416	12	0	0	198	415
13	450	0	153	422	13	0	0	101	410
14	450	0	152	428	14	0	0	99	405
15	450	0	148	433	15	0	0	104	400
16	450	0	150	437	16	0	0	106	395
17	450	0	147	442	17	300	0	115	396
18	450	0	9	442	18	300	0	100	396
19	450	0	192	448	19	300	0	95	396
20	52	0	200	442	20	281	0	93	395
21	0	0	204	437	21	0	0	80	391
22	0	0	188	430	22	0	0	85	386
23	0	0	208	425	23	244	0	207	387
24	0	0	210	420	24	245	0	102	387
25	0	181	105	417	25	263	0	170	387
26	0	193	90	414	26	251	0	139	387
27	0	193	78	411	27	0	0	194	385
28	0	193	98	408	28	0	0	190	382
					29	0	0	188	380
					30	0	0	189	377
					31	0	0	189	375
Total	6,729	760	4,119			4,693	1,531	3,799	

Table 12. 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 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Jan. 13, 1998 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Jan. 13, 1998 to date
Apr. 1	0	0	186	372	May 1	402	0	95	345
2	0	0	175	370	2	402	0	99	347
3	0	0	184	367	3	402	0	118	348
4	0	0	186	365	4	25	0	77	346
5	0	0	186	363	5	0	0	97	344
6	0	0	188	361	6	0	0	229	343
7	0	0	189	359	7	0	0	372	343
8	0	0	191	357	8	0	0	374	343
9	0	0	203	355	9	0	0	374	344
10	98	0	188	354	10	0	0	141	342
11	0	0	194	353	11	0	0	0	339
12	0	0	186	351	12	0	0	159	338
13	0	0	188	349	13	0	0	2	335
14	0	0	70	346	14	0	0	188	334
15	0	0	1	342	15	0	0	339	334
16	0	0	0	339	16	0	0	318	334
17	0	0	157	337	17	0	0	321	333
18	0	0	195	335	18	429	0	63	335
19	0	0	184	334	19	453	0	312	338
20	0	0	113	331	20	454	0	214	341
21	0	0	98	329	21	453	0	198	343
22	0	0	139	327	22	452	0	199	345
23	0	0	192	326	23	453	0	192	348
24	401	0	244	329	24	453	0	187	350
25	401	0	226	332	25	453	0	165	352
26	401	0	205	335	26	454	260	6	355
27	401	0	189	337	27	151	455	0	357
28	402	0	187	339	28	0	490	0	358
29	402	0	184	342	29	103	303	0	358
30	402	0	189	344	30	89	298	0	358
					31	54	298	0	358
Total	2,908	0	5,017			5,682	2,104	4,839	

Table 12. 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 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 to date
June 1	451	298	0	749	July 1	0	0	193	498
2	463	298	0	755	2	2	0	411	495
3	401	249	95	752	3	303	0	138	493
4	401	249	93	750	4	454	0	132	496
5	401	249	96	749	5	453	0	138	499
6	401	249	0	732	6	308	188	147	503
7	401	249	0	721	7	445	81	160	508
8	294	206	0	693	8	452	199	180	516
9	300	197	0	671	9	451	11	229	521
10	302	197	0	654	10	450	197	188	529
11	302	197	0	640	11	450	200	142	535
12	159	32	99	611	12	450	200	143	541
13	0	0	90	571	13	450	200	143	547
14	0	0	0	530	14	451	283	135	554
15	0	0	0	495	15	451	199	143	560
16	0	0	0	464	16	451	290	101	566
17	0	0	0	436	17	450	298	105	572
18	0	0	0	412	18	450	298	0	576
19	0	0	447	414	19	450	298	0	579
20	0	0	371	412	20	450	298	109	585
21	0	0	352	409	21	450	298	37	589
22	431	99	237	425	22	450	297	155	595
23	454	166	98	438	23	450	281	93	599
24	454	298	97	455	24	449	298	93	603
25	454	298	106	471	25	449	298	93	608
26	395	297	127	485	26	449	298	94	612
27	409	298	116	497	27	450	298	94	616
28	415	299	120	509	28	450	298	94	620
29	414	298	111	520	29	450	298	109	624
30	27	12	114	508	30	450	298	100	628
					31	450	298	153	632
Total	7,729	4,735	2,769			12,768	6,500	4,052	

Table 12. 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 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 to date
Aug. 1	449	297	103	636	Sept. 1	451	0	193	710
2	450	297	121	639	2	451	0	157	709
3	449	297	119	643	3	451	0	181	708
4	449	297	154	647	4	450	0	201	707
5	450	297	142	650	5	450	0	202	707
6	450	296	191	655	6	451	0	200	706
7	450	298	188	659	7	450	0	203	706
8	450	298	189	663	8	450	0	200	705
9	450	298	177	667	9	449	0	201	705
10	450	298	200	671	10	448	0	199	704
11	450	297	193	674	11	449	0	205	703
12	449	297	198	678	12	449	0	217	703
13	448	297	173	681	13	449	0	194	703
14	448	298	192	685	14	449	0	191	702
15	447	299	193	688	15	449	0	211	702
16	447	298	195	691	16	449	0	200	701
17	424	298	188	694	17	448	0	220	701
18	360	251	136	695	18	448	0	300	701
19	448	298	199	698	19	448	0	303	702
20	449	298	186	701	20	449	0	300	702
21	449	298	193	704	21	451	0	301	702
22	449	298	143	706	22	450	0	301	703
23	449	298	147	708	23	449	0	303	703
24	448	297	175	711	24	450	0	269	703
25	447	297	119	712	25	450	0	414	705
26	449	215	145	714	26	450	0	414	706
27	451	198	93	714	27	450	0	416	708
28	452	0	174	713	28	449	0	420	709
29	452	0	201	712	29	449	0	421	710
30	452	0	165	711	30	451	0	423	712
31	451	0	198	710					
Total	13,816	7,805	5,190			13,487	0	7,960	

Table 12. 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 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 to date	Date 1998	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1998 or Nov. 21, 1998 to date
Oct. 1	450	0	296	712	Nov. 1	350	272	112	709
2	449	0	318	712	2	339	199	111	708
3	448	0	318	713	3	336	198	110	708
4	448	0	300	713	4	295	198	108	707
5	448	0	317	713	5	433	197	106	707
6	448	0	319	714	6	448	0	109	706
7	449	0	326	714	7	450	0	106	705
8	450	0	321	715	8	449	0	112	704
9	450	0	295	715	9	450	0	106	704
10	450	0	255	715	10	450	0	105	703
11	450	0	305	715	11	450	0	105	702
12	449	0	306	715	12	450	0	113	701
13	451	0	317	716	13	450	0	112	700
14	451	0	307	716	14	450	0	111	699
15	450	161	342	718	15	124	0	0	696
16	449	197	277	719	16	252	0	89	694
17	450	197	336	721	17	446	0	143	693
18	450	197	279	723	18	445	0	137	692
19	399	197	107	723	19	446	0	0	691
20	320	199	118	722	20	444	0	219	691
21	399	199	0	721	21	445	0	107	552
22	397	198	1	720	22	445	0	162	580
23	349	198	0	719	23	448	0	0	536
24	364	206	0	718	24	311	0	0	480
25	349	198	0	717	25	390	0	296	521
26	350	250	0	716	26	530	0	139	546
27	298	179	0	715	27	532	0	107	559
28	228	136	0	712	28	537	0	106	569
29	206	127	0	710	29	540	0	107	578
30	237	147	9	708	30	539	0	112	585
31	445	272	106	708					
Total	12,431	3,258	5,875			12,674	1,064	3,250	

Table 13. Daily mean discharge, East Branch Delaware River at Downsville, N.Y. (station number 01417000) for year ending November 30, 1998
(U.S. Geological Survey published record)
[All values except total in cubic feet per second, ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	18	18	41	41	44	190	82	852	92	73	55	43
2	18	18	41	41	44	227	89	1150	92	65	47	44
3	18	18	41	41	44	355	89	953	92	65	47	44
4	18	18	41	41	44	497	89	597	92	65	47	44
5	18	18	40	41	44	903	89	486	92	65	47	44
6	18	18	38	41	147	1190	89	300	92	65	50	44
7	18	18	34	41	634	1310	90	219	91	68	54	44
8	18	19	34	41	938	1310	90	655	90	68	56	44
9	18	14	36	40	1160	1330	90	2850	90	65	54	44
10	18	6.8	41	42	1570	1740	89	2260	90	66	55	44
11	18	6.8	41	41	1460	2880	90	1490	92	67	54	43
12	18	6.8	41	41	1330	2970	90	1020	91	67	53	45
13	18	6.5	41	41	1220	2480	90	636	92	67	53	44
14	18	6.1	41	41	1130	1970	446	387	92	68	54	44
15	18	11	41	41	1050	1620	3660	237	92	69	55	44
16	18	18	41	41	973	1360	3840	132	92	69	54	44
17	18	18	41	40	883	1230	3160	93	92	69	54	44
18	18	18	41	40	789	967	2990	90	90	69	54	44
19	18	18	41	40	820	478	2620	94	90	67	54	44
20	18	17	41	41	1890	247	2160	103	89	67	54	44
21	18	17	41	41	2030	117	1550	103	89	67	54	44
22	18	17	41	41	1810	65	1030	99	90	68	54	44
23	18	17	41	41	1580	62	519	90	90	67	54	44
24	18	32	41	41	1280	62	336	90	90	67	54	44
25	18	40	40	42	838	62	201	91	90	67	54	44
26	18	40	40	42	637	64	127	92	90	67	54	44
27	18	40	40	41	587	67	100	92	90	67	54	44
28	18	41	40	42	427	67	90	92	89	68	54	44
29	18	41	---	43	314	76	95	92	87	69	48	45
30	18	41	---	43	231	68	184	92	87	69	43	46
31	18	41	---	43	---	68	---	92	87	---	43	---
Total	558	659.0	1121	1277	25948	26032	24264	15629	2804	2020	1617	1322
Mean	18.0	21.3	40.0	41.2	865	840	809	504	90.5	67.3	52.2	44.1

Year total 103,251 $(ft^3/s)\cdot d$
Mean 283 ft^3/s

Table 14. Daily mean discharge, West Branch Delaware River at Stilesville, N.Y. (station number 01425000) for year ending November 30, 1998
(U.S. Geological Survey published record)
[All values except total in cubic feet per second, ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$; e, estimated]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	e24	26	51	795	1930	848	138	1560	752	1010	598	1010
2	e30	26	51	1270	2430	801	205	2030	392	1070	1130	1010
3	e30	27	51	1540	2490	910	210	1850	430	1040	1110	1050
4	e30	30	51	1540	2280	1080	213	1450	619	1040	785	1040
5	e27	34	52	1420	2020	1100	213	1290	893	1100	795	1050
6	e25	37	51	1270	1750	1100	205	1210	887	1140	817	1070
7	e25	37	51	1110	1500	1080	205	949	934	336	613	1060
8	e25	50	51	996	1310	1050	205	1040	1030	245	385	1080
9	e25	51	51	1190	1300	1030	205	3600	959	270	81	1050
10	e25	24	52	3380	1530	1160	205	4130	840	427	55	581
11	e25	19	52	4670	1530	1670	208	3150	982	1170	53	581
12	e25	17	51	3870	1390	2000	213	2330	1020	1150	53	881
13	e26	16	54	2980	1270	1980	213	1740	965	828	53	750
14	e26	15	53	2420	1170	1800	286	1220	1050	827	56	739
15	e27	20	52	2010	1100	1580	973	862	1040	810	54	718
16	e27	36	53	1640	1040	1360	1750	689	1100	855	54	768
17	e28	33	53	1360	958	1180	1990	510	1080	843	191	824
18	28	32	55	1220	879	1050	2310	424	969	1170	381	813
19	28	32	57	1200	859	897	2390	404	910	1250	499	859
20	28	32	56	1320	1450	801	2240	368	830	958	547	984
21	28	27	55	1500	1950	676	1690	360	753	967	734	919
22	27	32	55	1620	1930	578	1270	350	908	974	836	699
23	28	33	58	1500	1800	486	1040	322	710	848	867	730
24	28	40	173	1350	1600	434	865	288	1010	807	1020	719
25	29	51	431	1240	1410	407	772	237	751	1150	1010	711
26	28	51	469	1230	1280	377	631	235	877	1140	1080	595
27	27	51	473	1500	1250	241	489	243	1000	746	956	456
28	27	51	485	1830	1140	170	405	278	948	526	865	128
29	28	51	---	2080	1020	223	356	292	1030	204	816	252
30	28	51	---	2140	923	159	505	290	1000	408	845	82
31	27	51	---	1990	---	107	---	650	1030	---	941	---
Total	839	1083	3247	55181	44489	28335	22600	34351	27699	25309	18280	23209
Mean	27.1	34.9	116	1780	1483	914	753	1108	894	844	590	774

Year total 284,622 $(ft^3/s)\cdot d$
Mean 780 ft^3/s

Table 15. Daily mean discharge, Neversink River at Neversink, N.Y. (station number 0143600) for year ending November 30, 1998
(U.S. Geological Survey published record)
[All values except total in cubic feet per second, ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	14	15	26	26	26	44	51	85	48	51	36	23
2	14	15	26	26	26	53	51	68	48	51	30	23
3	15	15	26	26	26	52	56	59	48	51	30	23
4	15	15	26	26	26	52	53	66	60	51	30	23
5	15	16	26	26	25	52	50	65	75	50	30	23
6	15	16	26	26	25	52	49	58	83	50	29	23
7	15	16	26	26	26	52	49	51	83	50	27	23
8	15	16	26	26	25	52	49	51	78	49	24	23
9	15	12	26	27	25	53	49	51	70	49	23	23
10	15	6.9	26	25	25	60	49	51	70	49	23	23
11	15	7.0	26	25	25	1310	49	51	63	51	23	23
12	15	7.0	26	26	26	1090	51	49	50	51	23	23
13	15	7.0	26	26	26	530	50	54	51	51	23	23
14	15	7.9	26	26	26	393	1630	85	51	58	23	22
15	15	12	26	26	26	155	2140	99	51	70	23	22
16	15	17	26	26	26	54	1380	74	51	63	23	22
17	15	17	26	26	26	51	878	56	51	49	23	22
18	12	17	26	26	25	51	607	63	51	49	23	22
19	8.9	17	26	26	26	51	277	89	52	49	23	22
20	15	17	26	26	26	51	64	102	55	49	23	22
21	15	17	26	26	25	51	64	99	59	49	23	22
22	15	17	26	25	25	51	62	91	59	49	23	22
23	15	17	26	25	26	50	62	74	59	49	23	22
24	15	23	26	25	25	51	66	62	55	51	23	22
25	15	26	25	25	25	51	68	51	52	51	23	22
26	15	26	28	25	26	51	68	50	58	49	24	22
27	15	26	26	25	26	51	62	49	75	50	24	22
28	15	26	26	25	26	57	48	58	84	49	24	22
29	15	26	---	25	26	64	55	57	79	49	23	22
30	15	26	---	25	26	51	57	48	70	49	23	22
31	15	26	---	25	---	51	---	48	63	---	23	---
Total	453.9	524.8	729	795	769	4837	8244	2014	1902	1536	768	673
Mean	14.6	16.9	26.0	25.6	25.6	156	275	65.0	61.4	51.2	24.8	22.4

Year total 23,245.7 $(ft^3/s)\cdot d$
Mean 63.7 ft^3/s

Table 16. Daily mean discharge, Wallenpaupack Creek at Wilsonville, Pa. (station number 01432000) for year ending November 30, 1998
(Record furnished by Pennsylvania Power & Light Company)
[All values except total in cubic feet per second, ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	0	183	0	0	1180	870	452	504	0	0	351	0
2	0	602	761	895	1080	0	532	476	0	0	352	0
3	0	0	607	1130	1200	0	450	474	247	0	0	0
4	0	0	741	1120	677	860	478	358	223	0	0	0
5	0	796	643	1050	641	813	437	303	0	0	448	30
6	0	802	735	1110	470	674	0	420	0	0	351	0
7	0	794	0	1160	691	963	0	435	131	0	432	0
8	64	885	0	1110	690	732	707	380	0	111	291	0
9	107	1060	751	1050	807	3	563	442	0	175	365	0
10	99	805	788	1090	832	0	1110	353	10	407	0	3
11	0	459	770	1220	0	695	1140	334	0	372	0	0
12	43	507	832	1250	0	1360	1060	328	0	0	264	0
13	0	806	785	1280	720	1780	632	457	0	0	193	60
14	0	912	79	1240	447	1450	705	354	0	495	262	0
15	0	1260	0	1290	629	1010	1060	418	0	412	219	0
16	0	1480	1000	1230	644	0	1020	537	0	325	251	0
17	0	918	819	1240	617	0	1100	416	0	422	45	0
18	0	914	777	1300	0	756	971	347	97	0	0	0
19	0	765	752	1230	0	771	1160	319	0	0	0	0
20	0	667	838	1250	738	773	643	493	0	0	0	0
21	0	656	0	1270	927	699	606	580	56	408	0	0
22	226	746	0	1270	1260	488	799	337	0	103	0	0
23	236	604	646	1250	1730	0	1200	461	0	360	0	0
24	0	581	1000	1220	1730	0	1170	430	358	296	0	0
25	0	557	1180	1160	2	0	1220	0	298	326	0	0
26	0	768	854	934	0	537	1090	0	192	0	0	0
27	0	807	855	954	1050	497	568	346	434	0	0	0
28	0	759	0	1240	943	441	523	495	88	370	0	0
29	226	742	---	1100	936	434	479	452	0	279	0	0
30	223	829	---	1170	1040	0	368	438	0	460	0	0
31	865	0	---	1070	---	0	---	345	0	---	0	---
Total	2089	21664	16213	34883	21681	16606	22243	12032	2134	5321	3824	93
Mean	67.4	699	579	1125	723	536	741	388	68.8	177	123	3.10

Year total 158,783 $(ft^3/s)\cdot d$
Mean 435 ft^3/s

Table 17. Daily mean discharge, Delaware River at Montague, N.J. (station number 01438500) for year ending November 30, 1998
(U.S. Geological Survey published record)
[All values except total in cubic feet per second, ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	5130	3980	3350	10900	10500	6700	6670	17900	1840	1750	1530	1690
2	6570	3330	3570	15100	15600	6330	5780	14800	1820	1730	1420	1790
3	5400	3710	3980	14500	15300	6870	7960	11400	2010	1830	1710	1820
4	4630	3480	4060	12500	12500	10700	7640	9290	1900	1940	1770	1830
5	4370	6290	4080	11000	10900	11600	5660	7680	1830	1940	1670	1830
6	4490	10900	4130	9760	9140	11700	4440	7710	1780	1880	1810	1840
7	3990	15900	3690	8860	8250	12100	3470	6450	1980	2000	1720	1820
8	3630	23600	2840	8170	7970	11400	3190	5420	2080	1990	2000	1840
9	3560	39100	3150	10900	8440	10600	3350	8120	2020	1530	2400	1880
10	3110	31200	3600	28200	17300	15100	3490	13400	2000	1370	3220	1780
11	2900	19400	3460	29000	17000	30600	3640	11500	2060	1530	2150	1900
12	2940	13600	5430	20400	12800	32100	4170	8980	1910	1660	1830	1540
13	2750	11000	8630	15800	11200	24900	7930	7460	2080	2120	1920	1730
14	2450	9530	7680	13300	10100	19100	14700	6630	1940	1900	1680	2020
15	2240	7990	5380	11500	9470	15200	20300	5320	2030	2070	1670	1780
16	2170	8750	5260	10300	9020	12000	23900	4590	2010	1890	1910	1710
17	2440	10800	5780	9040	8180	9840	21500	4370	2120	1840	1950	1680
18	2240	9230	6420	8690	7510	8810	20700	3570	2170	1880	1610	1710
19	2060	8010	8660	9940	6780	8090	17800	3000	2300	1500	1390	1710
20	2130	7110	10200	11100	14200	7050	14400	3160	1970	1890	1520	1710
21	2120	6660	8950	11200	18700	6320	12200	3320	1910	1810	1590	1780
22	1890	5780	7500	12900	15400	5130	9790	3440	1830	2100	1640	1910
23	2260	5540	7160	11900	13800	4280	8870	3020	1760	1860	1760	1830
24	2110	5660	8330	10700	12400	3500	7530	2780	1840	2030	1800	1640
25	2300	6180	9590	10100	9910	3180	6760	2460	2030	1870	1910	1610
26	3040	5590	9200	9150	8070	3820	5950	1940	2240	1860	1950	1710
27	3750	5130	9000	11100	9220	4330	4790	1720	1740	1870	1920	1940
28	3730	4960	8470	12900	8910	3640	4170	2130	2150	1790	1980	2320
29	3560	4780	---	13200	7960	3310	3740	2250	1800	2180	1810	1990
30	4100	4740	---	12500	7280	3020	4280	2060	1710	1860	1760	1560
31	4080	4250	---	11200	---	2920	---	2070	1790	---	1740	---
Total	102140	306180	171550	395810	333810	314240	268770	187940	60650	55470	56740	53900
Mean	3295	9877	6127	12770	11130	10140	8959	6063	1956	1849	1830	1797

Year total 2,307,200 $(ft^3/s)\cdot d$
Mean 6,321 ft^3/s

Table 18. Diversions by New Jersey; daily mean discharge, Delaware and Raritan Canal at Port Mercer, N.J. (station number 01460440) for year ending November 30, 1998. (U.S. Geological Survey published record)
[All data except total in million gallons per day, Mgal/d; total in Million gallons, Mgal]

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	72	70	85	86	79	94	83	102	96	98	105	103
2	72	77	86	87	69	81	86	103	95	97	101	103
3	72	76	87	85	84	88	90	102	98	98	101	101
4	81	77	89	84	86	92	90	97	98	98	106	101
5	85	79	83	85	87	90	90	96	97	98	105	101
6	83	79	80	87	87	91	92	96	97	96	103	101
7	84	76	89	88	88	91	92	96	100	95	102	101
8	83	63	89	89	90	76	94	94	100	91	96	101
9	81	78	87	56	84	43	93	95	100	96	96	103
10	82	34	87	76	25	35	94	98	100	101	106	102
11	82	21	89	80	78	55	92	97	100	103	101	101
12	80	20	65	81	84	39	94	98	100	103	100	101
13	79	61	88	84	85	83	72	97	100	102	103	101
14	79	90	87	85	87	86	86	97	98	101	99	101
15	79	92	87	87	89	84	90	98	98	101	98	101
16	79	78	88	89	89	92	91	99	99	101	98	101
17	79	87	89	89	89	90	90	96	94	98	98	103
18	79	85	63	90	87	86	95	94	99	101	98	102
19	78	86	86	31	89	89	94	94	98	100	99	101
20	79	87	84	73	84	89	94	96	97	101	100	102
21	79	87	84	51	86	89	81	96	99	99	103	101
22	79	89	86	69	89	89	90	97	98	95	107	101
23	77	63	88	77	89	90	94	96	98	98	107	102
24	75	28	41	81	87	90	92	97	96	98	106	100
25	67	69	61	87	90	88	92	97	97	101	107	100
26	67	74	81	86	87	88	93	97	102	102	107	101
27	73	85	84	87	81	89	98	97	89	100	107	96
28	77	92	87	87	86	90	96	98	98	100	107	97
29	77	85	---	88	87	88	96	96	96	102	107	58
30	28	84	---	87	93	90	100	98	97	103	107	93
31	66	86	---	86	---	89	---	96	98	---	104	---
Total	2353	2258	2300	2498	2515	2554	2734	3010	3032	2977	3184	2980
Mean	75.9	72.8	82.1	80.6	83.8	82.4	91.1	97.1	97.8	99.2	103	99.3

Year total 32,395 Mgal
Mean 88.8 Mgal/d

SECTION III

QUALITY OF WATER IN THE DELAWARE ESTUARY

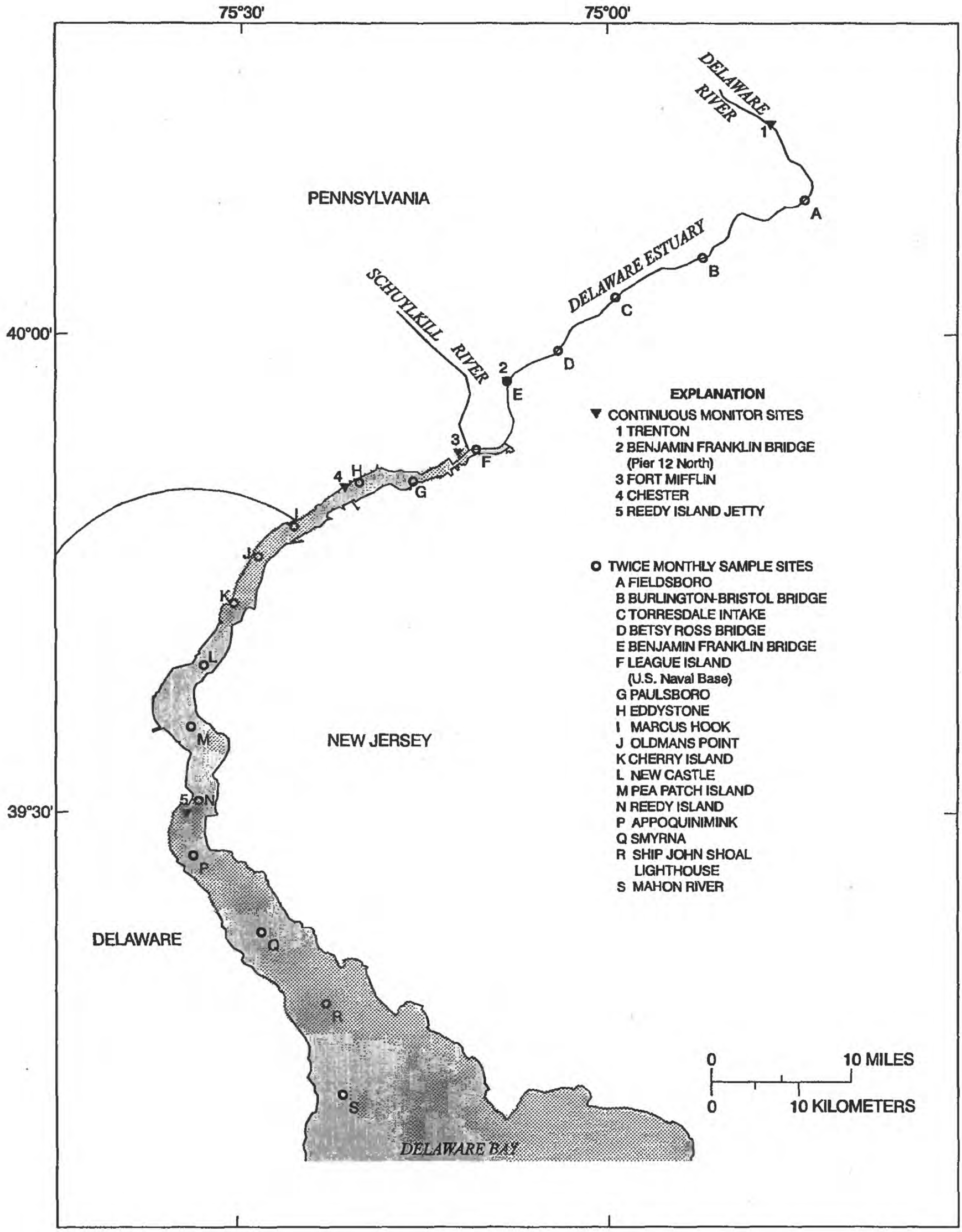

Figure 6.- Location of water-quality monitoring sites on the Delaware Estuary.

Section III
QUALITY OF WATER IN THE DELAWARE ESTUARY
By Hugh L. Darling

INTRODUCTION

This section describes the water-quality monitoring program for the Delaware Estuary during the 1998 report year, December 1, 1997, to November 30, 1998. This program is conducted by the U.S. Geological Survey, in cooperation with the Delaware River Basin Commission. Selected data collected for this program are presented and water-quality conditions are described. The Delaware River Basin Commission uses these data to monitor water-quality conditions and track the movement of the "salt front" in the Delaware Estuary.

WATER-QUALITY MONITORING PROGRAM

As part of a long-term cooperative program, the quality of water in the Delaware Estuary between Trenton, N.J. and Reedy Island Jetty, Del. was monitored at various locations (fig. 6). Data on temperature, specific conductance, dissolved oxygen, and pH were collected by electronic instruments at four sites -- Trenton, Benjamin Franklin Bridge, Chester, and Reedy Island Jetty. Data on temperature and specific conductance were collected by monitors at Fort Mifflin. Water-quality monitors at Benjamin Franklin Bridge, Fort Mifflin, and Chester are operated from (approximately) April to November. Monitors at Trenton and Reedy Island Jetty are operated continuously.

From March to November, additional data were obtained on a twice-monthly basis at 18 sites between Fieldsboro, N.J. and the mouth of Mahon River (fig. 6). These data were collected by the State of Delaware for the Delaware River Basin Commission. At each of these sites, water samples were collected near the center of the channel and analyzed for 28 physical properties and chemical constituents including temperature, chloride, alkalinity, specific conductance, dissolved oxygen, pH, nutrients, and trace metals. These analyses consist of field measurements and laboratory determinations.

Data obtained from the water-quality monitors are processed and stored in the U.S. Geological Survey's National Water Information System database. These data are published annually by the Survey in the report "Water Resources Data for Pennsylvania, Volume 1, Delaware River Basin." Water-quality data for the 18 bimonthly sampling sites are not presented in this report but are available from the Delaware River Basin Commission. All data collected before 1999 are available from STORET, the U.S. Environmental Protection Agency's electronic storage and retrieval system for water-quality data.

WATER QUALITY DURING THE 1998 REPORT YEAR

Streamflow

Streamflow has a major influence on the quality of water in the Delaware Estuary. Increased streamflow usually results in improved water quality by limiting the upstream movement of oceanic salt water and reducing the concentration of dissolved substances. Increased flow also aids in maintaining lower water temperatures during warm weather and in supporting greater concentrations of dissolved oxygen. Under certain conditions, however, increased streamflow can transport large quantities of nutrients to the estuary, which may result in noxious algae blooms.

During the report year, monthly mean streamflow for the U.S. Geological Survey gaging station Delaware River at Trenton, N.J. was lowest during September (3,010 ft^3/s) and highest during March (25,710 ft^3/s) (table 19).[1] Monthly mean streamflows were greater than long-term mean monthly flows from January to July and were less than the long-term flows for the other months of the report year. Monthly mean streamflow in November was less than 30 percent of the long-term mean monthly flow. Long-term monthly mean streamflow is computed on the basis of data for the period from 1913 to 1997.

Water Temperature

Water temperature is an important factor affecting water quality, as it influences various physical, chemical, and biological properties of water. Generally, increases in water temperature have deleterious effects on water quality by decreasing the saturation level of dissolved oxygen and increasing the biological activity of aquatic organisms. Although the primary factors that control water temperature in the Delaware Estuary are climatic, various kinds of water use, especially powerplant cooling, also can have significant effects.

Water-temperature records for the monitoring site at Benjamin Franklin Bridge (Pier 12 North), Philadelphia, Pa., show that monthly mean temperatures from April to November 1998 were less than the long-term mean monthly temperatures only during June and July. In April and May, and from August to November, monthly mean water temperatures exceeded long-term mean monthly temperatures. Long-term mean water temperatures are computed on the basis of data for the period from 1962 to 1997 (fig. 7).

Specific Conductance and Chloride Concentration

Specific conductance is a measure of the ability of a solution to conduct an electric current. It can be used as an indicator of ion concentration in the solution and relates approximately to the content of dissolved solids. Elevated concentrations of ions in oceanic salts and some contaminants from man-made sources can have a substantial effect on specific conductance. Dilution associated with increased streamflow results in decreased concentrations of dissolved solids and,

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[1]All numbered tables in Section III are grouped at the end of this section, beginning on page 81.

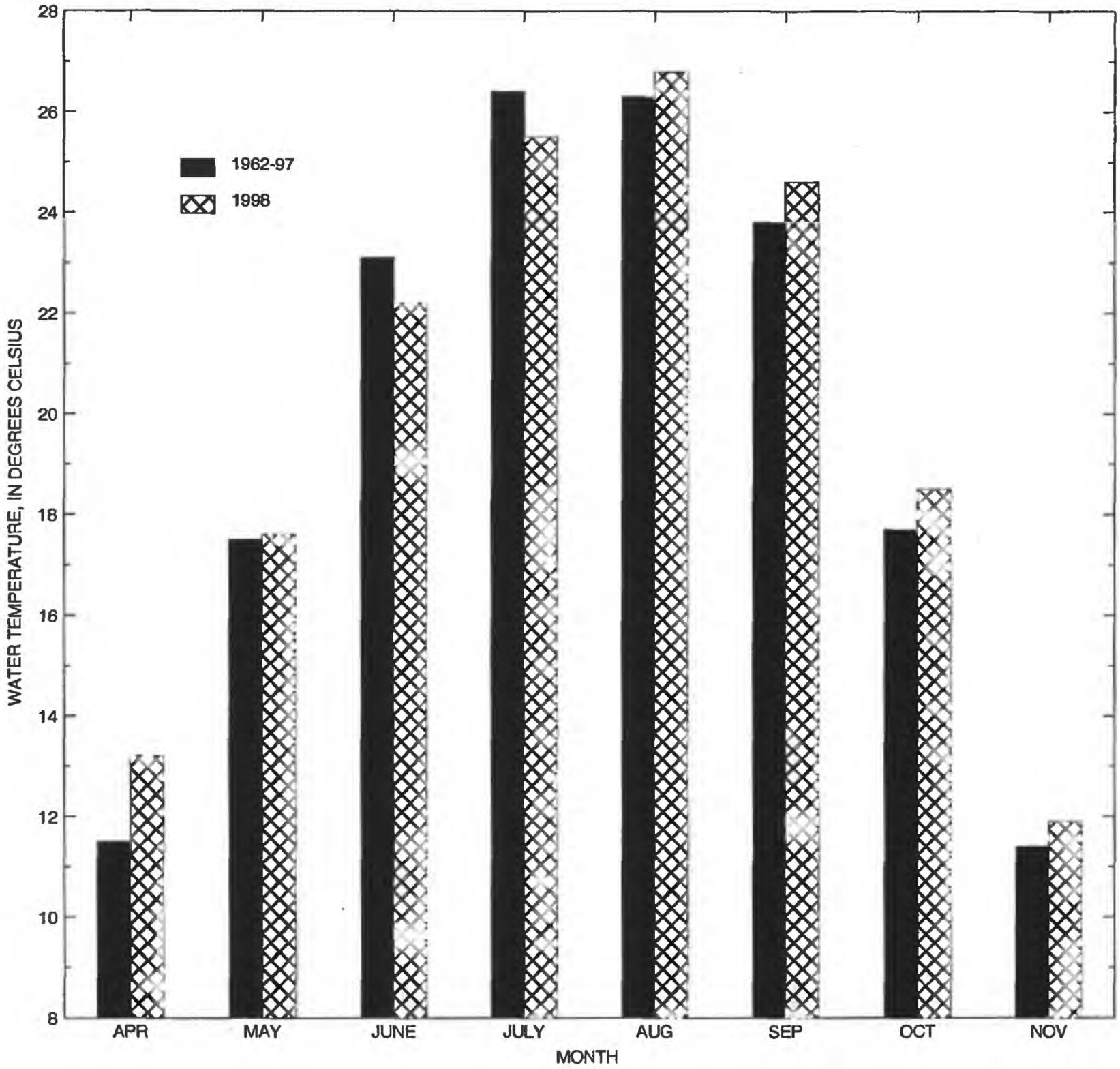

Figure 7.--Monthly mean water temperature of the Delaware Estuary at Benjamin Franklin Bridge, Philadelphia, Pa.

consequently, decreased specific conductance. Decreased streamflows have the opposite effect on dissolved solids and specific conductance.

In the Delaware Estuary, the upstream movement of oceanic salts, and the accompanying increase in chloride concentrations, is an important concern to those who use the estuary as a source of water supply. Water with chloride concentrations greater than 250 mg/L (milligrams per liter) is considered undesirable for domestic use, and water with concentrations in excess of 50 mg/L is unsatisfactory for some industrial uses. Chloride concentrations in the estuary generally increase in a downstream direction, that is, in proximity to the Atlantic Ocean.

Chloride concentration was not measured directly at the monitoring sites at Fort Mifflin, Pa., and Reedy Island Jetty, Del. Instead, relationships between specific conductance and chloride concentration have been developed on the basis of long-term measured values of specific conductance and laboratory analyses of water samples, and these relationships can be used to estimate chloride concentrations from specific conductance data. Chloride concentrations estimated from the relationships are presented in tables 20 and 21. The specific conductance-chloride relationships are less reliable when chloride concentrations are less than 30 mg/L, because other ionized substances may be present in amounts large enough to affect the relationships. Therefore, chloride concentrations estimated from specific conductance data are not tabulated when concentrations of less than 30 mg/L would result from the relationships. Chloride concentrations at Chester, Pa., (table 22) were measured directly by Kimberly Clark Chester Operations.

At the Fort Mifflin monitoring site, the estimated maximum daily chloride concentration for the periods December 1- 9, 1997 and March 25 to November 30, 1998 was 110 mg/L on October 7 and 8 (table 20). During the same period, the maximum daily concentration exceeded 50 mg/L on 30 percent of the days. The estimated minimum daily chloride concentration was less than 30 mg/L on many days during the report year (table 20), and it exceeded 50 mg/L on 15 percent of the days. From April to July, daily minimum chloride concentrations were consistently less than 30 mg/L, and the daily maximum concentration was 43 mg/L. From August to November, daily minimum chloride concentrations ranged from less than 30 to 73 mg/L, and estimated daily maximum concentrations ranged from less than 30 to 110 mg/L.

At the Chester monitoring site, the maximum daily chloride concentration was 620 mg/L on October 9, 1998 (table 22). During the report year, the maximum daily concentration exceeded 50 mg/L on 49 percent of the days. The minimum daily chloride concentration was 12 mg/L on January 18, 1998 (table 22), and it exceeded 50 mg/L on 30 percent of the days. From December to June, daily minimum chloride concentrations at Chester ranged from 12 to 96 mg/L, and daily maximum concentrations ranged from 28 to 120 mg/L. From July to November, daily minimum chloride concentrations ranged from 26 to 336 mg/L, and daily maximum concentrations ranged from 37 to 620 mg/L.

At the Reedy Island Jetty monitoring site, the estimated maximum daily chloride concentration was 7,600 mg/L on November 1, 8, and 10, 1998 (table 21). The maximum daily chloride concentration during the report year exceeded 1,000 mg/L on 72 percent of the days. The estimated minimum daily chloride concentration for the period from March 1 to May 31 was less than 30 mg/L on 15 days (table 21); the longest continuous period of concentrations less than 30 mg/L was May 12-20. The minimum daily chloride concentration for the report year exceeded 1,000 mg/L on 49 percent of the days. From December to May, daily minimum chloride concentrations at Reedy Island Jetty ranged from less than 30 to 3,100 mg/L, and daily maximum concentrations ranged from 38 to 6,800 mg/L. From June to November, daily minimum chloride concentrations ranged from 340 to 4,800 mg/L, and daily maximum concentrations ranged from 1,700 to 7,600 mg/L.

Dissolved Oxygen

Dissolved oxygen in water is necessary for the respiratory processes of aquatic organisms. Dissolved oxygen also plays a major role in chemical reactions in aquatic environments. Fish and many other clean-water biota require relatively high dissolved-oxygen concentrations at all times. The major source of dissolved oxygen in water is diffusion from the atmosphere and, to a lesser extent, photosynthesis by aquatic plants. The principal factors that affect concentrations of dissolved oxygen in the Delaware Estuary are water temperature, biochemical oxygen demand, freshwater inflow, phytoplankton, turbidity, salinity, and tidal and wind-driven mixing.

Concentrations of dissolved oxygen at various sites on the Delaware Estuary have been measured since 1962 by the U.S. Geological Survey. Two of these sites, Delaware River at Benjamin Franklin Bridge at Philadelphia, Pa., and Delaware River at Chester, Pa., have nearly continuous records and are in the reach of the estuary most affected by contaminant loadings. Figure 8 shows mean monthly dissolved-oxygen concentrations during July at these two stations from 1965 to 1998. An upward trend in concentration is evident. Although dissolved-oxygen concentrations have increased considerably from 1965 to 1998, concentrations may vary widely from year to year.

Concentrations of dissolved oxygen in the estuary generally are greatest near Trenton and decrease in a downstream direction to an area below the Benjamin Franklin Bridge, where concentrations usually reach minimum levels. During the report year, daily mean concentrations of dissolved oxygen at the Benjamin Franklin Bridge monitoring site were lowest during August, and the lowest recorded daily mean was 4.1 mg/L on August 19 (table 23). The minimum hourly concentration was 3.8 mg/L on August 20. At Chester, daily mean dissolved oxygen concentrations were lowest at the end of September and the beginning of October, and the lowest recorded daily mean concentration was 4.5 mg/L on October 5 (table 24). The minimum hourly concentration was 4.3 mg/L on September 27. At Reedy Island Jetty, the minimum hourly concentration was 5.4 mg/L on August 7.

The histogram of hourly dissolved-oxygen concentrations at the Benjamin Franklin Bridge and Chester monitoring sites during the critical summer period--July to September 1998--is presented in figure 9. Concentrations of dissolved oxygen at the bridge were less than 4 mg/L for 1 percent of the time in 1998. In 1997, concentrations did not decrease to levels less than 4 mg/L. In 1996, concentrations declined below 4 mg/L for 13 percent of the time and, in 1995, for 1 percent of the time. From April through most of June and from October to November, daily mean concentrations of dissolved oxygen mostly were greater than 6.0 mg/L. At Chester, the concentration of dissolved oxygen did not decline below 4 mg/L in 1997 and 1998. In 1996, concentrations were less than 4 mg/L for 0.1 percent of the time and, in 1995, for 3 percent of the time. From April through mid-June, and from mid-August through November, minimum daily mean concentrations of dissolved oxygen generally were greater than 6.0 mg/L.

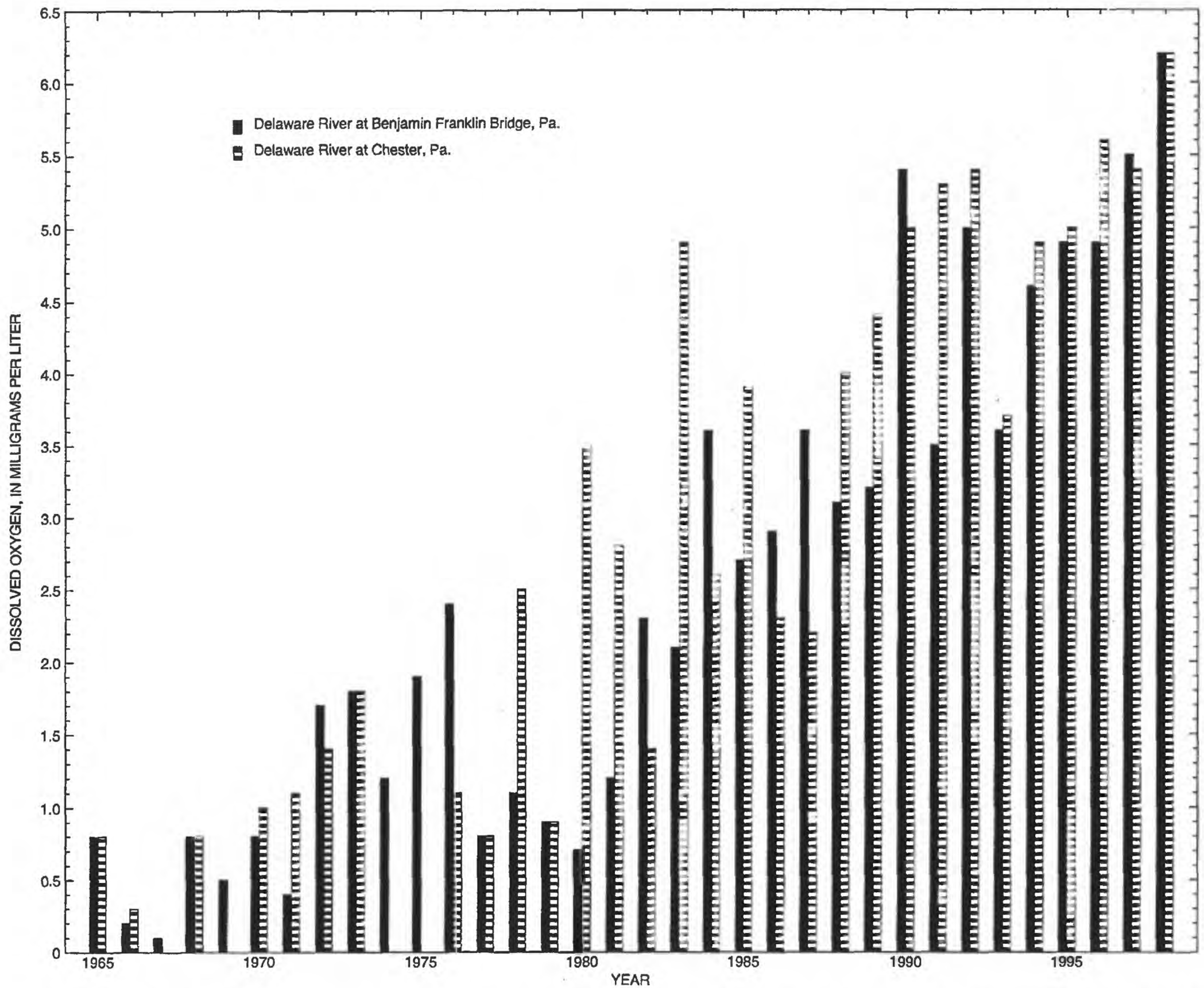

Figure 8.-- Mean monthly dissolved-oxygen concentrations during July for two monitoring sites on the Delaware Estuary, 1965-98.

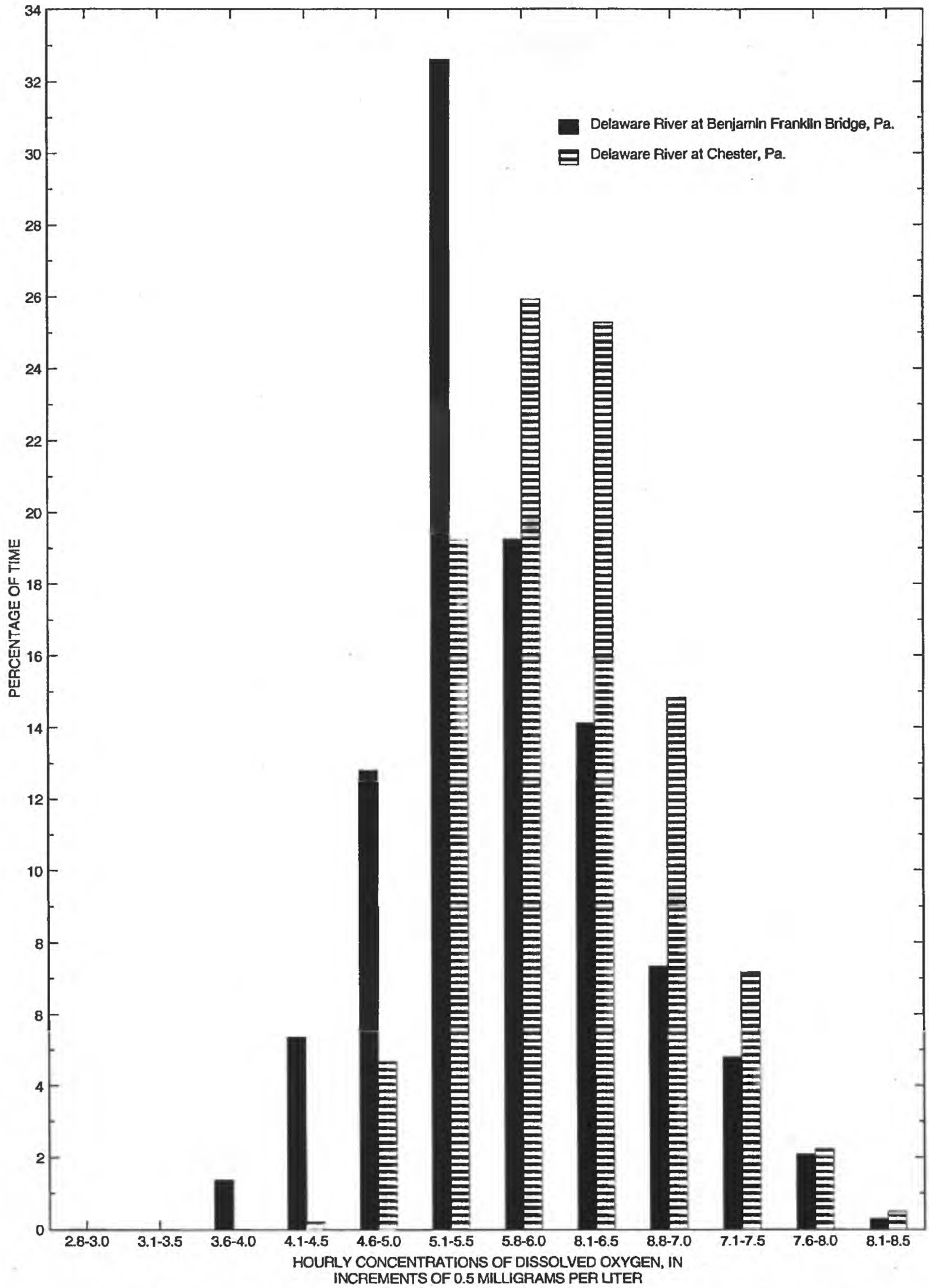

Figure 9.--Distribution of dissolved-oxygen concentrations at two monitoring sites on the Delaware Estuary, July to September 1998.

Hydrogen-Ion Activity (pH)

The pH of a solution is a measure of the effective concentration (activity) of dissolved hydrogen ions. Values of pH less than 7 indicate an acidic solution whereas values greater than 7 indicate an alkaline solution. The pH of uncontaminated surface water generally ranges from 6.5 to 8.5. The major factors controlling the pH of surface water usually are the geochemical composition of the drainage basin and human inputs such as effluent discharges. Photosynthetic activity also can have a considerable influence on pH. During the report year, pH values measured at the Benjamin Franklin Bridge, Chester, and Reedy Island Jetty monitoring sites ranged from 6.6 to 8.0. The pH ranges for each station are as follows: Benjamin Franklin Bridge, 6.6 to 7.5; Chester, 6.7 to 7.7; and Reedy Island Jetty, 7.1 to 8.0. Generally, the pH of water in the Delaware Estuary is lowest near Trenton, N.J. and increases in a downstream direction.

Table 19. Daily mean discharge, Delaware River at Trenton, N.J., (01463500) for the year ending November 30, 1998 (U.S. Geological Survey published record)

[All values except total in cubic feet per second ft^3/s; total in cubic feet per second days, $(ft^3/s)\cdot d$]

Date	December	January	February	March	April	May	June	July	August	September	October	November
1	6380	10500	11400	20500	20000	15400	7930	7610	3670	2790	3040	3000
2	8010	8550	9890	23000	27000	16200	11500	21100	3380	2890	2880	2930
3	10800	7510	9180	27500	27200	16500	12000	18900	3030	3360	2480	2840
4	9630	8390	9650	26000	25400	16300	12200	15500	2920	3490	2510	2880
5	8570	8270	11600	22600	21600	19000	12500	13200	3060	3130	2890	2900
6	8080	10300	15600	20100	19200	22600	10300	11200	2960	3030	2960	2880
7	7940	18300	14100	18000	16900	25400	8710	10900	2860	2940	2760	2960
8	7590	29100	12900	16800	15400	25800	7300	9910	2830	3350	3100	3260
9	6940	49400	10900	24000	15100	32600	6610	9400	3000	3670	6800	3090
10	6790	60200	9990	38900	33200	34900	6710	9800	3100	3360	7130	2830
11	6850	45900	10400	56100	39200	46300	6370	16300	3610	2820	8970	2980
12	6220	32400	13100	47000	32800	66800	7620	14900	3670	2710	7140	3250
13	5900	24500	17700	35400	26600	59400	11800	12500	3300	2750	5340	3370
14	6020	20300	19400	28600	23000	45700	23100	10400	2980	2660	4510	2920
15	5400	17800	18100	24900	20900	36400	29100	9530	3120	3070	4810	2990
16	5130	18600	15200	22100	19400	30000	33000	8210	3020	2810	4510	3180
17	4930	19100	13400	19700	18100	25200	35900	7200	3230	2980	4150	2940
18	4770	20100	17600	17800	17000	21000	31300	6760	3610	3110	4220	2830
19	5040	18000	20000	23100	15900	18300	29700	6170	3840	2940	4080	2750
20	4570	16400	21600	24300	19200	16900	25700	5290	3740	2940	3330	2810
21	4540	15000	22700	26000	30500	15400	20900	4790	3510	2770	3020	2830
22	4440	13600	20200	29000	32300	13900	18400	5110	3090	2960	2920	2830
23	4540	15000	18100	28100	27500	12200	16000	5230	3070	2920	2930	2840
24	4820	23800	25400	25500	24400	11100	14900	5060	3550	3210	2980	2950
25	6410	19200	28900	23100	21700	9820	13200	4700	2950	2890	3090	2890
26	8640	17400	26000	21300	18600	9250	11900	4160	3120	3080	3120	2810
27	8510	15500	22900	19800	20100	8930	10600	3950	4120	3000	3180	3550
28	8890	14100	21100	21500	19600	9480	9750	3330	4050	2970	3230	3950
29	9180	13700		23000	18000	8780	8430	3100	3260	2910	3210	3720
30	14000	12900		22400	16300	8350	7780	3560	3390	2780	3290	3930
31	12700	12100		21000		8180		3730	3000		3130	
Total	222230	615920	467010	797100	682100	706090	461210	271500	102040	90290	121710	91890
Mean	7170	19870	16680	25710	22740	22780	15370	8760	3290	3010	3930	3060
Max	14000	60200	28900	56100	39200	66800	35900	21100	4120	3670	8970	3950
Min	4440	7510	9180	16800	15100	8180	6370	3100	2830	2660	2480	2750

Year mean 12,700 ft^3/s

Year total 4,629,090 $(ft^3/s)\cdot d$

Table 20. Daily maximum and minimum chloride concentrations estimated from values of specific conductance, Delaware River at Fort Mifflin, Pa., December 1, 1997 to November 30, 1998

[Concentrations in milligrams per liter; monitor was not in operation December 10, 1997 to March 24, 1998; --, missing data; *, less than 30 milligrams per liter; Max, maximum value; Min, minimum value; <, less than]

Date	December		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
1	48	31			*	*	*	*	30	*	*	*	32	*	42	35	72	56	61	43
2	41	31			31	*	*	*	34	*	*	*	34	*	41	33	78	55	59	43
3	40	*			*	*	*	*	35	*	*	*	*	*	47	35	77	56	57	43
4	39	*			*	*	*	*	31	*	*	*	*	*	44	37	74	54	69	43
5	40	*			*	*	30	*	30	*	35	*	*	*	44	38	81	57	66	45
6	44	*			*	*	*	*	31	*	34	*	*	*	41	37	95	58	79	44
7	54	30			*	*	*	*	37	*	*	*	*	*	43	36	110	60	75	48
8	45	*			*	*	*	*	36	*	34	*	*	*	45	36	110	64	77	51
9	36	*			*	*	*	*	35	*	39	*	31	*	42	38	89	65	80	51
10					33	*	*	*	31	*	39	*	30	*	44	38	85	59	81	55
11					*	*	*	*	*	*	33	*	41	*	44	39	73	48	86	55
12					*	*	*	*	35	*	*	*	42	*	48	37	68	43	76	55
13					*	*	*	*	43	*	*	*	44	*	45	39	67	46	76	54
14					*	*	*	*	43	*	*	*	37	*	53	41	65	43	83	57
15					*	*	*	*	*	*	*	*	40	*	52	39	56	41	88	55
16					--	--	*	*	*	*	*	*	42	*	52	41	53	41	83	56
17					--	--	*	*	*	*	*	*	43	*	56	42	52	41	84	59
18					*	*	*	*	*	*	*	*	87	*	58	43	52	41	88	62
19					*	*	*	*	*	*	*	*	81	31	64	43	52	40	89	60
20					*	*	*	*	*	*	*	*	61	32	67	44	46	38	96	63
21					*	*	*	*	*	*	*	*	55	31	65	45	48	40	89	63
22					*	*	*	*	*	*	*	*	43	32	65	46	46	39	87	60
23					*	*	*	*	*	*	*	*	39	32	66	50	46	39	85	65
24					*	*	*	*	*	*	*	*	42	32	69	49	50	40	85	62
25			*	*	*	*	*	*	33	*	*	*	38	31	71	52	49	39	97	68
26			*	*	*	*	*	*	35	*	*	*	44	31	71	53	50	39	97	73
27			*	*	*	*	34	*	33	*	*	*	56	34	72	54	51	41	91	65
28			*	*	30	*	34	*	*	*	*	*	46	33	68	53	53	42	83	67
29			*	*	*	*	31	*	*	*	*	*	41	34	71	52	50	43	84	65
30			*	*	*	*	33	*	*	*	32	*	43	33	78	52	54	42	99	66
31			*	*			33	*			33	*	41	34			56	43		
Max	54	31			33		34		43		39		87	34	78	54	110	65	99	73
Min	36	<30			<30		<30		<30		<30		<30	<30	41	33	46	38	57	43

Table 21. Daily maximum and minimum chloride concentrations estimated from values of specific conductance, Delaware River at Reedy Island Jetty, Del., December 1, 1997 to November 30, 1998

[Concentrations in milligrams per liter; --, missing data; *, less than 30 milligrams per liter; Max, maximum value; Min, minimum value; <, less than]

Date	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	5600	3000	2900	1300	3400	940	2700	560	130	30	420	110	--	--	1800	430	4300	1400	6200	2900	5600	3300	7600	4100
2	5700	3000	2500	1200	3100	1000	2600	490	66	31	1100	110	--	--	2700	390	4700	1600	6700	3100	6200	3200	6800	4200
3	5600	2200	5500	1200	2900	900	2500	440	46	*	850	95	--	--	2800	450	5000	1900	6500	3200	6300	3400	6700	4100
4	5600	2300	5200	1900	3800	900	2100	370	53	*	710	94	--	--	3500	550	5100	2000	6400	3400	6400	3600	7000	4200
5	5800	2700	6200	2100	5800	2700	1200	290	810	*	440	83	--	--	3600	690	5400	2100	6500	3500	6400	3700	7300	4300
6	5300	2700	5700	2200	5600	2300	1400	290	1700	*	510	85	--	--	4200	810	5500	2100	6100	3300	6700	3800	7500	4400
7	3900	2100	5700	2300	4300	2000	1400	230	2000	38	1000	67	--	--	3700	910	5400	2400	5600	3100	6600	4100	7500	4300
8	4800	1700	6200	2300	4300	1800	1500	230	2000	130	530	67	--	--	3900	1000	5300	2600	6000	3200	6800	4100	7600	4300
9	5700	1900	--	--	4300	1700	2100	330	2400	300	580	37	--	--	3500	1000	5500	2600	5800	3300	6400	4000	7300	4500
10	6000	2300	--	--	3700	1500	710	83	2700	400	1200	41	--	--	--	--	5400	2600	5900	3300	6400	3900	7600	4400
11	6100	2600	--	--	3600	1500	170	34	1900	260	600	38	--	--	3500	1100	5200	2600	6200	3400	6500	3700	7100	4800
12	5900	2900	--	--	3500	1400	310	30	1600	230	1200	*	--	--	3900	1100	4700	2400	6300	3500	6700	3800	6500	4100
13	5800	2700	--	--	2400	1100	350	*	1400	170	690	*	--	--	3800	1100	5200	2400	6700	3500	7300	3900	6600	4100
14	5000	2500	--	--	2600	950	450	31	1400	200	310	*	--	--	3400	1100	4900	2800	6600	3800	6200	4100	7100	3900
15	5300	2300	--	--	2700	800	53	31	1200	210	170	*	--	--	2500	990	4700	2700	6100	3800	6000	3800	6900	4200
16	5100	2300	--	--	--	--	53	31	1200	220	38	*	2800	820	--	--	4700	2700	5700	3400	5900	3600	6900	4200
17	5600	2300	--	--	--	--	120	31	890	170	420	*	2200	660	--	--	4900	2600	6300	3400	6300	3600	6500	4100
18	5500	2500	1900	230	--	--	190	32	630	160	650	*	2100	500	3200	840	4800	2500	6500	3600	6400	3700	7000	4200
19	5000	2500	2200	220	--	--	140	31	760	150	680	*	2200	430	3400	880	5500	2400	6800	3800	5700	3300	6700	4400
20	5200	2400	2300	250	--	--	270	*	1600	120	1300	*	2300	350	3200	920	5600	2800	6500	3800	5400	3300	6800	4400
21	5400	2200	3300	250	--	--	720	37	1500	120	1600	32	2200	340	--	--	5400	2700	5900	3800	5700	3400	6600	4100
22	5000	2700	4200	1500	--	--	780	210	1700	100	1700	48	2100	340	--	--	4900	2600	6000	3700	5800	3300	6700	4000
23	5900	3100	4800	1800	--	--	710	100	2000	130	1900	66	2300	350	--	--	5400	2700	6300	3600	6200	3600	6600	3700
24	6100	2900	3600	1100	--	--	550	75	1500	140	1800	120	2300	370	--	--	5200	2700	6000	3900	6400	3500	5900	3500
25	6800	3100	2100	640	--	--	560	70	750	95	2000	190	2200	380	--	--	4300	2500	5700	3700	6400	3300	6800	3600
26	5700	2900	1800	570	--	--	400	77	1200	120	1900	250	--	--	--	--	4900	2500	5800	3400	--	--	6700	3900
27	5100	2800	1500	510	--	--	150	65	860	94	2200	270	1700	380	--	--	4600	2600	6300	3500	--	--	6200	3800
28	5300	2800	2000	550	--	--	110	36	990	86	2200	340	2100	380	--	--	5200	2700	6300	3300	7200	3700	6500	3400
29	5300	2900	2600	1200			130	31	870	96	1800	340	2300	390	3200	1300	5600	3000	6400	3400	6600	3900	6600	3200
30	5000	2400	2200	1100			220	35	360	88	1400	330	1700	450	3400	1300	5600	2800	6800	3700	7100	3900	6700	3500
31	3000	1400	1700	880			200	31			1300	320			4300	1400	5600	2800			7100	4000		
Max	6800	3100	6200	2300	5800	2700	2700	560	2700	400	2200	340	2800	820	4300	1400	5600	3000	6800	3900	7300	4100	7600	4800
Min	3000	1400	1500	220	2400	800	53	<30	46	<30	38	<30	1700	340	1800	390	4300	1400	5600	2900	5400	3200	5900	3200

Table 22. Daily maximum and minimum chloride concentrations, Delaware River at Chester, Pa., December 1, 1997 to November 30, 1998

[Collection and analysis by Kimberly Clark Chester Operations; concentrations in milligrams per liter; Max, maximum value; Min, minimum value]

Date	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	120	88	54	44	38	32	36	30	46	28	61	31	34	28	51	27	50	32	124	110	310	240	340	180
2	120	96	42	35	36	32	53	27	51	30	56	42	34	30	51	28	58	36	132	110	330	185	300	178
3	110	60	48	35	44	36	50	27	48	33	70	40	57	32	50	32	51	38	110	96	340	218	285	174
4	92	84	40	18	44	38	57	28	43	32	40	35	44	38	46	32	48	38	112	90	380	166	285	174
5	90	72	53	32	44	38	50	30	40	29	32	30	56	31	50	26	48	38	122	96	410	221	410	198
6	90	64	51	35	44	38	57	35	35	28	41	32	45	30	51	34	40	38	116	104	400	235	340	210
7	96	60	47	36	44	38	56	36	32	25	61	33	61	30	48	32	56	42	120	108	440	220	340	210
8	92	55	45	32	44	40	66	38	54	26	57	28	60	32	45	30	56	46	118	110	500	240	360	240
9	92	60	46	44	42	36	48	39	55	26	48	38	61	34	37	30	55	47	195	144	620	240	320	162
10	100	80	48	41	44	40	38	34	41	27	46	38	40	30	48	30	66	47	165	130	320	244	400	320
11	86	68	52	32	62	45	71	36	50	26	66	26	41	30	52	36	60	46	185	140	320	225	380	336
12	82	60	42	30	56	42	48	30	50	27	56	30	45	32	58	32	65	46	205	174	246	190	336	246
13	76	57	38	32	64	40	46	30	46	33	32	25	44	30	46	38	62	44	190	170	240	172	362	230
14	68	53	46	34	58	40	61	36	42	24	34	27	48	32	58	38	82	60	210	150	232	190	346	245
15	72	50	42	25	62	38	51	38	40	34	44	26	45	30	54	40	82	71	240	165	236	182	320	240
16	68	52	36	30	72	36	81	36	38	29	48	30	44	32	48	40	82	75	240	150	196	120	380	240
17	74	57	36	21	64	42	51	33	46	32	53	27	43	34	44	40	90	76	220	145	206	130	340	260
18	64	56	36	12	46	38	42	40	32	28	44	32	44	40	40	36	126	92	232	195	172	126	390	280
19	72	59	36	27	44	35	38	26	38	26	28	25	38	28	40	35	84	66	300	184	190	126	450	280
20	60	42	44	30	44	32	50	23	38	30	34	28	32	28	45	30	120	98	300	196	160	115	410	240
21	62	52	35	30	57	34	86	24	42	32	38	29	32	27	48	30	86	70	320	175	185	158	430	290
22	63	52	30	25	58	44	42	26	40	33	30	24	44	30	51	32	86	76	300	190	168	138	364	245
23	63	56	33	27	55	34	42	36	36	25	28	26	29	25	54	30	98	74	260	200	170	120	360	260
24	68	52	48	30	73	30	51	23	42	30	34	28	32	26	49	32	120	110	305	240	190	126	355	250
25	73	44	49	34	62	34	76	36	41	26	41	30	38	26	37	34	118	100	330	212	148	118	430	240
26	60	52	48	32	66	35	66	35	42	29	56	30	38	31	40	34	118	100	280	228	280	140	463	260
27	62	58	42	32	37	30	46	29	50	42	42	38	34	30	40	34	118	110	304	226	285	175	347	210
28	62	45	41	38	40	28	35	25	64	28	48	30	41	28	40	36	140	82	320	210	228	170	367	220
29	52	42	42	35			36	23	48	25	47	28	36	30	71	32	134	90	285	232	220	158	400	186
30	66	45	35	32			47	30	46	26	60	28	38	21	60	34	53	47	340	235	260	180	276	240
31	64	58	36	34			50	28			42	35			62	32	140	98			240	190		
Max	120	96	54	44	72	45	86	40	64	42	70	42	61	40	71	40	140	110	340	240	620	244	463	336
Min	52	42	30	12	36	28	35	23	32	24	28	24	29	21	37	26	40	32	110	90	148	115	276	162

Table 23. Daily mean dissolved-oxygen concentrations, Delaware River at Benjamin Franklin Bridge at Philadelphia, Pa., December 1, 1997 to November 30, 1998

[Concentrations in milligrams per liter; monitor not in operation December 10, 1997 to March 26, 1998; --, missing data]

Date	December	March	April	May	June	July	August	September	October	November
1	10.3		10.4	9.2	6.8	5.3	5.2	--	5.6	7.6
2	10.7		9.8	8.9	6.9	5.3	5.2	--	5.9	7.7
3	10.9		--	8.9	7.0	5.4	5.2	5.4	6.2	7.9
4	10.9		9.4	8.8	7.1	5.2	5.2	5.4	6.2	7.9
5	10.9		9.1	8.6	7.2	5.0	5.4	5.4	6.1	5.0
6	11.1		9.0	8.3	7.1	5.6	5.1	5.5	6.3	4.5
7	11.4		9.3	8.1	7.3	5.6	5.2	5.7	6.3	8.3
8	11.5		9.5	7.9	7.2	5.7	5.1	5.5	6.1	8.4
9	11.4		9.6	7.9	7.3	5.4	5.7	5.8	5.9	8.5
10			9.9	8.0	7.1	5.3	5.6	6.0	5.6	8.5
11			10.5	8.1	7.0	5.5	5.1	6.1	5.7	8.5
12			10.5	8.5	6.6	5.9	5.0	6.2	6.0	8.6
13			10.6	8.9	6.1	6.1	5.1	6.4	6.2	8.6
14			10.5	8.9	6.1	6.3	5.0	6.4	6.5	8.7
15			10.4	8.8	6.4	6.5	5.0	6.5	6.6	8.6
16			10.1	8.7	6.9	6.7	4.9	6.5	6.7	8.7
17			9.9	8.4	7.5	6.9	4.6	6.2	6.5	8.8
18			9.6	8.3	7.8	7.1	4.2	5.9	6.6	8.8
19			9.3	8.0	7.9	7.4	4.1	5.7	6.7	8.9
20			9.1	7.9	7.8	7.6	4.2	5.5	6.6	8.8
21			9.0	7.7	7.8	7.7	4.4	5.4	6.8	8.9
22			9.1	7.7	7.7	7.6	4.4	5.2	6.9	9.1
23			9.2	7.7	7.2	7.2	4.5	5.3	7.1	9.2
24			9.2	7.6	6.8	6.9	4.6	5.4	7.2	9.4
25			9.4	7.5	6.4	6.7	5.2	5.4	7.2	9.5
26			9.5	7.2	6.2	6.7	--	5.3	7.1	9.4
27		12.1	9.4	7.0	5.7	6.5	--	5.3	7.1	9.4
28		11.9	9.3	6.9	5.8	6.4	--	5.3	7.0	9.5
29		11.7	9.3	6.7	5.7	6.2	--	5.6	7.1	9.5
30		11.4	9.2	6.7	5.4	6.0	--	5.6	7.3	9.6
31		10.9		6.8		5.5	--		7.6	
Mean	11.0	11.6	9.6	8.0	6.9	6.2	4.9	5.7	6.5	8.5
Max	11.5	12.1	10.6	9.2	7.9	7.7	5.7	6.5	7.6	9.6
Min	10.3	10.9	9.0	6.7	5.4	5.0	4.1	5.2	5.6	4.5

Table 24. Daily mean dissolved-oxygen concentration, Delaware River at Chester, Pa., December 1, 1997 to November 30, 1998

[Concentrations in milligrams per liter; monitor not in operation December 28, 1997 to March 19, 1998; --, missing data]

Date	December	March	April	May	June	July	August	September	October	November
1	--		10.2	--	--	6.6	5.2	7.5	5.9	7.4
2	--		10.1	--	--	6.6	5.5	7.7	5.9	7.5
3	--		10.0	--	--	6.6	5.6	7.5	6.0	7.5
4	--		9.7	--	--	6.5	--	--	4.7	7.7
5	--		9.6	9.0	--	6.6	--	--	4.5	7.9
6	--		9.5	8.9	--	6.7	--	--	6.6	8.1
7	--		9.4	8.9	--	6.7	--	--	--	8.3
8	--		9.1	8.6	--	6.4	--	--	7.0	8.5
9	--		9.3	8.3	--	6.3	--	--	6.7	8.7
10	--		9.4	8.2	--	6.2	--	--	6.4	8.7
11	10.4		9.4	8.2	--	6.4	--	--	6.3	9.0
12	10.3		9.7	8.5	6.2	6.8	5.5	6.5	6.3	9.0
13	10.3		10.0	8.7	5.8	6.9	5.9	6.6	6.5	8.7
14	10.4		10.1	8.6	5.5	7.0	6.1	6.5	6.6	8.3
15	10.5		10.1	8.6	5.5	6.9	6.1	6.4	6.4	8.1
16	10.5		10.1	8.3	5.8	6.7	5.9	6.0	6.5	8.9
17	10.4		9.8	8.1	6.2	6.4	5.8	5.8	6.5	8.8
18	10.5		9.7	8.0	6.7	6.2	6.0	5.7	6.8	8.8
19	10.7		9.4	7.7	7.0	6.2	6.0	5.7	6.9	8.9
20	10.7	11.2	9.3	--	7.4	.0	5.7	5.5	6.8	8.8
21	10.7	11.3	9.1	--	7.7	5.8	--	5.4	6.8	8.8
22	10.8	11.4	9.0	--	7.4	5.7	--	5.2	6.6	8.9
23	11.0	11.4	8.8	--	7.0	5.7	--	5.2	6.8	9.1
24	11.0	11.4	8.8	--	6.7	5.5	--	5.4	7.0	9.0
25	11.1	11.4	8.8	--	6.6	5.5	--	5.3	7.0	9.1
26	10.9	11.3	8.9	--	6.4	5.3	6.5	4.9	7.0	9.2
27	10.9	11.1	9.2	--	6.4	5.4	6.5	4.9	7.2	9.2
28		10.9	9.4	--	6.9	5.7	6.9	5.5	7.2	9.2
29		10.7	9.3	--	6.9	5.7	7.0	5.6	7.1	9.1
30		10.6	--	--	6.7	5.3	6.9	5.8	7.2	9.0
31		10.4		--		5.1	7.2		7.3	
Mean	10.7	11.1	9.5	8.4	6.6	6.2	6.1	5.9	6.6	8.6
Max	11.1	11.4	10.2	9.0	7.7	7.0	7.2	7.7	7.3	9.2
Min	10.3	10.4	8.8	7.7	5.5	5.1	5.2	4.9	4.5	7.4

SECTION IV

APPENDIXES

AGREEMENT

The Parties to the U.S. Supreme Court Decree agreed on November 18, 1997 to modify the agreement reached on October 22, 1997, pursuant to the Delaware River Basin Commission Resolution No. 83-13, to consider modification of current diversions to New York City and New Jersey, releases from the New York City reservoirs, and target flows at the Montague and Trenton gaging stations.

The modified agreement is as follows:

1. Establishment of an emergency fisheries protection program designed to allow special stream releases designed by the NYSDEC within the terms specified by this Agreement as requested and specified in Section (d). The emergency program includes the following provisions:

   a. There will be no net loss of storage in the New York City Delaware River Basin Reservoirs.

   b. The maximum use of 3,000 cfs-days (cubic feet per second-days) will be made available through reductions in releases required to meet the Montague target.

   c. The credits from releases required for Montague targets may occur at the following rates:

When Trenton flow equals or exceeds	Allowed credit reduction in directed releases
3500 cfs	100 cfs
3300 cfs	50 cfs

   d. The term of this emergency program begins immediately and continues until one of the NYC Delaware reservoirs spills, or when all summer basic conservation releases are restored in accordance with Docket No. D-77-20 (Revision 3).

   e. The release rates under this program shall not exceed the summer basic conservation level as established in Docket No. D-77-20 (Revision 3). (15 cfs at Neversink, 19 cfs at Pepacton, 23 cfs at Cannonsville). Special stream releases will be suspended if the combined storage in the Delaware River Basin reservoirs declines below the midpoint of the drought-warning zone and will remain suspended until the storage increases above that level again.

f. The operation of this emergency program will be designed by NYSDEC upon a continuing showing of need for these extra releases; and will be coordinated with the River Master and New York City. DRBC will be informed of the River Master's directed release each day when it is computed. The River Master's office will maintain the ongoing accounting for credits and releases, embodied in this agreement.

g. For purposes of defining drought conditions as per the operation curves for NYC reservoirs embodied in DRBC Resolution 83-13, the usable storage in the NYC Delaware basin reservoirs shall be reduced by the cumulative unexpended credits.

h. The parties to this agreement will reconvene as needed by meeting or telephone call to reconsider these arrangements should any party request it.

i. This agreement will take effect immediately upon entry into drought warning and will continue until conditions described in "d" are met <u>or</u> modified by unanimous agreement of the Parties to the Decree or terminated by any one of these Parties, but in any case to be terminated automatically on June 15, 1998.

/S/	Stephanie J. Baxter	11/18/97
/S/	Gerard L. Esposito	11/19/97
State of Delaware		Date

/S/	Steven Nieswand	11/19/97
State of New Jersey		Date

/S/	John Middelkoop	11/19/97
State of New York		Date

/S/	Irene B. Brooks	11/19/97
Commonwealth of Pennsylvania		Date

/S/	Mark D. Hoffer	11/19/97
City of New York		Date

Note: Original Signatures are on file at the Delaware River Master Office.

AGREEMENT

As Parties to the U.S. Supreme Court Decree of 1954 (as amended) the Parties agree to the April 27, 1998 request of the Executive Director of the Delaware River Basin Commission to direct New York City to increase the experimental release of bottom water from the outlet works of Cannonsville Reservoir at 100 cfs per day up to a maximum of 500 cfs whenever the spillage exceeds 1000 cfs for up to a two-week period. The Parties also agree that monitoring would be done to compare phosphorus, nitrogen, temperature, pH, BOD and suspended solids during this experimental bottom release.

	* Robert R. Jordan	6/23/98			
/S/	Gerard L. Esposito	5/04/98	/S/	Robert C. Shinn, Jr.	5/05/98
State of Delaware		Date	State of New Jersey		Date
/S/	N.G. Kaul	5/04/98	/S/	Irene B. Brooks	5/07/98
State of New York		Date	Commonwealth of Pennsylvania		Date

/S/	William N. Stasiuk, Jr.	5/07/98
City of New York		Date

Note: Original signatures are on file at the Delaware River Master Office.
* Letter of approval on file at the Delaware River Master Office.

Delaware River Basin Commission
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PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

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Appendix C.

Carol R. Collier
Executive Director

Jeffrey P. Featherstone
Deputy Executive Director

October 13, 1998

Mr. William Harkness
Office of the Delaware River Master
405 Broad Street
Milford, PA 18337

Dear Mr. Harkness

This will confirm agreement, by a conference call at 2:00 p.m. on October 8, 1998 by the Parties to the Supreme Court Decree of 1954 (as amended), to bank the remaining excess release quantity in the New York City Reservoirs as provided for in Section 2.5.6 A of DRBC Resolution 88-22 (Revised). The banking of the remaining excess release quantity will allow releases to be made from the New York City reservoirs to assist meeting the Trenton streamflow objective. This would extend the time at which the storage in the lower Delaware River basin reservoirs, Blue Marsh and Beltzville, would remain above the drought warning zones.

Commission staff intends to communicate daily with the River Master to determine the volume of release which would be required from the excess release bank to supplement the flow at Trenton. Initially, an additional 200 cfs is being considered but, depending on rainfall, could be less. These requested releases by the Commission would be in addition to any from New York City Delaware Reservoir storage directed by the River Master to maintain 1750 cfs at the Montague gage.

/S/	John H. Talley	10/14/98			
/S/	Harry W. Otto	10/14/98	/S/	Robert Tudor	10/12/98
State of Delaware		Date	State of New Jersey		Date
/S/	John L. Middelkoop, P.E.	10/19/98	/S/	Irene B. Brooks	10/13/98
State of New York		Date	Commonwealth of Pennsylvania		Date

/S/	William N. Stasiuk, Jr.	10/14/98
City of New York		Date

Note: Original signatures are on file at the Delaware River Master Office.

AGREEMENT

The Parties to the U.S. Supreme Court Decree and the Delaware River Basin Commission agreed on November 20, 1998 during two conference calls, pursuant to the Delaware River Basin Commission Resolution No. 83-13, to consider modifications of current diversions to New York City and target flows at the Montague and Trenton gaging stations. This was prompted by a review of current hydrologic conditions and a projection that the New York City Delaware reservoir system would enter drought warning around December 10, 1998 unless there is significant precipitation and runoff. The intent of this emergency program is to delay or avert entry into drought warning conditions.

The modified agreement is as follows:

1. New York City diversion from the New York City Delaware River Basin reservoir system would be reduced to 680 million gallons per day (mgd).

2. The Montague flow target would be reduced to 1655 cfs and the Trenton flow target would be reduced to 2700 cfs.

3. Remainder of the excess release bank of 903 cfs-days would be placed in a fishery protection bank for enhancing the winter basic conservation releases during drought warning to the summer basic conservation level as established in Docket No. D-77-20 (Revision No. 3; 15 cfs at Neversink, 19 cfs at Pepacton and 23 cfs at Cannonsville). The operation of this emergency program will be designed by NYSDEC and will be coordinated with the Delaware River Master and NYCDEP.

4. The term of this emergency program begins on November 20, 1998 and continues until December 4, 1998.

5. The parties to this agreement will reconvene via another conference call on November 30 / December 1 to review hydrologic conditions and consider additional steps.

/S/	Harry W. Otto	11/25/98			
/S/	John H. Talley	11/25/98	/S/	Robert Tudor	
State of Delaware		Date	State of New Jersey		Date
/S/	John L Middelkoop, P.E.	11/24/98	/S/	Irene B. Brooks	
State of New York		Date	Commonwealth of Pennsylvania		Date

/S/ William N. Stasiuk, Jr.
City of New York Date

Note: Original signatures are on file at the Delaware River Master Office.