WATER QUALITY ON DAYS OF DIVERSION AND DAYS OF NO DIVERSION, POMPTON AND PASSAIC RIVERS, NEW JERSEY, 1987-95

By R. Edward Hickman

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CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS--Continued

ILLUSTRATIONS--Continued

TABLES

TABLES--Continued

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
	Mass	
ounce, avoirdupois (oz)	28.35	gram
pound, avoirdupois (lb)	0.4536	kilogram
ton, short	0.9072	megagram
	Temperature	
degree Celsius (°C)	°C = 5/9 x (°F-32)	degree Fahrenheit (°F)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum 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.

WATER QUALITY ON DAYS OF DIVERSION AND DAYS OF NO DIVERSION, POMPTON AND PASSAIC RIVERS, NEW JERSEY, 1987-95

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ABSTRACT

Diversions from the Pompton River and its tributary, the Ramapo River, could adversely affect the water quality of the Passaic River downstream from its junction with the Pompton River. In general, the water quality of the Pompton River is better than that of the Passaic River upstream and downstream from this junction.

This report presents the results of an analysis of water-quality measurements of the Pompton and Passaic Rivers made during 1987-95 to identify differences between water quality on days of diversion and water quality on days of no diversion. Statistical tests were conducted on year-round and growing-season measurements of the following water-quality characteristics: water temperature, dissolved-oxygen concentration, dissolved-oxygen saturation, 5-day biochemical-oxygen demand, and concentrations of total phosphorus and selected forms of nitrogen.

At each of four stations, differences in water-quality measurements and relations between water quality and streamflow were identified with a rank-sum test and an analysis of covariance, respectively. Three stations are downstream from one or both diversion sites; one station is on the Pompton River and two are on the Passaic River downstream from the junction with the Pompton River. The fourth station is not downstream from the diversion sites; this station is on the Passaic River upstream from the junction.

For the station on the Pompton River, differences in values of the following water-quality characteristics were identified by using either rank-sum tests or analyses of covariance: water temperature and concentrations of dissolved oxygen, total nitrite, total organic nitrogen plus ammonia, dissolved ammonia, and total phosphorus. Only year-round measurements were tested.

For the two stations on the Passaic River downstream from its junction with the Pompton River, differences in values of the following water-quality characteristics were identified by using either rank-sum tests or analyses of covariance: 5-day biochemical-oxygen demand and concentrations of total nitrogen, total nitrate plus nitrite, and total phosphorus. These differences were identified at one or both stations on the Passaic River downstream from the junction with the Pompton River, but not by use of the same test on corresponding measurements at the station on the Passaic River upstream from the junction.

Changes in water quality of the Passaic River from a station upstream from the junction with the Pompton River to a station downstream from the junction were determined. By using a rank-sum test, differences between downstream changes in values of water temperature and concentrations of total phosphorus and all nitrogen species on days of diversion and downstream changes in these values on days of no diversion were identified. These differences are due to the following: (1) The fraction of the streamflow in the Passaic River contributed by the Pompton River was smaller on days of diversion than on days of no diversion. (2) Concentrations of phosphorus and nitrogen were smaller and temperatures were lower in the Pompton River than in the Passaic River upstream from the junction.

INTRODUCTION

The water quality of the Passaic River near its junction with the Pompton River in northeastern New Jersey is generally poorer than the water quality of the Pompton River (fig. 1). The water quality of the Passaic River upstream and downstream from the Pompton River has an overall rating of fair (New Jersey Department of Environmental Protection and Energy, 1993, p. III-252 and p. III-294); the water quality of the Pompton River has a rating of good (New Jersey Department of Environmental Protection and Energy, 1993, p. III-284). These ratings were calculated from values of water-quality characteristics, including water temperature, concentrations of dissolved oxygen, and concentrations of selected forms of phosphorus and nitrogen.

Reductions in the flow of the Pompton River to the Passaic River could adversely affect the water quality of the Passaic downstream from the junction. Flow in the Pompton River is being reduced by diversions from the Pompton and the Ramapo River, a tributary of the Pompton; these diversions are controlled by the North Jersey District Water Supply Commission (NJDWSC). Therefore, a study was conducted by the U.S. Geological Survey (USGS), in cooperation with the North Jersey District Water Supply Commission (NJDWSC), to determine whether the water quality of the Pompton and Passaic Rivers on days of diversion is different from the water quality on days of no diversion.

Purpose and Scope

This report presents the results of a study to compare the water quality of the Pompton and Passaic Rivers on days of diversion to water quality on days of no diversion. Three types of differences between water quality on days of diversion and on days of no diversion were identified by use of statistical tests of measured water-quality characteristics. Differences in values of water-quality characteristics were identified with a rank-sum test. Differences in relations between water quality and streamflow were identified with an analysis of covariance. Differences in downstream changes in water quality of the Passaic River upstream to downstream from the junction with the Pompton River were identified with a rank-sum test. Tests were conducted on water-quality data collected year-round and on data from the growing season, during 1987-95; the growing season is from April 1 through October 30. A minimal interpretation of the results of the tests is presented.

Description of the Study Area

The study area consists of the reaches of the Passaic, Pompton, and Ramapo Rivers in the vicinity of the junction of the Passaic and Pompton Rivers in northeastern New Jersey (fig. 1). This includes the entire Pompton River, the Ramapo River from the Pompton River upstream to Pompton Lake, and the Passaic River from USGS water-quality station 01382000, Passaic River at Two Bridges, downstream to station 01389500, Passaic River at Little Falls.

A diagram of the study area shows the rivers, diversion sites, and water-quality stations (fig. 2). In general, the streamflow of the Pompton River discharges to the Passaic River. However, under conditions of a low rate of streamflow and a high rate of diversion, streamflow in the most downstream reach of the Pompton River may flow upstream from the junction to the diversion site at Two Bridges.

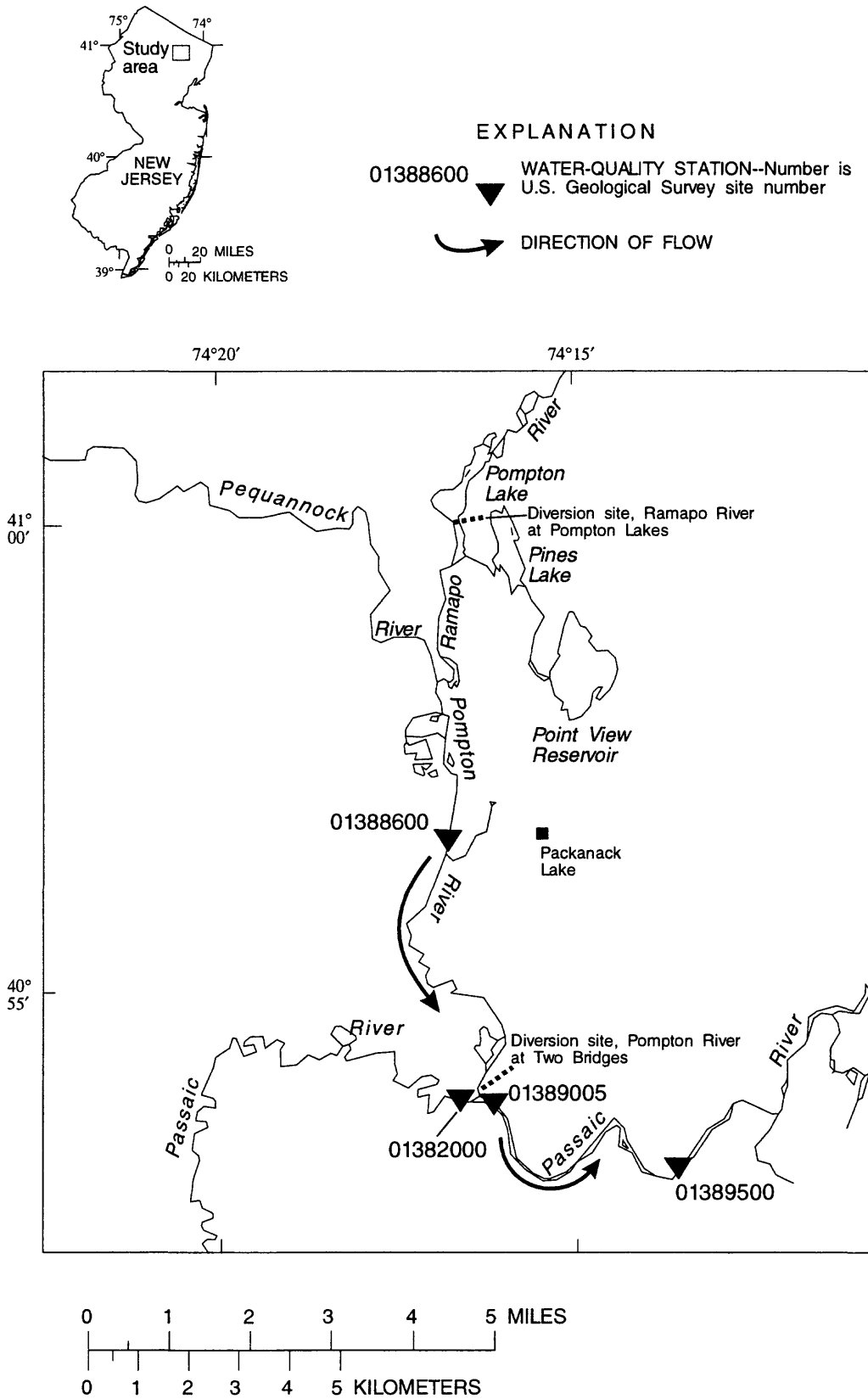

Figure 1. Locations of selected water-quality stations and diversion sites on the Ramapo, Pompton, and Passaic Rivers, New Jersey.

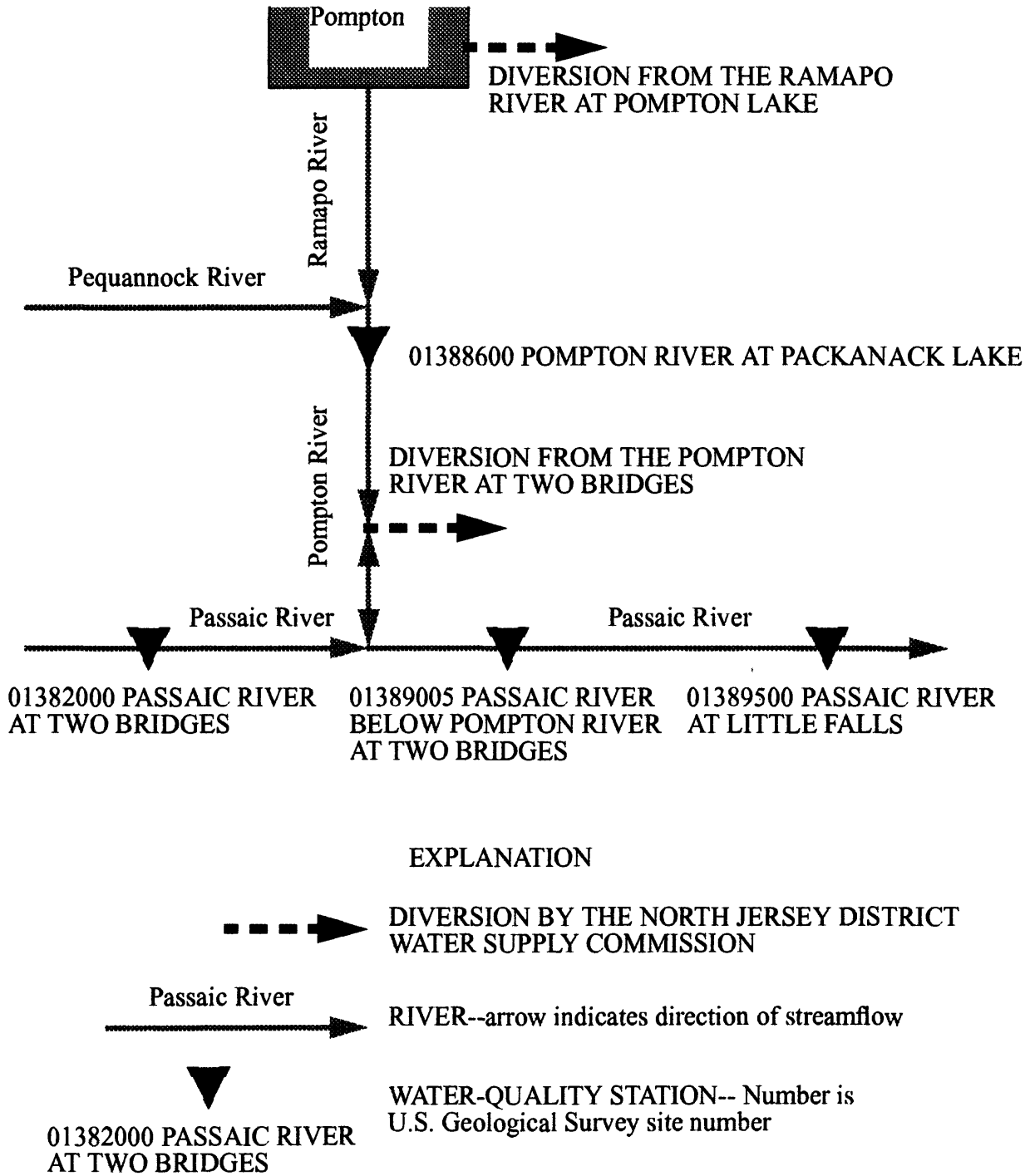

Figure 2. Diagram of study area, showing rivers, diversions by the North Jersey District Water Supply Commission, and water-quality stations of the U.S. Geological Survey.

METHODS FOR COMPARISON OF WATER QUALITY ON DAYS WITH AND WITHOUT DIVERSION

Measurement of Water-Quality Characteristics

Water-quality characteristics were measured by the USGS, in cooperation with the NJDWSC, at stations shown in figures 1 and 2 from June 1, 1987, through September 30, 1995. These data were stored and subsequently retrieved from the USGS QWDATA computer data base. The State of New Jersey does not allow NJDWSC to divert from the Ramapo and Pompton Rivers during July and August. To reduce bias in the interpretation of the results, measurements made during July and August were not included in this study.

Water-quality characteristics included in the analyses are water temperature, dissolved-oxygen concentration, dissolved-oxygen saturation, 5-day biochemical-oxygen demand, and concentrations of total nitrogen, total nitrate plus nitrite, total nitrite, total organic nitrogen plus ammonia, dissolved ammonia, and total phosphorus. Dissolved-oxygen saturation is the dissolved-oxygen concentration in percent of saturation. Only those measurements with an associated value of instantaneous streamflow were included. Values of dissolved nitrate plus nitrite and dissolved nitrite were used in place of missing values of the total forms; both constituents are highly soluble. Measured concentrations included uncensored and censored, "less-than" values; "less-than" values indicate that the actual value is less than a reporting limit. A summary of the values of water-quality characteristics measured year-round at each station is listed in table 1. All tables are at the end of the report.

Values of the water-quality characteristics included in this report were determined by use of two types of field techniques. The concentrations of nutrients and biochemical-oxygen demand were determined from discharge-weighted samples (Edwards and Glysson, 1988). Values of water temperature, dissolved-oxygen concentration, and dissolved-oxygen saturation are the average of measurements made at several points across the streams.

Records of diversions from the Ramapo River at Pompton Lake and the Pompton River at Two Bridges were provided by the NJDWSC (Charles Cuyulis, North Jersey District Water Supply Commission, written commun., 1996). The daily rates of diversion were calculated from measurements made from 8 AM to 8 AM; the rates are listed in the records with the date of the end of each 24-hour period. Because the recorded date corresponds to the end of each 24-hour period, most of each day's diversion probably occurred on the day prior to the recorded date. Therefore, for this study, the date associated with each daily diversion was set back one day from the date listed by the NJDWSC.

Identification of Differences in Values of Water-Quality Characteristics

The rank-sum test (Helsel and Hirsch, 1992) was used to determine whether values of a water-quality characteristic measured at a station on days of diversion were, as a group, different from the group of values measured at this station on days of no diversion. The rank-sum test is a nonparametric test that compares the relative magnitudes of two groups of values. For this analysis, differences in value were designated at a 0.05 level of significance. Tests were conducted for each characteristic at each of the four stations when 10 or more measurements were made during days of diversion and 10 or more measurements were made during days of no diversion. Measurements made at the station in the Pompton River were tested on the basis of days of diversion from the Ramapo River at Pompton Lake. Measurements made at the three Passaic River stations were tested on the basis of days of diversion from either the Ramapo River at Pompton Lake or the Pompton River at Two Bridges.

Results are given in tables 2 (year-round measurements) and 3 (growing-season measurements). The number of measurements and median values for the measurements made during days of diversion and days of no diversion are included in the tables to indicate the magnitudes of the differences in water quality. For a given station and characteristic, the results of the rank-sum test are not always mirrored by a comparison of the medians on days of diversion and days of no diversion; the test compares all the values for days of diversion and days of no diversion, not just the medians. Therefore, the results of the test may indicate differences in concentrations when the medians are identical or nearly so.

Identification of Differences in Relations Between Water Quality and Streamflow

An analysis of covariance of relations between the values of water-quality characteristics and the values of the associated streamflow was used to identify any changes in water quality due to factors other than variation in streamflow. The analysis of covariance was used to determine whether relations between water quality and streamflow measured on days of diversion were different from the relations between water quality and streamflow measured on days of no diversion.

Analyses of covariance were conducted on water-quality measurements at all four stations. Measurements at the station in the Pompton River were tested on the basis of days of diversion from the Ramapo River at Pompton Lake. Measurements at the three Passaic River stations were tested on the basis of days of diversion from either the Ramapo River at Pompton Lake or the Pompton River at Two Bridges.

Three tasks were accomplished as part of this test. First, relations between water-quality values and streamflow were determined. Second, an analysis of covariance was used to test whether relations for measurements on days of diversion were different from relations for measurements on days of no diversion. Third, relations for days of diversion and days of no diversion were calculated if a difference was determined in the second step. The form of all relations between water quality and streamflow is given in equation 1. Relations were determined only if there were 9 or more uncensored measurements. Separate tests were run for each characteristic at each station.

$$\text{Log10(water-quality value)} = \text{SLOPE}*\text{Log10(streamflow)} + \text{INT}, \qquad (1)$$

where Log10 is base-10 logarithm,
water-quality value is in appropriate units (per table 1),
streamflow is in cubic feet per second,
SLOPE is the slope of the relation between the water-quality value and streamflow, and
INT is the intercept of the relation.

Tobit regression (Cohn, 1988) was used in place of ordinary least-squares regression to determine relations between water quality and streamflow because Tobit regression allows for the inclusion of censored (less than) measurements. Ordinary least-squares regression does not allow for the inclusion of censored data without requiring assumptions about the actual values of the censored data. For data sets with no censored values, Tobit regression produces the same relation as does ordinary least-squares regression.

The analysis of covariance followed the approach in Helsel and Hirsch (1992), except that Tobit regression was used in place of ordinary least-squares regression. The analysis was conducted only if there were nine or more uncensored measurements during days of diversion and nine or more uncensored measurements during days of no diversion.

The analysis of covariance determined whether a complex model with a diversion index was significantly more accurate than a simple model without a diversion index. The simple model is given in equation (1); the complex model is given in equation (2). The diversion index indicated whether or not a diversion was occurring upstream on the day of measurement.

$$\text{Log10(water-quality value)} = [\text{SLOPE1}*\text{Log10(streamflow)} + \text{INT1}] + [\text{SLOPE2}*\text{Log10}*\text{(streamflow)} + \text{INT2}] * \text{I}, \quad (2)$$

where Log10 is base-10 logarithm,
water-quality value is in appropriate units (per table 1),
streamflow is in cubic feet per second,
I is a diversion index (I = 0 for days of no diversion, and I = 1 for days of diversion),
SLOPE1 is the slope of the relation between the water-quality value and streamflow for days of no diversion,
INT1 is the intercept of the relation for days of no diversion,
SLOPE2 is the difference between slope on days of diversion and the slope on days of no diversion, and
INT2 is the difference between the intercept on days of diversion and the intercept on days of no diversion.

A test statistic different from that shown in Helsel and Hirsch (1992) was calculated because of the use of Tobit regression in the analysis of covariance (T.A. Cohn, U.S. Geological Survey, written commun., 1995). The value, X, was determined from the results of the simple and complex models, then compared to the value of the chi-square distribution with 2 degrees of freedom and a 0.05 level of significance. If the value of X equalled or exceeded the corresponding value of chi-square distribution, the relation for days of diversion differed from the relation for days of no diversion in SLOPE or INT or both. Whether SLOPE was different or INT was different was not determined. The value of X was calculated as follows:

$$X = -2 * \text{Ln}(\text{LKHDS}/\text{LKHDC}), \quad (3)$$

where X is the test statistic,
Ln is natural logarithm,
LKHDS is the likelihood of the simple relation, and
LKHDC is the likelihood of the complex relation.

Results of the analyses of covariance are given in tables 4 (year-round measurements) and 5 (growing-season measurements). Relations for all measurements, results of the analysis of covariance, and relations for days of diversion and for days of no diversion are included in the tables. Relations for days of diversion and for days of no diversion are presented only where they are different from one another. Each relation is reported only where the value for SLOPE is significantly different from zero at the 0.05 level of significance; a value of "0" is reported for SLOPE if it is not different from zero. For each relation, the value of INT was not reported where the value of SLOPE was not different from zero.

Values of water-quality characteristics plotted against streamflow are shown in figures 3A-12D. Figures 3A-22 are at the end of the report. Relations between water quality and streamflow are shown only where the SLOPE of the relation is different from zero. Relations for days of diversion and days of no diversion are shown only where the analysis of covariance indicated that they are different from one another.

Identification of Differences in Downstream Changes in Water Quality of the Passaic River at the Junction with the Pompton River

The rank-sum test was used to determine whether the downstream changes in the water quality of the Passaic River from station 01382000 to station 01389005 on days of diversion were different from changes on days of no diversion. Test were conducted on the basis of diversions from either the Ramapo River or the Pompton River. Only water-quality measurements made on the same day at both stations were included. Differences in changes were designated at a 0.05 level of significance. Censored values were treated as if they were uncensored.

Results are given in tables 6 (year-round measurements) and 7 (growing-season measurements). Also, values of the median downstream change between station 01382000 and station 01389005 on days of diversion and on days of no diversion are shown. Downstream changes in water quality that are greater than zero indicate that the values of the water-quality characteristics increased from station 01382000 to station 01389005; values less than zero indicate that the value of the water-quality characteristic decreased from station 01382000 to station 01389005. For a given characteristic, the results of the rank-sum test are not always mirrored by a comparison of the median change on days of diversion with that on days of no diversion; the test compares all the values for days of diversion and days of no diversion, not just the medians. Therefore, the results of the test may indicate differences in downstream changes when the medians are identical or nearly so.

Downstream changes in year-round, same-day water-quality characteristics plotted against the ratio of streamflow at station 01382000 to streamflow at station 01389005 are shown in figures 13-22. Ratios of streamflow greater than 100 percent indicate that (1) streamflow in the Passaic River upstream from the junction with the Pompton River was greater than streamflow downstream from this junction and (2) water was flowing upstream into the mouth of the Pompton River.

COMPARISON OF WATER QUALITY OF THE RIVERS WITH AND WITHOUT DIVERSION

Differences in all water-quality characteristics except dissolved-oxygen saturation were identified at one or more stations by use of the rank-sum tests of water-quality measurements and (or) analyses of covariance (summarized in table 8); these were identified by at least one of the statistical tests of either year-round or growing-season measurements. The results presented in this paper may not represent future conditions; water quality could change over time. Preliminary results of an ongoing study (Debra Buxton, U.S. Geological Survey, oral commun., 1996) indicate that values of water quality at some stations in the Passaic River Basin have changed during 1975-93.

Physical effects of the diversions probably caused some of the differences summarized in table 8. One physical effect is the change in relative amounts of streamflow from the tributaries draining to the station at which water-quality characteristics were measured. Diversions reduce the percentage of streamflow from the tributary on which the diversion is located and increase the percentage of streamflow from the other tributaries. Differences in water-quality measurements or relations between water quality and streamflow are likely at the station if the water quality of the tributary being diverted is different from the water quality of the other tributaries. The second effect is a decrease in the dilution of point-source discharges downstream from the diversion; increased concentrations of materials discharged at the point source may result. The third effect is the increase in changes of the values of water-quality characteristics due to instream processes, such as photosynthesis; diversions reduce the velocity of the streamflow and increase travel time, therefore, making it more likely that instream processes will change the water quality.

Not all of the differences listed in table 8, however, were caused by physical effects of the diversions; some are related to the variation of water quality with streamflow. Differences may be identified if the values of a water-quality characteristic decreased or increased with increasing streamflow, and if diversions occurred only on days of low or high streamflow. Values of some characteristics at all four stations changed with increasing streamflow (tables 4 and 5). Differences in water-quality at station 01382000, Passaic River at Two Bridges, cannot result from the physical effects of diversions because this station is not downstream from the NJDWSC diversion sites.

Differences in water-quality measurements and relations between water-quality and streamflow at station 01388600, Pompton River at Packanack Lake, are summarized in table 9. Differences in water temperature and concentrations of dissolved oxygen, total nitrogen, total nitrite, total organic nitrogen plus ammonia, dissolved ammonia, and total phosphorus were identified. Only differences in year-round water quality are presented; tests of growing-season water quality were not conducted because of insufficient data.

Differences in water-quality measurements and relations between water-quality and streamflow at either station 013890005, Passaic River below Pompton River at Two Bridges, or station 01389500, Passaic River at Little Falls, are summarized in table 10. Differences in 5-day biochemical-oxygen demand and concentrations of total nitrogen, total nitrate plus nitrite, and total phosphorus were identified. In table 10, for each water-quality characteristic, a "yes" indicates that differences were identified by a test of either year-round or growing-season measurements at either station 01389005 or station 01389500, but not by the same test of corresponding measurements at station 01382000. These differences, identified downstream from but not upstream from the diversion sites, are likely due to the physical effects of the diversions. A "no" indicates either (1) no differences were identified at either station 01389005 or station 01389500 or (2) differences identified at either station 01389005 or station 01389500 were also identified by the same test of corresponding measurements at station 01382000.

Differences in downstream changes in water quality of the Passaic River at the junction of the Pompton River are summarized in table 10. Differences were identified for water temperature and concentrations of total phosphorus and all nitrogen species. Tests were conducted on both year-round and growing-season measurements.

Differences in downstream changes in water quality of the Passaic River are due to the following: (1) The fraction of the streamflow in the Passaic River contributed by the Pompton River was smaller on days of diversion than on days of no diversion. (2) Concentrations of phosphorus and nitrogen were smaller and temperatures were lower in the Pompton River than in the Passaic River upstream from the junction. On days of no diversion, streamflow in the Pompton River tends to dilute concentrations of phosphorus and nitrogen species and to reduce the growing-season temperatures in the Passaic River; downstream changes in these characteristics on days of no diversion (as indicated by median changes listed in tables 6 and 7) are negative. On days of diversion, the downstream changes in these characteristics are less negative than on days of no diversion; less streamflow in the Pompton River is available to dilute phosphorus and nitrogen concentrations and reduce growing-season temperatures in the Passaic River. Measurements were made on several days of diversion when no Pompton River streamflow reached the junction (the ratio of streamflow at station 01382000 to streamflow at station 01389005 was greater than or equal to 100 percent) (figs. 17-22). Downstream changes in water quality on these days were generally near zero; the water quality of the Passaic River downstream from the Pompton River was about the same as the water quality of the Passaic upstream from its junction with the Pompton.

SUMMARY AND CONCLUSIONS

In general, water quality of the Pompton River is better than water quality of the Passaic River upstream from the junction with the Pompton River. Streamflow in the Pompton River is reduced by the North Jersey District Water Supply Commission diversions from the Ramapo River at Pompton Lake and from the Pompton River at Two Bridges. The reductions of streamflow of the Pompton River reaching the Passaic River may be adversely affecting the water quality of the Passaic River downstream from the Pompton River.

Three statistical tests were conducted on measurements from three stations on the Passaic River and one station on the Pompton River to determine whether there were differences between water quality on days of diversion and water quality on days of no diversion. Differences in values of water quality were identified with a rank-sum test. Differences in relations between water quality and streamflow were identified with an analysis of covariance. Differences in downstream changes in water quality of the Passaic River at the junction with the Pompton River were identified with a rank-sum test. Tests were conducted on year-round and growing-season measurements.

Differences in water-quality measurements and (or) relations between water quality and streamflow were identified for the following characteristics at one or more stations: water temperature, dissolved-oxygen concentration, 5-day biochemical-oxygen demand, and concentrations of total phosphorus and all nitrogen species. Differences were identified in either year-round or growing-season values. No differences in values of dissolved-oxygen saturation were identified for any station.

Differences identified by the rank-sum tests of water-quality measurements and the analysis of covariance could be caused by the physical effects of the diversions or could be related to changes in water quality with increasing streamflow. Differences identified for station 01382000, Passaic River at Two Bridges, are related to the variation of water quality with streamflow; this station is not downstream from the NJDWSC diversions.

For the station on the Pompton River, differences in water-quality measurements and (or) relations between water quality and streamflow were identified for the following characteristics: water temperature and concentrations of dissolved oxygen, total nitrogen, total nitrite, total ammonia plus organic nitrogen, dissolved ammonia, and total phosphorus. Tests were conducted on year-round measurements; growing-season measurements were not tested.

For the two stations on the Passaic River downstream from the Pompton River, differences in water-quality measurements and (or) relations between water quality and streamflow were identified for the following characteristics: 5-day biochemical-oxygen demand and concentrations of total nitrogen, total nitrate plus nitrite, and total phosphorus. These differences are likely due to the physical effects of diversions rather than the variation of water quality with streamflow. Differences identified for these characteristics were not identified by tests of the corresponding measurements at the station on the Passaic River upstream from the Pompton River; the water quality of this station is not affected by the diversions. Differences identified by the same test of both measurements at either station downstream from the Pompton River and of measurements at the station upstream from the Pompton River are likely the result of the variation of water quality with streamflow.

Changes in water quality of the Passaic River from a station upstream from the junction with the Pompton River to a station downstream from the junction were determined. By using a rank-sum test, differences between downstream changes in values of water temperature and concentrations of total phosphorus and all nitrogen species on days of diversion and downstream

changes in these values on days of no diversion were identified. These differences are due to the following: (1) The fraction of the streamflow in the Passaic River contributed by the Pompton River was smaller on days of diversion than on days of no diversion. (2) Concentrations of phosphorus and nitrogen were smaller and temperatures were lower in the Pompton River than in the Passaic River upstream from the junction.

REFERENCES CITED

Cohn, T.A., 1988, Adjusted maximum likelihood estimation of the moments of lognormal populations from type I censored samples: U.S. Geological Survey Open-File Report 88-350, 34 p.

Edwards, T.K., and Glysson, G.D., 1988, Field methods for measurement of fluvial sediment: U.S. Geological Survey Open-File Report 86-531, 118 p.

Helsel, D.R., and Hirsch, R.M., 1992, Statistical methods in water resources: New York, Elsevier Science Publishers, Studies in Environmental Science 49, 522 p.

New Jersey Department of Environmental Protection and Energy, 1993, New Jersey 1992 state water quality inventory report: Environmental Regulation, Office of Land and Water Planning, p. I-1 to V-29.

Table 1. Summary of water-quality measurements made at selected stations on the Pompton and Passaic Rivers, June 1, 1987-September 30, 1995

[Measurements made during July and August are not included.]

Station	Summary of water-quality measurements			
	Number of measurements	Minimum	Median	Maximum
Water temperature, in degrees Celsius				
01382000 Passaic River at Two Bridges	106	0.0	14.5	26.5
01388600 Pompton River at Packanack Lake	108	.5	14.5	25.0
01389005 Passaic River below Pompton River at Two Bridges	98	.0	15.0	27.0
01389500 Passaic River at Little Falls	107	.0	14.2	25.0
Dissolved-oxygen concentration, in milligrams per liter				
01382000 Passaic River at Two Bridges	105	1.4	8.0	15.1
01388600 Pompton River at Packanack Lake	106	5.3	10.7	17.9
01389005 Passaic River below Pompton River at Two Bridges	94	2.3	8.3	14.0
01389500 Passaic River at Little Falls	106	6.3	10.0	16.6
Dissolved-oxygen saturation, in percent				
01382000 Passaic River at Two Bridges	104	15	76	160
01388600 Pompton River at Packanack Lake	105	60	102	149
01389005 Passaic River below Pompton River at Two Bridges	94	25	80	156
01389500 Passaic River at Little Falls	105	66	99	119

Table 1. Summary of water-quality measurements made at selected stations on the Pompton and Passaic Rivers, June 1, 1987-September 30, 1995--Continued

[Measurements made during July and August are not included.]

Station	Summary of water-quality measurements			
	Number of measurements	Minimum	Median	Maximum
5-Day biochemical oxygen demand, in milligrams per liter				
01382000 Passaic River at Two Bridges	102	0.6	2.9	18.6
01388600 Pompton River at Packanack Lake	97	.6	2.5	9.6
01389005 Passaic River below Pompton River at Two Bridges	89	.5	2.9	15.3
01389500 Passaic River at Little Falls	92	.5	2.7	11.7
Total nitrogen, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	105	0.94	3.3	8.5
01388600 Pompton River at Packanack Lake	106	.67	1.3	3.8
01389005 Passaic River below Pompton River at Two Bridges	97	.78	3.3	8.0
01389500 Passaic River at Little Falls	103	.95	2.9	7.8
Total nitrate plus nitrite, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	106	0.34	2.3	7.9
01388600 Pompton River at Packanack Lake	107	.34	0.79	2.7
01389005 Passaic River below Pompton River at Two Bridges	97	.38	2.1	7.5
01389500 Passaic River at Little Falls	105	.44	2.0	7.0

Table 1. Summary of water-quality measurements made at selected stations on the Pompton and Passaic Rivers, June 1, 1987-September 30, 1995--Continued

[Measurements made during July and August are not included.]

Station	Summary of water-quality measurements			
	Number of measurements	Minimum	Median	Maximum
Total nitrite, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	105	<0.01	0.04	0.27
01388600 Pompton River at Packanack Lake	107	< .01	.02	.14
01389005 Passaic River below Pompton River at Two Bridges	98	< .01	.03	.22
01389500 Passaic River at Little Falls	106	< .01	.04	.21
Total organic nitrogen plus ammonia, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	105	0.3	0.9	4.0
01388600 Pompton River at Packanack Lake	106	< .2	.5	2.7
01389005 Passaic River below Pompton River at Two Bridges	98	.2	.8	3.2
01389500 Passaic River at Little Falls	104	.3	.8	4.8
Dissolved ammonia, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	106	<0.01	0.19	3.1
01388600 Pompton River at Packanack Lake	106	< .015	.09	.61
01389005 Passaic River below Pompton River at Two Bridges	96	< .015	.15	2.4
01389500 Passaic River at Little Falls	106	< .015	.13	1.8

Table 1. Summary of water-quality measurements made at selected stations on the Pompton and Passaic Rivers, June 1, 1987-September 30, 1995--Continued

[Measurements made during July and August are not included.]

Station	Summary of water-quality measurements			
	Number of measurements	Minimum	Median	Maximum
Total phosphorus, in milligrams per liter as P				
01382000 Passaic River at Two Bridges	105	0.03	0.44	1.6
01388600 Pompton River at Packanack Lake	106	< .01	.07	.45
1389005 Passaic River below Pompton River at Two Bridges	98	.04	.38	1.3
01389500 Passaic River at Little Falls	104	.06	.32	1.2

Table 2. Results of rank-sum tests of year-round measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion

[Measurements made during July and August are not included. "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Water temperature, in degrees Celsius					
01382000 Passaic River at Two Bridges	Same	61	14.5	45	13.5
01388600 Pompton River at Packanack Lake	Different	93	15.0	15	6.5
01389005 Passaic River below Pompton River at Two Bridges	Same	56	14.5	42	15.2
01389500 Passaic River at Little Falls	Same	63	14.5	44	13.5
Dissolved-oxygen concentration, in milligrams per liter					
01382000 Passaic River at Two Bridges	Same	61	8.0	44	8.0
01388600 Pompton River at Packanack Lake	Different	91	10.6	15	13.3
1389005 Passaic River below Pompton River at Two Bridges	Same	55	8.8	39	8.0
01389500 Passaic River at Little Falls	Same	62	10.3	44	9.7

Table 2. Results of rank-sum tests of year-round measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements made during July and August are not included. "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Dissolved-oxygen saturation, in percent					
01382000 Passaic River at Two Bridges	Same	60	77	44	75
01388600 Pompton River at Packanack Lake	Same	90	102	15	104
1389005 Passaic River below Pompton River at Two Bridges	Same	55	83	39	79
01389500 Passaic River at Little Falls	Same	61	99	44	99
5-Day biochemical oxygen demand, in milligrams per liter					
01382000 Passaic River at Two Bridges	Same	59	3.0	43	2.7
01388600 Pompton River at Packanack Lake	Same	83	2.7	14	2.4
1389005 Passaic River below Pompton River at Two Bridges	Same	51	2.8	38	3.2
01389500 Passaic River at Little Falls	Same	51	3.0	41	2.5

Table 2. Results of rank-sum tests of year-round measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements made during July and August are not included. "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Total nitrogen, in milligrams per liter as N					
01382000 Passaic River at Two Bridges	Different	60	2.55	45	4.30
01388600 Pompton River at Packanack Lake	Different	91	1.33	15	1.17
1389005 Passaic River below Pompton River at Two Bridges	Different	55	2.14	42	3.95
01389500 Passaic River at Little Falls	Different	61	2.20	42	4.25
Total nitrate plus nitrite, in milligrams per liter as N					
01382000 Passaic River at Two Bridges	Different	61	1.6	45	3.0
01388600 Pompton River at Packanack Lake	Same	92	.8	15	.7
1389005 Passaic River below Pompton River at Two Bridges	Different	55	1.3	42	3.0
01389500 Passaic River at Little Falls	Different	62	1.4	43	3.3

Table 2. Results of rank-sum tests of year-round measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements made during July and August are not included. "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Total nitrite, in milligrams per liter as N					
01382000 Passaic River at Two Bridges	Same	61	0.03	44	0.04
01388600 Pompton River at Packanack Lake	Different	92	.02	15	.02
1389005 Passaic River below Pompton River at Two Bridges	Same	56	.03	42	.04
01389500 Passaic River at Little Falls	Same	62	.04	44	.04
Total organic nitrogen plus ammonia, in milligrams per liter as N					
01382000 Passaic River at Two Bridges	Same	60	1.0	45	0.8
01388600 Pompton River at Packanack Lake	Different	91	.5	15	.3
1389005 Passaic River below Pompton River at Two Bridges	Same	56	.8	42	.8
01389500 Passaic River at Little Falls	Same	61	.8	43	.8

Table 2. Results of rank-sum tests of year-round measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements made during July and August are not included. "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Dissolved ammonia, in milligrams per liter as N					
01382000 Passaic River at Two Bridges	Same	61	0.28	45	0.18
01388600 Pompton River at Packanack Lake	Different	91	.09	15	.03
1389005 Passaic River below Pompton River at Two Bridges	Same	54	.16	42	.13
01389500 Passaic River at Little Falls	Same	62	.15	44	.10
Total phosphorus, in milligrams per liter as P					
01382000 Passaic River at Two Bridges	Different	60	0.32	45	0.53
01388600 Pompton River at Packanack Lake	Same	91	.07	15	.06
1389005 Passaic River below Pompton River at Two Bridges	Different	56	.22	42	.52
01389500 Passaic River at Little Falls	Different	61	.24	43	.50

Table 3. Results of rank-sum tests of growing-season measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion

[Measurements during July and August are not included. "ND" is not determined; "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Water temperature, in degrees Celsius					
0138200 Passaic River at Two Bridges	Same	37	19.5	29	17.0
01388600 Pompton River at Packanack Lake	ND	61	19.0	7	15.5
01389005 Passaic River below Pompton River at Two Bridges	Same	33	19.0	29	17.5
01389500 Passaic River at Little Falls	Same	38	18.8	29	17.5
Dissolved-oxygen concentration, in milligrams per liter					
0138200 Passaic River at Two Bridges	Same	38	5.4	28	6.0
01388600 Pompton River at Packanack Lake	ND	60	9.4	7	10.4
1389005 Passaic River below Pompton River at Two Bridges	Same	32	6.8	29	7.0
01389500 Passaic River at Little Falls	Same	37	9.0	29	9.1

Table 3. Results of rank-sum tests of growing-season measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements during July and August are not included. "ND" is not determined; "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Dissolved-oxygen saturation, in percent					
0138200 Passaic River at Two Bridges	Same	37	67	28	68
01388600 Pompton River at Packanack Lake	ND	59	99	7	98
1389005 Passaic River below Pompton River at Two Bridges	Same	32	72	29	76
01389500 Passaic River at Little Falls	Same	36	97	29	99
5-Day biochemical oxygen demand, in milligrams per liter					
0138200 Passaic River at Two Bridges	Same	37	3.6	27	2.9
01388600 Pompton River at Packanack Lake	ND	55	3.2	6	3.1
1389005 Passaic River below Pompton River at Two Bridges	Same	33	3.0	26	3.8
01389500 Passaic River at Little Falls	Same	33	3.3	26	2.8

Table 3. Results of rank-sum tests of growing-season measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements during July and August are not included. "ND" is not determined; "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Total nitrogen, in milligrams per liter as N					
0138200 Passaic River at Two Bridges	Same	37	3.6	29	4.6
01388600 Pompton River at Packanack Lake	ND	60	1.39	7	.95
1389005 Passaic River below Pompton River at Two Bridges	Different	34	3.4	29	4.3
01389500 Passaic River at Little Falls	Different	37	3.2	28	4.6
Total nitrate plus nitrite, in milligrams per liter as N					
0138200 Passaic River at Two Bridges	Different	38	2.1	29	3.9
01388600 Pompton River at Packanack Lake	ND	61	.80	7	.67
1389005 Passaic River below Pompton River at Two Bridges	Different	34	2.0	29	3.6
01389500 Passaic River at Little Falls	Different	38	2.0	29	3.6

Table 3. Results of rank-sum tests of growing-season measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements during July and August are not included. "ND" is not determined; "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Total nitrite, in milligrams per liter as N					
0138200 Passaic River at Two Bridges	Same	38	0.05	28	0.05
01388600 Pompton River at Packanack Lake	ND	61	.02	7	.01
1389005 Passaic River below Pompton River at Two Bridges	Same	34	.04	29	.05
01389500 Passaic River at Little Falls	Same	38	.04	29	.05
Total organic nitrogen plus ammonia, in milligrams per liter as N					
0138200 Passaic River at Two Bridges	Same	37	1.0	29	0.8
01388600 Pompton River at Packanack Lake	ND	60	.6	7	.3
1389005 Passaic River below Pompton River at Two Bridges	Same	34	.9	29	.8
01389500 Passaic River at Little Falls	Same	37	.8	28	.85

Table 3. Results of rank-sum tests of growing-season measurements to determine whether water-quality measurements on days of diversion were different from water-quality measurements on days of no diversion--Continued

[Measurements during July and August are not included. "ND" is not determined; "Different" indicates water quality on days of diversion was different from water quality on days of no diversion; "Same" indicates that water quality on days of diversion was not different from water quality on days of no diversion]

Station	Results of rank-sum test for differences between measurements on days of diversion and days of no diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number of days	Median	Number of days	Median
Dissolved ammonia, in milligrams per liter as N					
0138200 Passaic River at Two Bridges	Same	38	0.19	29	0.17
01388600 Pompton River at Packanack Lake	ND	60	.09	7	.02
1389005 Passaic River below Pompton River at Two Bridges	Same	32	.12	29	.14
01389500 Passaic River at Little Falls	Same	38	.12	29	.09
Total phosphorus, in milligrams per liter as P					
0138200 Passaic River at Two Bridges	Same	37	0.40	29	0.57
01388600 Pompton River at Packanack Lake	ND	60	.07	7	.03
1389005 Passaic River below Pompton River at Two Bridges	Different	34	.38	29	.55
01389500 Passaic River at Little Falls	Different	37	.29	28	.50

Table 4. Relations between year-round water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion

[Measurements made during July and August were not included. Fig. is the figure showing measurements and relations; "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance]

Station	Fig.	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
						Measurements on days of no diversion		Measurements on days of diversion	
		Direction of slope	Slope	Int		Slope	Int	Slope	Int
Water temperature, in degrees Celsius									
01382000 Passaic River at Two Bridges	3A	Down	-0.306	1.74	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	3B	Down	- .221	1.5	Different	- .232	1.568	0	ND
01389005 Passaic River below Pompton River at Two Bridges	3C	Down	- .336	1.914	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	3D	Down	- .290	1.73	Same	ND	ND	ND	ND
Dissolved-oxygen concentration, in milligrams per liter									
01382000 Passaic River at Two Bridges	4A	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	4B	Up	.091	.813	Different	.099	0.782	0	ND
01389005 Passaic River below Pompton River at Two Bridges	4C	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	4D	Up	.064	.841	Same	ND	ND	ND	ND

Table 4. Relations between year-round water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included. Fig. is the figure showing measurements and relations; "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance]

Station	Fig.	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
						Measurements on days of no diversion		Measurements on days of diversion	
		Direction of slope	Slope	Int		Slope	Int	Slope	Int
Dissolved-oxygen saturation, in percent									
01382000 Passaic River at Two Bridges	5A	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	5B	Up	.035	1.921	Same	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	5C	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	5D	Up	.014	1.952	Same	ND	ND	ND	ND
5-Day biochemical oxygen demand, in milligrams per liter									
01382000 Passaic River at Two Bridges	6A	--	0	ND	Same				
01388600 Pompton River at Packanack Lake	6B	Down	-.219	0.926	Same	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	6C	Down	-.177	0.948	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	6D	--	0	ND	Different	-.236	1.145	0	ND

Table 4. Relations between year-round water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included. Fig. is the figure showing measurements and relations; "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance]

Station	Fig.	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
						Measurements on days of no diversion		Measurements on days of diversion	
		Direction of slope	Slope	Int		Slope	Int	Slope	Int
Total nitrogen, in milligrams per liter as N									
01382000 Passaic River at Two Bridges	7A	Down	-0.589	2.105	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	7B	Down	- .165	.529	Different	- .186	.598	0	ND
01389005 Passaic River below Pompton River at Two Bridges	7C	Down	- .561	2.045	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	7D	Down	- .434	1.657	Different	- .507	1.866	- .324	1.392
Total nitrate plus nitrite, in milligrams per liter as N									
01382000 Passaic River at Two Bridges	8A	Down	-0.742	2.322	Different	-0.700	2.250	-0.729	2.256
01388600 Pompton River at Packanack Lake	B8	Down	- .196	.37	Same	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	8C	Down	- .708	2.285	Different	- .688	2.201	- .650	2.162
01389500 Passaic River at Little Falls	8D	Down	- .529	1.739	Different	- .589	1.898	- .405	1.457

Table 4. Relations between year-round water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included. Fig. is the figure showing measurements and relations; "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance]

Station	Fig.	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
						Measurements on days of no diversion		Measurements on days of diversion	
		Direction of slope	Slope	Int		Slope	Int	Slope	Int
Total nitrite, in milligrams per liter as N									
01382000 Passaic River at Two Bridges	A9	Down	-0.342	-0.467	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	9B	Down	-.174	-1.241	Different	-.206	-1.128	0	ND
01389005 Passaic River below Pompton River at Two Bridges	9C	Down	-.367	-.424	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	9D	Down	-.147	-1.058	Same	ND	ND	ND	ND
Total organic nitrogen plus ammonia, in milligrams per liter as N									
01382000 Passaic River at Two Bridges	10A	Down	-0.244	0.645	Different	0	ND	-0.332	0.943
01388600 Pompton River at Packanack Lake	10B	--	0	ND	Different	-.156	.130	0	ND
01389005 Passaic River below Pompton River at Two Bridges	10C	Down	-.195	.46	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	10D	Down	-.187	.437	Different	-.314	.829	0	ND

Table 4. Relations between year-round water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included. Fig. is the figure showing measurements and relations; "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance]

Station	Fig.	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
						Measurements on days of no diversion		Measurements on days of diversion	
		Direction of slope	Slope	Int		Slope	Int	Slope	Int
Dissolved ammonia, in milligrams per liter as N									
01382000 Passaic River at Two Bridges	11A	--	0	ND	Different	0	ND	-0.448	0.646
01388600 Pompton River at Packanack Lake	11B	--	0	ND	Different	0	ND	0	ND
01389005 Passaic River below Pompton River at Two Bridges	11C	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	11D	--	0	ND	Same	ND	ND	ND	ND
Total phosphorus, in milligrams per liter as P									
01382000 Passaic River at Two Bridges	12A	Down	-0.638	1.346	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	12B	Down	-.224	-0.624	Different	-.267	-.491	0	ND
01389005 Passaic River below Pompton River at Two Bridges	12C	Down	-.695	1.491	Different	-.710	1.513	-.563	1.175
01389500 Passaic River at Little Falls	12D	Down	-.480	.839	Different	-.551	1.028	-.337	.509

Table 5. Relations between growing-season water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion

[Measurements made during July and August were not included in analysis. "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance; ND, not determined]

Station	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
					Measurements on days of no diversion		Measurements on days of diversion	
	Direction of slope	Slope	Int		Slope	Int	Slope	Int
Water temperature, in degrees Celsius								
01382000 Passaic River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	Down	-.071	1.399	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Down	-.082	1.477	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	Down	-.054	1.384	Same	ND	ND	ND	ND
Dissolved-oxygen concentration, in milligrams per liter								
01382000 Passaic River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	Up	.065	.816	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	Up	.034	.87	Same	ND	ND	ND	ND

Table 5. Relations between growing-season water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included in analysis. "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance; ND, not determined]

Station	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
					Measurements on days of no diversion		Measurements on days of diversion	
	Direction of slope	Slope	Int		Slope	Int	Slope	Int
Dissolved-oxygen saturation, in percent								
01382000 Passaic River at Two Bridges	Down	-0.120	2.112	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	Up	.039	1.901	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	--	0	ND	Same	ND	ND	ND	ND
5-Day biochemical oxygen demand, in milligrams per liter								
01382000 Passaic River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	--	0	ND	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Different	- .222	1.143	0	ND
01389500 Passaic River at Little Falls	--	0	ND	Same	ND	ND	ND	ND

Table 5. Relations between growing-season water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included in analysis. "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance; ND, not determined]

Station	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
					Measurements on days of no diversion		Measurements on days of diversion	
	Direction of slope	Slope	Int		Slope	Int	Slope	Int
Total nitrogen, in milligrams per liter as N								
01382000 Passaic River at Two Bridges	Down	-0.606	2.148	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	Down	-.146	.48	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Down	-.552	2.027	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	Down	-.441	1.672	Different	-.521	1.887	-.281	1.3
Total nitrate plus nitrite, in milligrams per liter as N								
01382000 Passaic River at Two Bridges	Down	-0.821	2.517	Different	-0.717	2.302	-0.813	2.461
01388600 Pompton River at Packanack Lake	Down	-0.210	.375	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Down	-.746	2.376	Different	-.742	2.337	-.646	2.154
01389500 Passaic River at Little Falls	Down	-.557	1.802	Different	-.643	2.017	-.343	1.328

Table 5. Relations between growing-season water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included in analysis. "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance; ND, not determined]

Station	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
					Measurements on days of no diversion		Measurements on days of diversion	
	Direction of slope	Slope	Int		Slope	Int	Slope	Int
Total nitrite, in milligrams per liter as N								
01382000 Passaic River at Two Bridges	Down	-0.232	-0.667	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	--	0	ND	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	--	0	ND	Same	ND	ND	ND	ND
Total organic nitrogen plus ammonia, in milligrams per liter as N								
01382000 Passaic River at Two Bridges	Down	-0.185	0.498	Different	0	ND	-0.236	0.699
01388600 Pompton River at Packanack Lake	--	0	ND	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	Down	-.166	.386	Same	ND	ND	ND	ND

Table 5. Relations between growing-season water quality and streamflow and results of analysis of covariance to determine whether relations on days of diversion were different from relations on days of no diversion--Continued

[Measurements made during July and August were not included in analysis. "Up" and "Down" indicate that the water-quality characteristic increases and decreases with increasing streamflow, respectively; -- indicates that the characteristic does not change with streamflow; Slope and Int are the slope and intercept of the relation, respectively; "Same" indicates that the relations for days of no diversion and days of diversion are not different; "Different" indicates that these relations are different at the 0.05 level of significance; ND, not determined]

Station	Relation between water quality and streamflow, all measurements			Results of analysis of covariance	Relations between water quality and streamflow			
					Measurements on days of no diversion		Measurements on days of diversion	
	Direction of slope	Slope	Int		Slope	Int	Slope	Int
Dissolved ammonia, in milligrams per liter as N								
01382000 Passaic River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	--	0	ND	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	--	0	ND	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	--	0	ND	Same	ND	ND	ND	ND
Total phosphorus, in milligrams per liter as P								
01382000 Passaic River at Two Bridges	Down	-0.556	1.153	Same	ND	ND	ND	ND
01388600 Pompton River at Packanack Lake	--	0	ND	ND	ND	ND	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Down	-.611	1.287	Same	ND	ND	ND	ND
01389500 Passaic River at Little Falls	Down	-.420	.691	Different	-.499	.903	-.259	.318

Table 6. Results of rank-sum tests of year-round measurements to determine whether the same-day changes in water quality from station 01382000, Passaic River at Two Bridges, to station 01389005, Passaic River below Pompton River at Two Bridges, N.J., on days of no diversion were different from changes on days of diversion

[Measurements made during July and August are not included.]

Characteristic	Figure showing changes in water-quality characteristic as a function of streamflow	Results of rank-sum test on changes in water-quality characteristic from station 01382000 to station 01389005 on the basis of diversion	Measurements on days of no diversion		Measurements on days of diversion	
			Number	Median change	Number	Median change
Water temperature, in degrees Celsius	13	Same	31	0.0	30	0.0
Dissolved-oxygen concentration, in milligrams per liter	14	Same	31	.7	38	.4
Dissolved-oxygen saturation, in percent	15	Same	30	7	28	3
Biochemical oxygen demand, in milligrams per liter	16	Same	28	-.6	28	-.3
Total nitrogen concentration, in milligrams per liter as N	17	Different	31	-.6	30	-.05
Total nitrate plus nitrite concentration, in milligrams per liter as N	18	Different	31	-.2	30	.0
Total nitrite concentration, in milligrams per liter as N	19	Different	31	-.01	29	.0
Total organic nitrogen plus ammonia, in milligrams per liter as N	20	Different	31	-.2	30	.0
Dissolved ammonia, in milligrams per liter as N	21	Different	30	-0.115	30	-0.005
Total phosphorus, in milligrams per liter as P	22	Different	31	-.12	30	-.02

Table 7. Results of rank-sum test of growing-season measurements to determine whether the same-day changes in water quality from station 01382000, Passaic River at Two Bridges, to station 01389005, Passaic River below Pompton River at Two Bridges, N.J., on days of no diversion were different from changes on days of diversion

[Measurements made during July and August are not included.]

Characteristic	Results of rank-sum test on changes in water-quality characteristic from station 01382000 to station 01389005 on the basis of diversion	Measurements on days of no diversion		Measurements on days of diversion	
		Number	Median change	Number	Median change
Water temperature, in degrees Celsius	Different	18	-0.2	19	0.0
Dissolved-oxygen concentration, in milligrams per liter	Same	19	.8	19	.5
Dissolved-oxygen saturation, in percent	Same	18	8	19	5
Biochemical oxygen demand, in milligrams per liter	Same	19	-.5	17	.1
Total nitrogen concentration, in milligrams per liter as N	Different	19	-.7	19	.0
Total nitrate plus nitrite concentration, in milligrams per liter as N	Different	19	-.27	19	.00
Total nitrite concentration, in milligrams per liter as N	Different	19	-.01	18	.0
Total organic nitrogen plus ammonia, in milligrams per liter as N	Different	19	-.2	19	.0
Dissolved ammonia, in milligrams per liter as N	Same	18	-.045	19	-.01
Total phosphorus, in milligrams per liter as P	Different	19	-.13	19	-.01

Table 8. Summary of results of rank-sum tests of water-quality measurements and analyses of covariance to determine whether water quality on days of diversion was different from water quality on days of no diversion

[Measurements made during July and August were not included in tests. ND, not determined]

Station	Results of tests to determine whether water quality on days of diversion was different from water quality on days of no diversion			
	Year-round water quality		Growing-season water quality	
	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow
Water temperature, in degrees Celsius				
01382000 Passaic River at Two Bridges	Same	Same	Same	Same
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Same	Same	Same
Dissolved-oxygen concentration, in milligrams per liter				
01382000 Passaic River at Two Bridges	Same	Same	Same	Same
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Same	Same	Same

Table 8. Summary of results of rank-sum tests of water-quality measurements and analyses of covariance to determine whether water quality on days of diversion was different from water quality on days of no diversion--Continued

Station	Results of tests to determine whether water quality on days of diversion was different from water quality on days of no diversion			
	Year-round water quality		Growing-season water quality	
	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow
Dissolved-oxygen saturation, in percent				
01382000 Passaic River at Two Bridges	Same	Same	Same	Same
01388600 Pompton River at Packanack Lake	Same	Same	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Same	Same	Same
5-Day Biochemical oxygen demand, in milligrams per liter				
01382000 Passaic River at Two Bridges	Same	Same	Same	Same
01388600 Pompton River at Packanack Lake	Same	Same	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Different
01389500 Passaic River at Little Falls	Same	Different	Same	Same

Table 8. Summary of results of rank-sum tests of water-quality measurements and analyses of covariance to determine whether water quality on days of diversion was different from water quality on days of no diversion--Continued

Station	Results of tests to determine whether water quality on days of diversion was different from water quality on days of no diversion			
	Year-round water quality		Growing-season water quality	
	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow
Total nitrogen, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	Different	Same	Same	Same
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Different	Same	Different	Same
01389500 Passaic River at Little Falls	Different	Different	Different	Different
Total nitrate plus nitrite, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	Different	Same	Different	Different
01388600 Pompton River at Packanack Lake	Same	Same	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Different	Different	Different	Different
01389500 Passaic River at Little Falls	Different	Different	Different	Different

Table 8. Summary of results of rank-sum tests of water-quality measurements and analyses of covariance to determine whether water quality on days of diversion was different from water quality on days of no diversion--Continued

Station	Results of tests to determine whether water quality on days of diversion was different from water quality on days of no diversion			
	Year-round water quality		Growing-season water quality	
	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow
Total nitrite, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	Same	Same	Same	Same
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Same	Same	Same
Total organic nitrogen plus ammonia, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	Same	Different	Same	Different
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Different	Same	Same

Table 8. Summary of results of rank-sum tests of water-quality measurements and analyses of covariance to determine whether water quality on days of diversion was different from water quality on days of no diversion--Continued

Station	Results of tests to determine whether water quality on days of diversion was different from water quality on days of no diversion			
	Year-round water quality		Growing-season water quality	
	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow	Rank-sum test for differences in water quality	Analysis of covariance test for differences in relations between water quality and streamflow
Dissolved ammonia, in milligrams per liter as N				
01382000 Passaic River at Two Bridges	Same	Different	Same	Same
01388600 Pompton River at Packanack Lake	Different	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Same	Same	Same	Same
01389500 Passaic River at Little Falls	Same	Same	Same	Same
Total phosphorus, in milligrams per liter as P				
01382000 Passaic River at Two Bridges	Different	Same	Same	Same
01388600 Pompton River at Packanack Lake	Same	Different	ND	ND
01389005 Passaic River below Pompton River at Two Bridges	Different	Different	Different	Same
01389500 Passaic River at Little Falls	Different	Different	Different	Different

Table 9. Summary of results of analyses to determine whether water quality at station 01388600, Pompton River at Packanack Lake, N.J., on days of diversion was different from water quality on days of no diversion

['Yes" indicates that a difference was identified; "No" indicates that no difference was identified]

Characteristic	Difference between measurements on days of diversions and on days of no diversions identified by tests using year-round measurements	
	Rank-sum test of water-quality characteristic	Analysis of covariance
Water temperature	Yes	Yes
Dissolved-oxygen concentration	Yes	Yes
Dissolved-oxygen saturation	No	No
5-Day biochemical-oxygen demand	No	No
Total nitrogen concentration	Yes	Yes
Total nitrate plus nitrite concentration	No	No
Total nitrite concentration	Yes	Yes
Total organic nitrogen plus ammonia concentration	Yes	Yes
Dissolved-ammonia concentration	Yes	Yes
Total phosphorus concentration	No	Yes

Table 10. Summary of results of analyses to determine whether water quality at stations on the Passaic River on days of diversion was different from water quality on days of no diversion

["Yes" indicates that differences in either year-round or growing-season values were identified; "No" indicates that no differences were identified; stations 01389005 and 01389500 are on the Passaic River downstream from the Pompton River; station 01382000 is on the Passaic River upstream from the Pompton River.]

Characteristic	Differences between measurements on days of diversions and days of no diversions identified by tests using either year-round measurements or growing-season measurements		
	Differences identified at either station 01389005 or station 01389500, but not identified by the same test at station 01382000		Rank-sum tests of changes in water-quality characteristic from station 01382000 to station 01389005
	Rank-sum tests of water-quality characteristic	Analysis of covariance	
Water temperature	No	No	Yes
Dissolved-oxygen concentration	No	No	No
Dissolved-oxygen saturation	No	No	No
5-Day biochemical oxygen demand	No	Yes	No
Total nitrogen concentration	Yes	Yes	Yes
Total nitrate plus nitrite concentration	Yes	Yes	Yes
Total nitrite concentration	No	No	Yes
Total organic nitrogen plus ammonia concentration	No	No	Yes
Dissolved ammonia concentration	No	No	Yes
Total phosphorus concentration	Yes	Yes	Yes

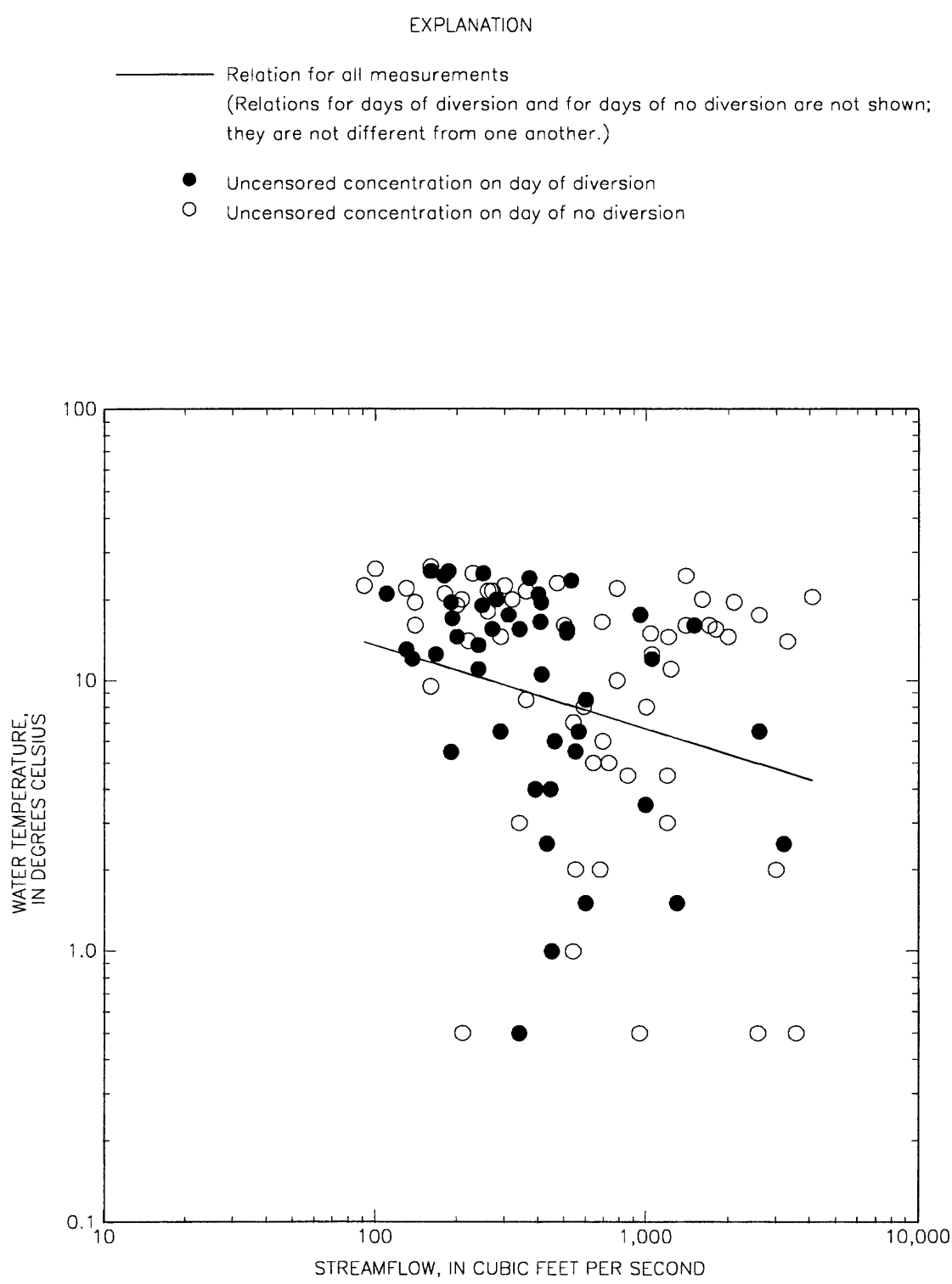

Figure 3A. Relations between water temperature and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

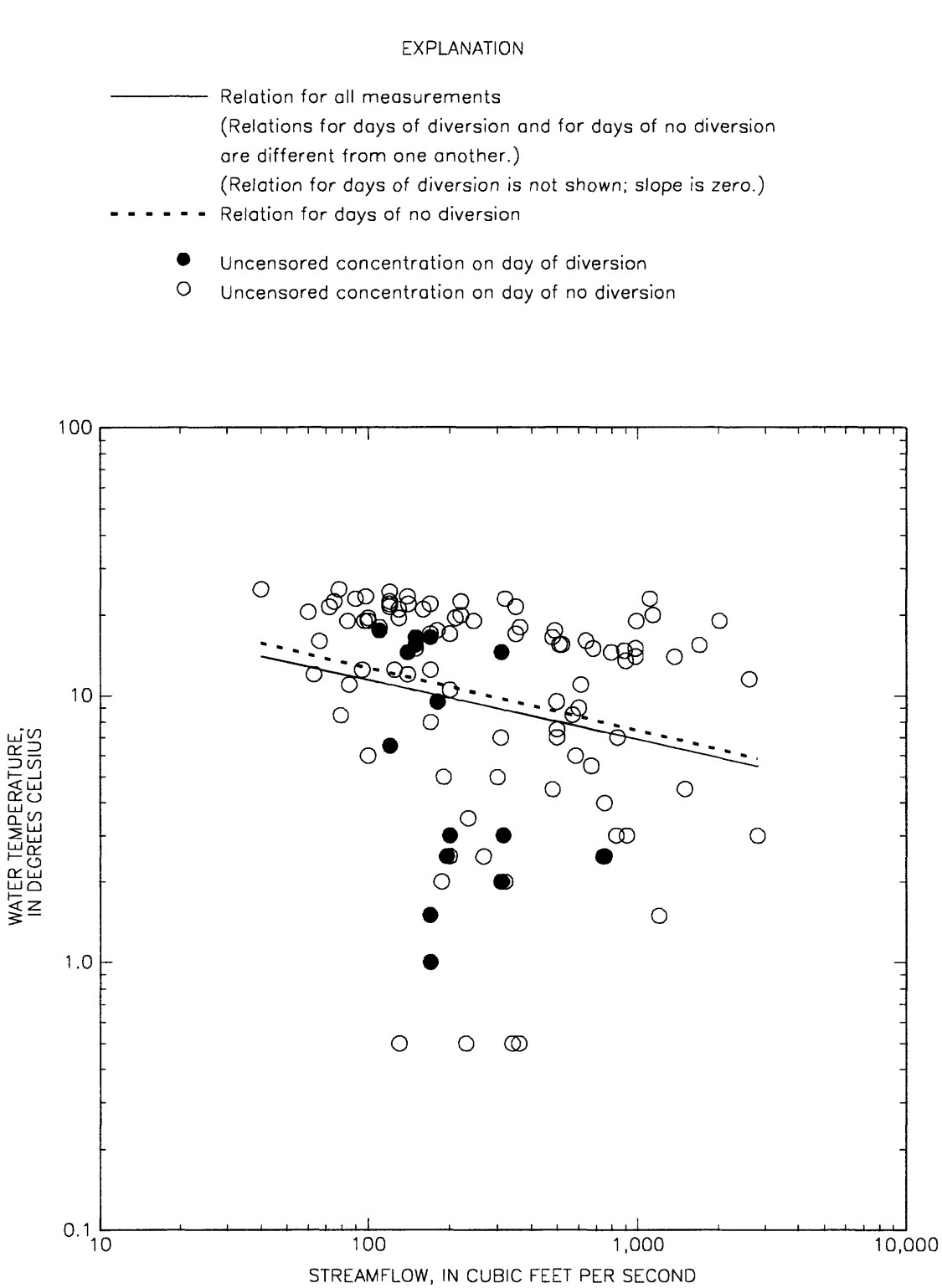

Figure 3B. Relations between water temperature and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

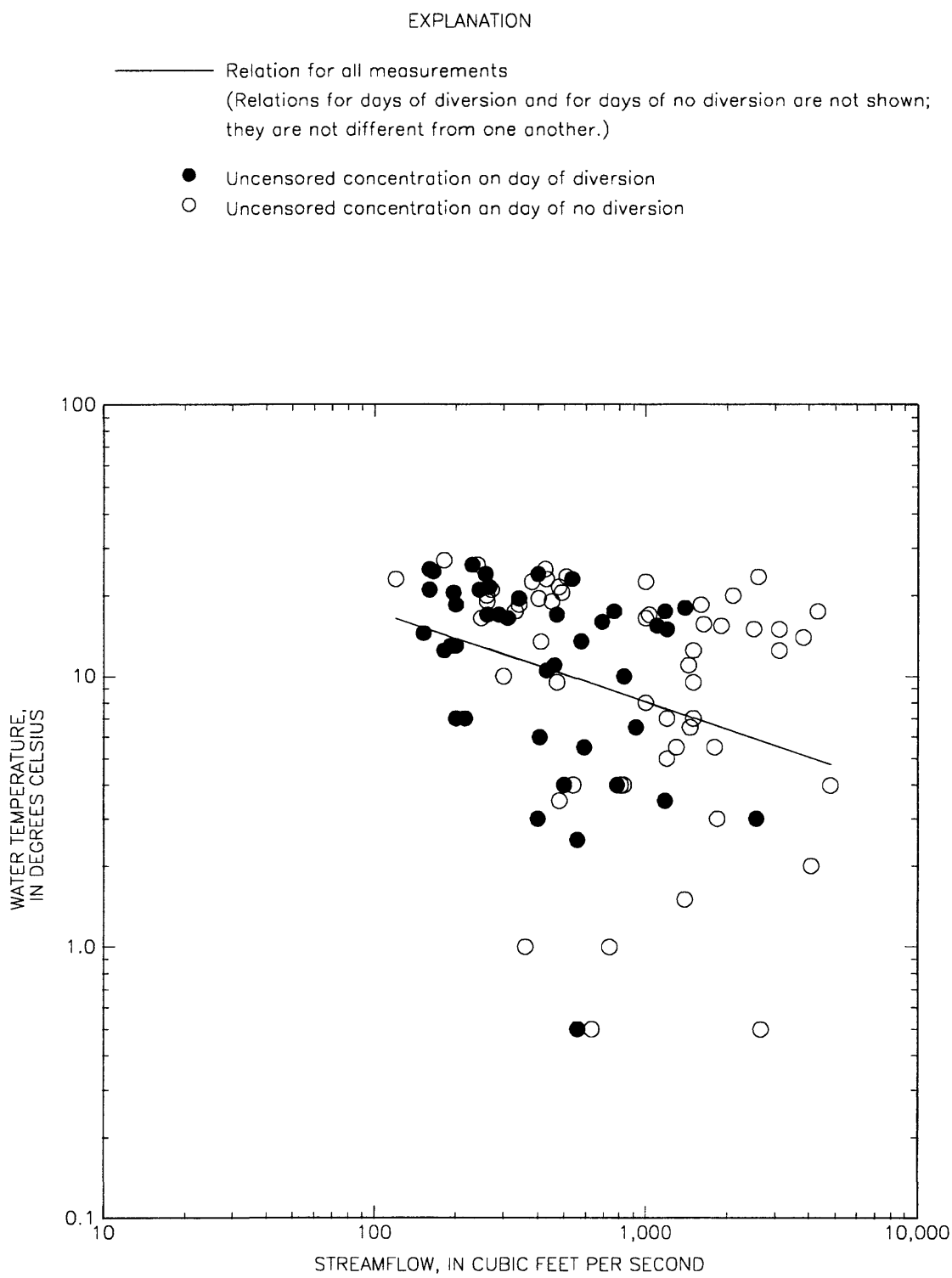

Figure 3C. Relations between water temperature and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

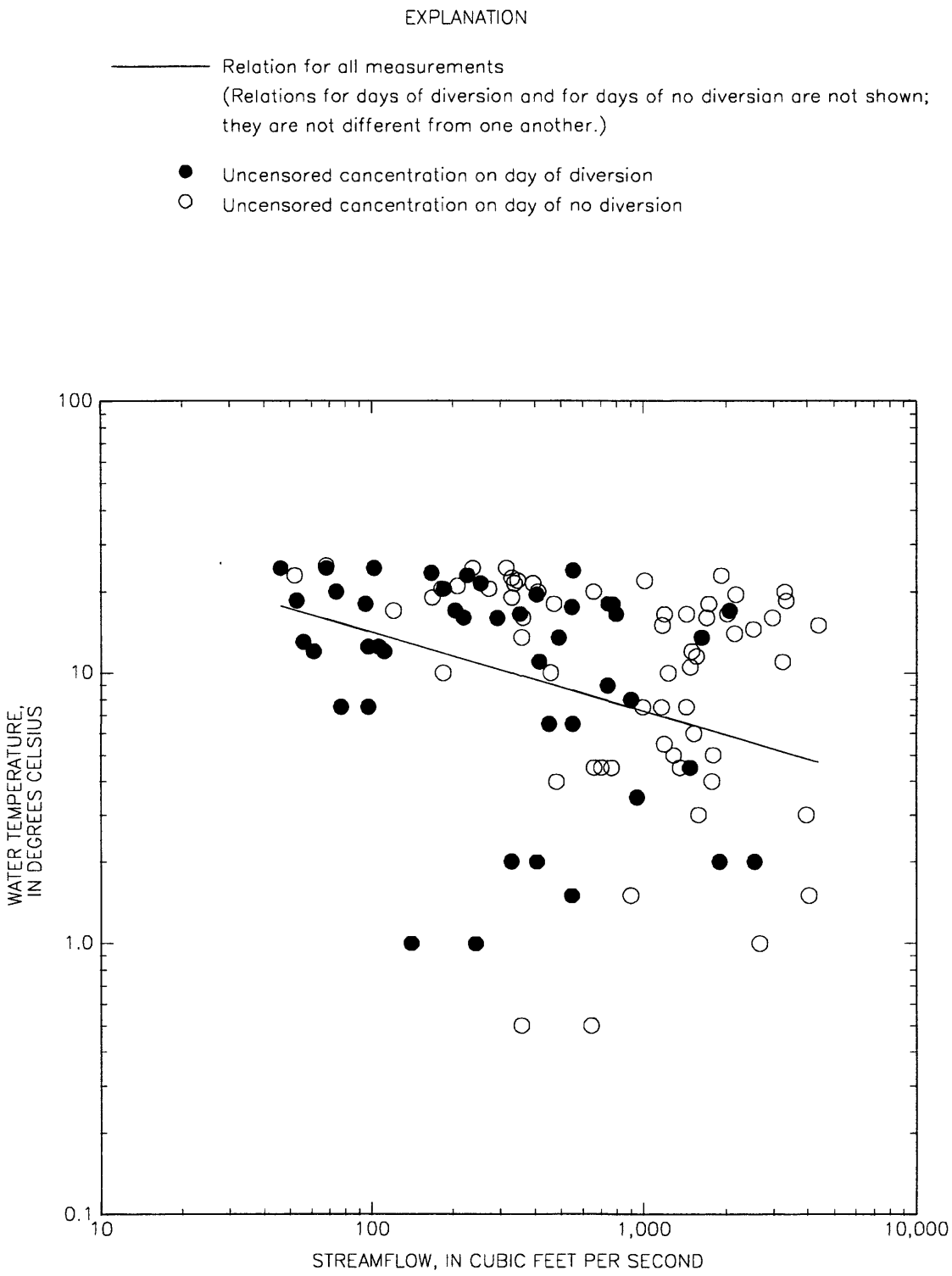

Figure 3D. Relations between water temperature and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

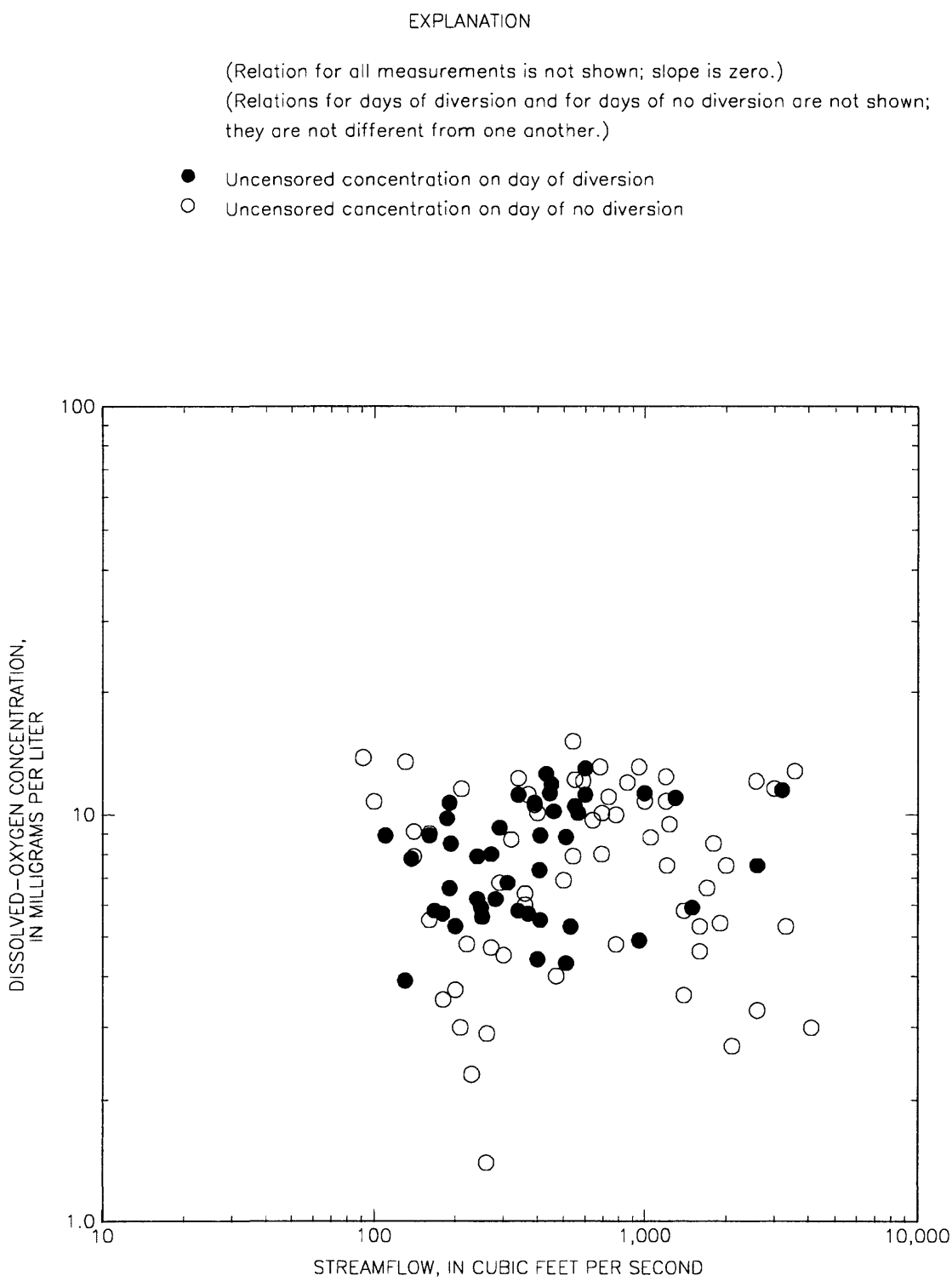

Figure 4A. Relations between concentration of dissolved oxygen and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

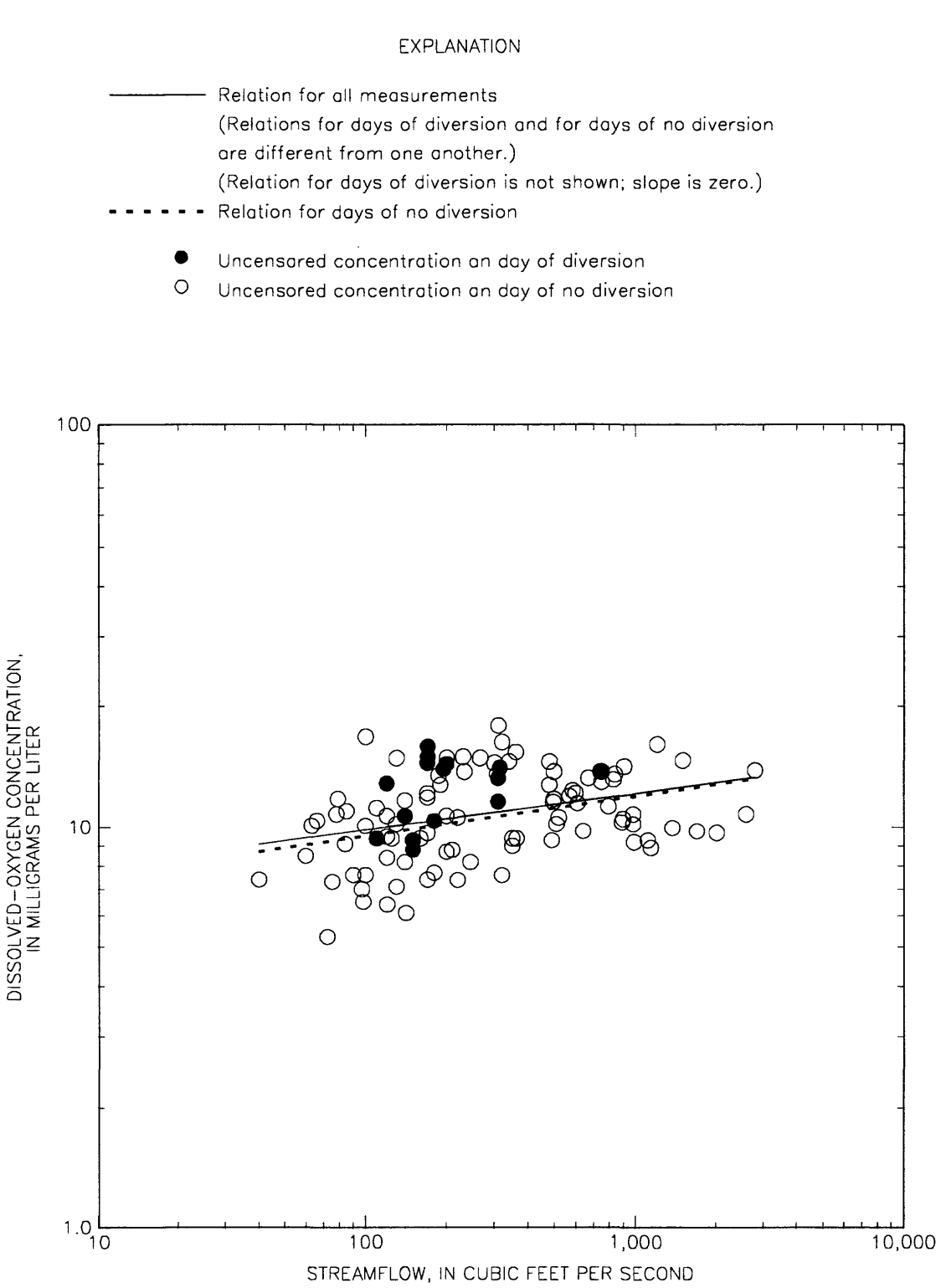

Figure 4B. Relations between concentration of dissolved oxygen and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

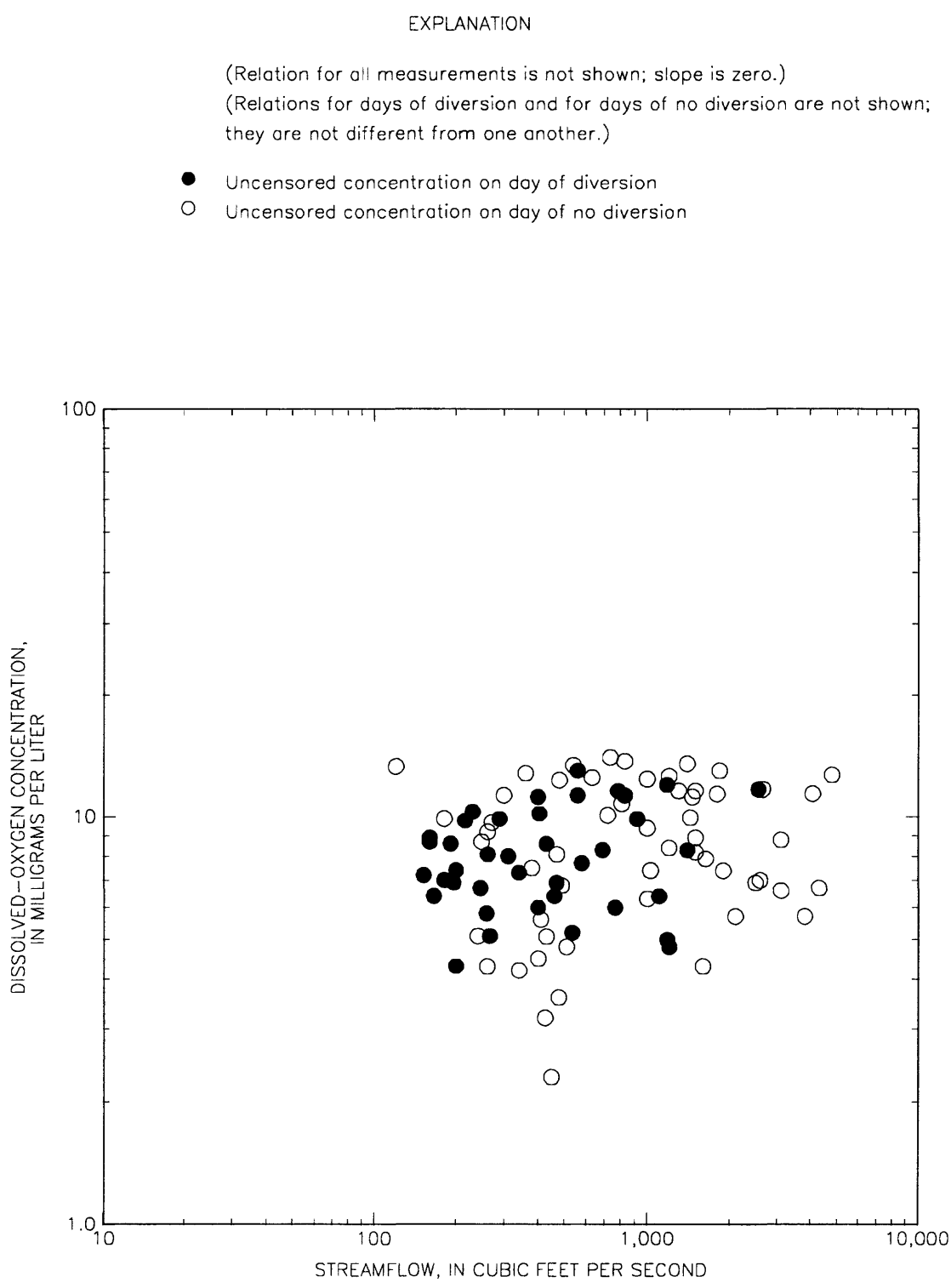

Figure 4C. Relations between concentration of dissolved oxygen and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

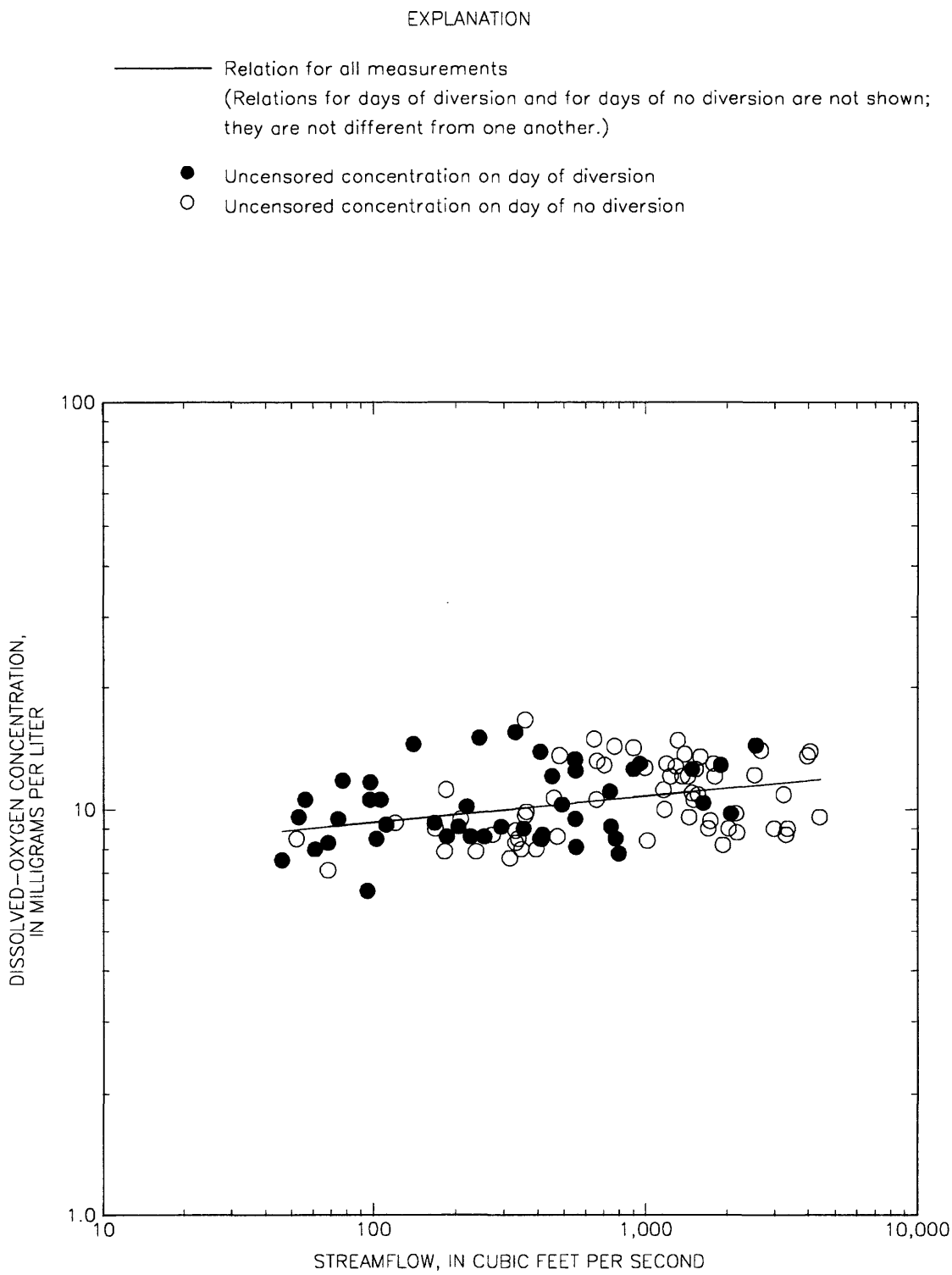

Figure 4D. Relations between concentration of dissolved oxygen and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year-round, except during July and August.)

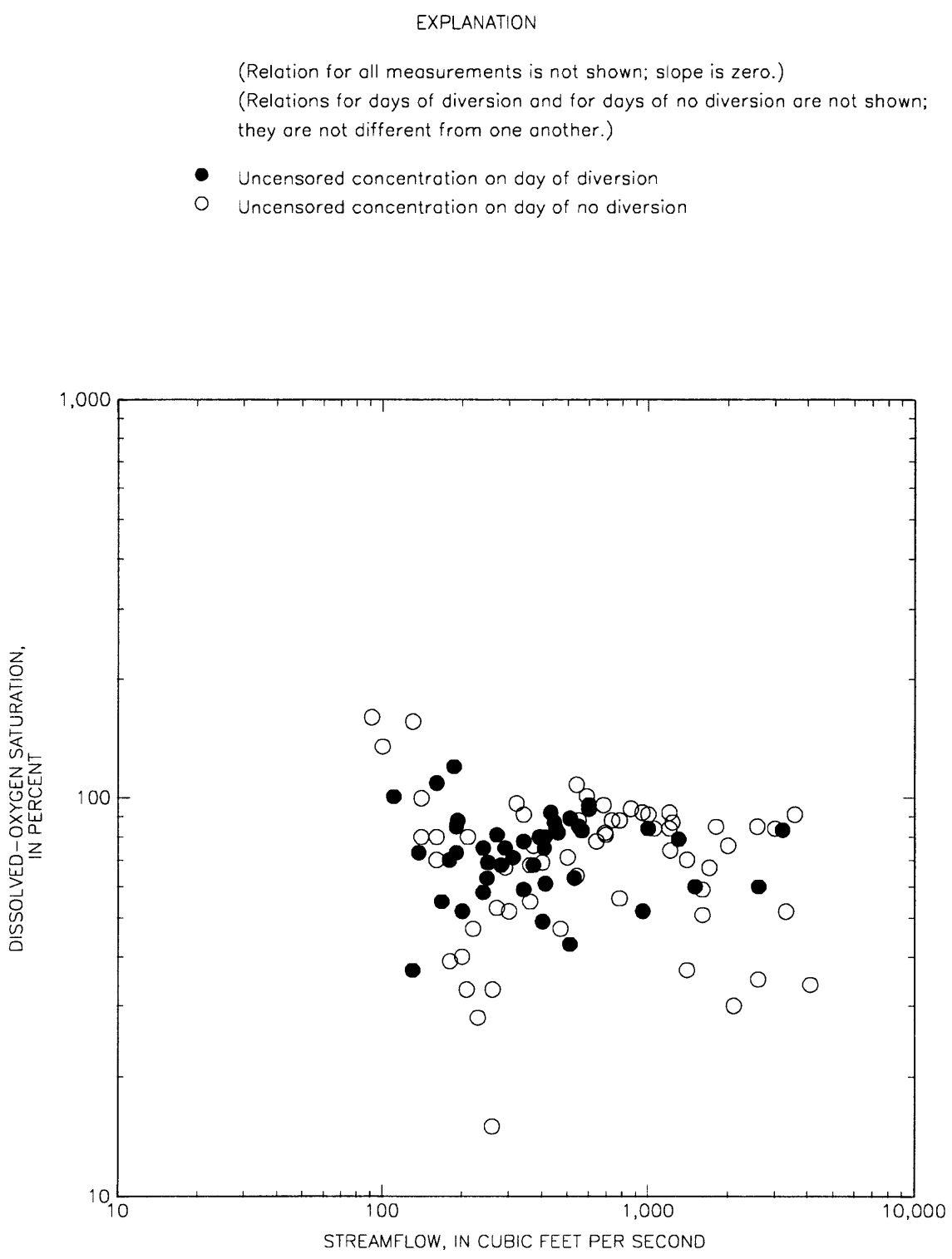

Figure 5A. Relations between dissolved-oxygen saturation and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

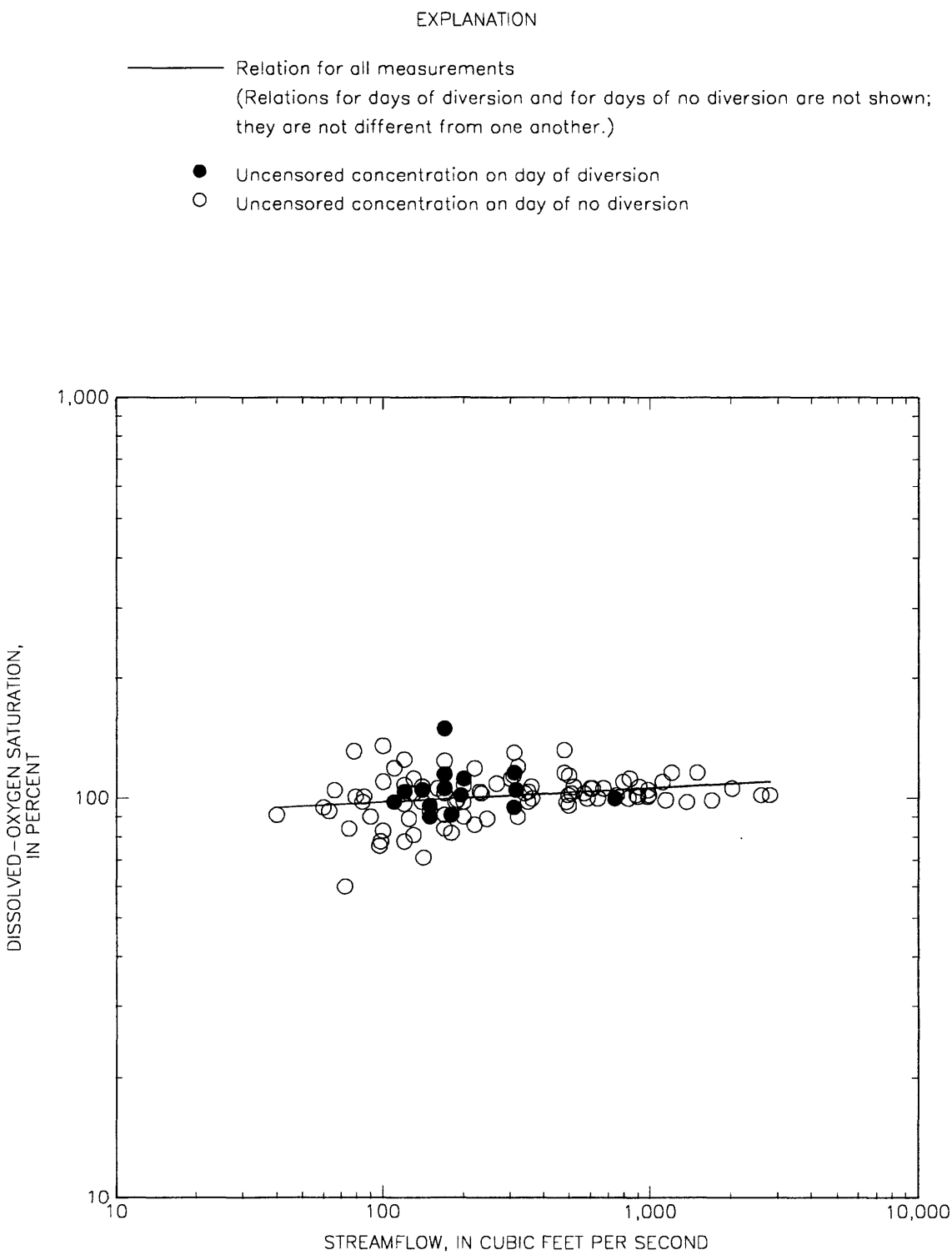

Figure 5B. Relations between dissolved-oxygen saturation and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

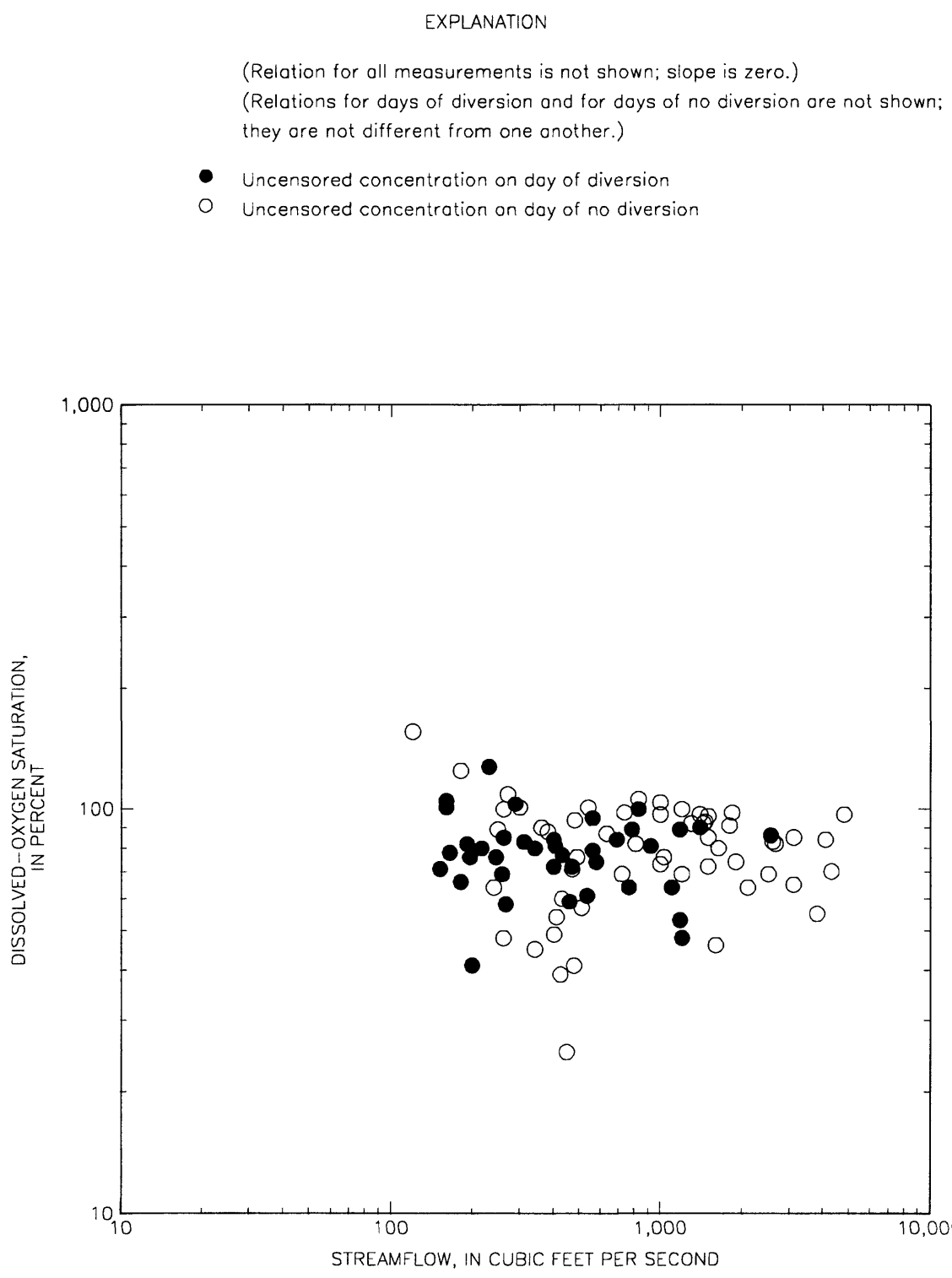

Figure 5C. Relations between dissolved-oxygen saturation and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

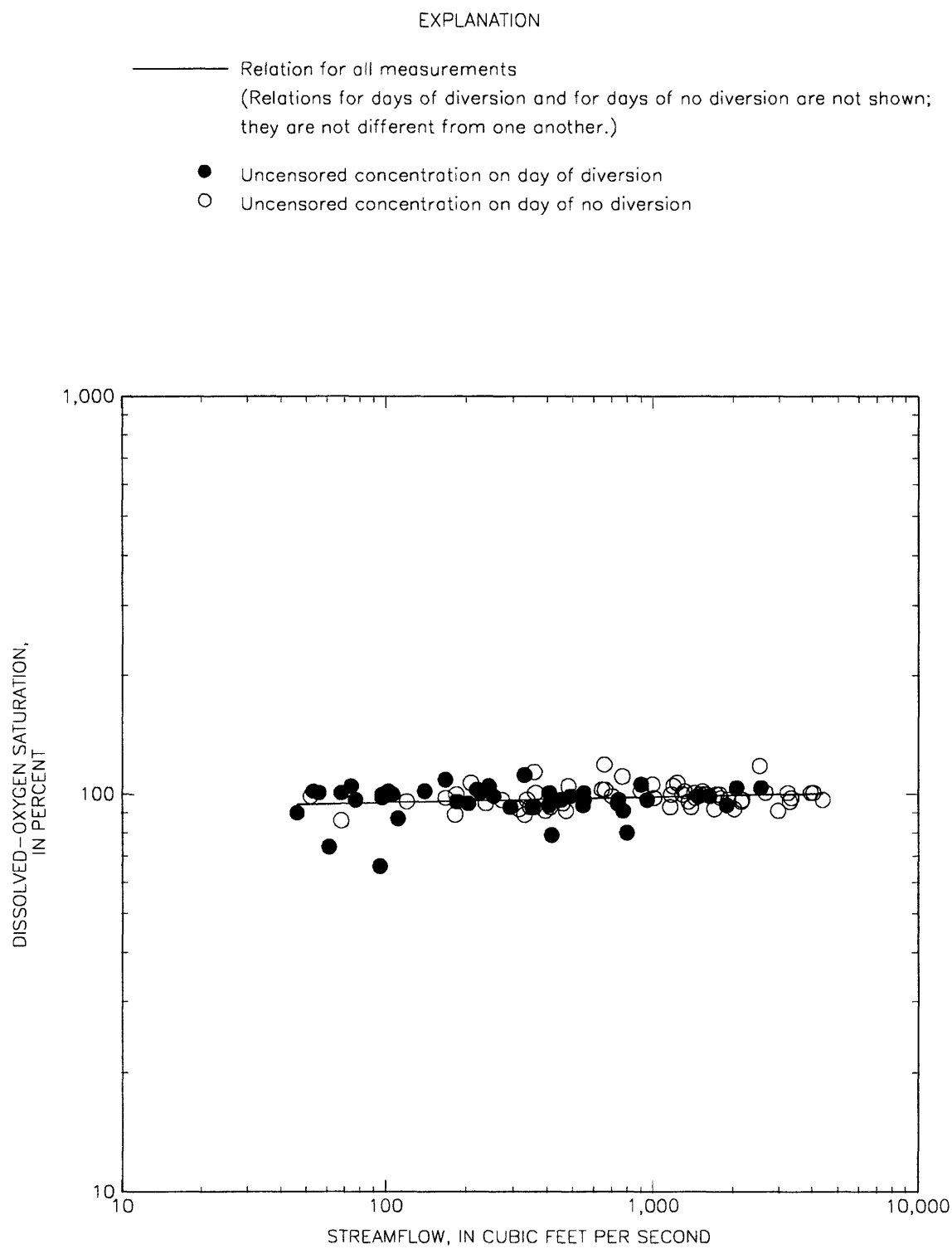

Figure 5D. Relations between dissolved-oxygen saturation and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

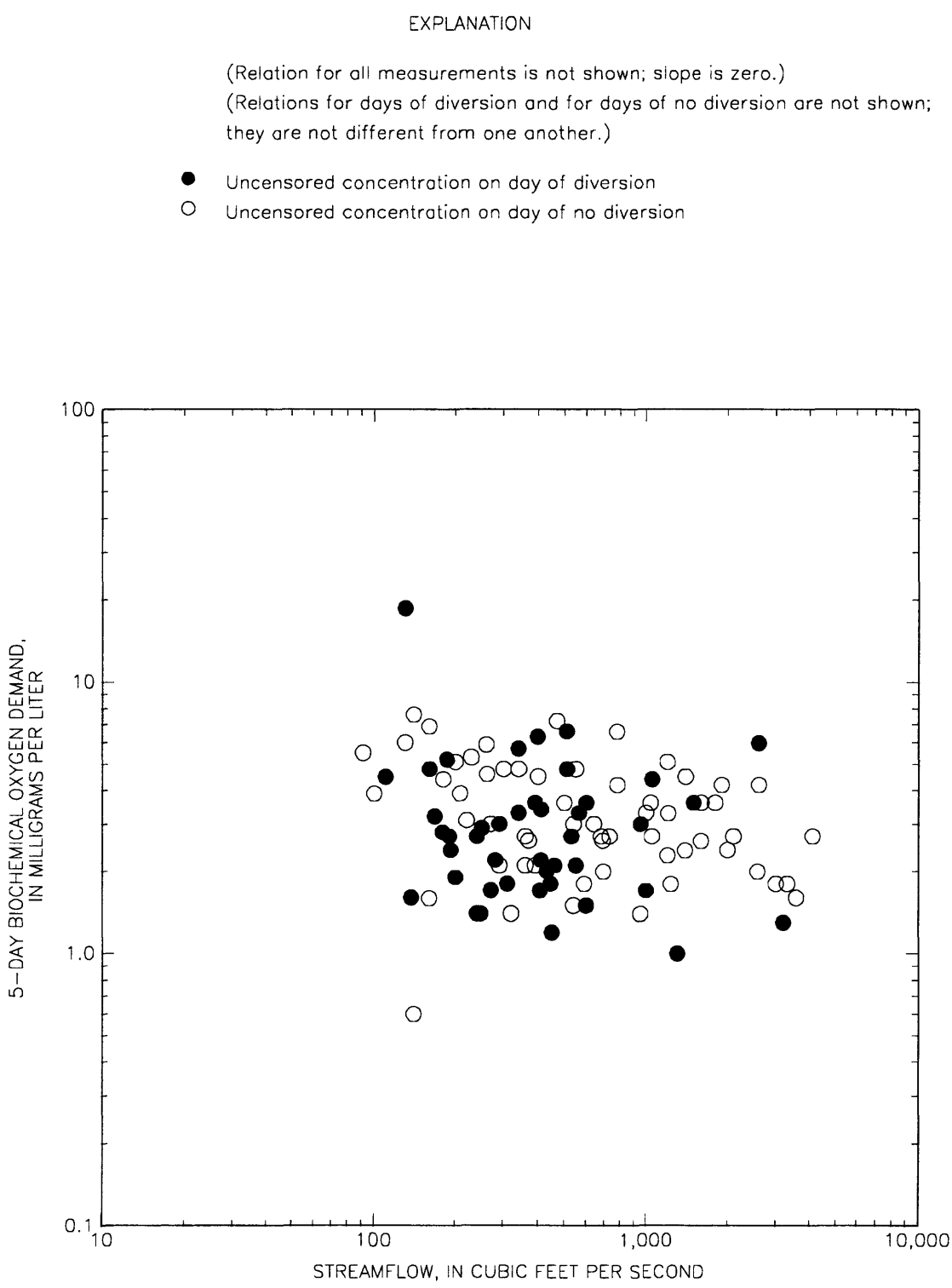

Figure 6A. Relations between 5-day biochemical-oxygen demand and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

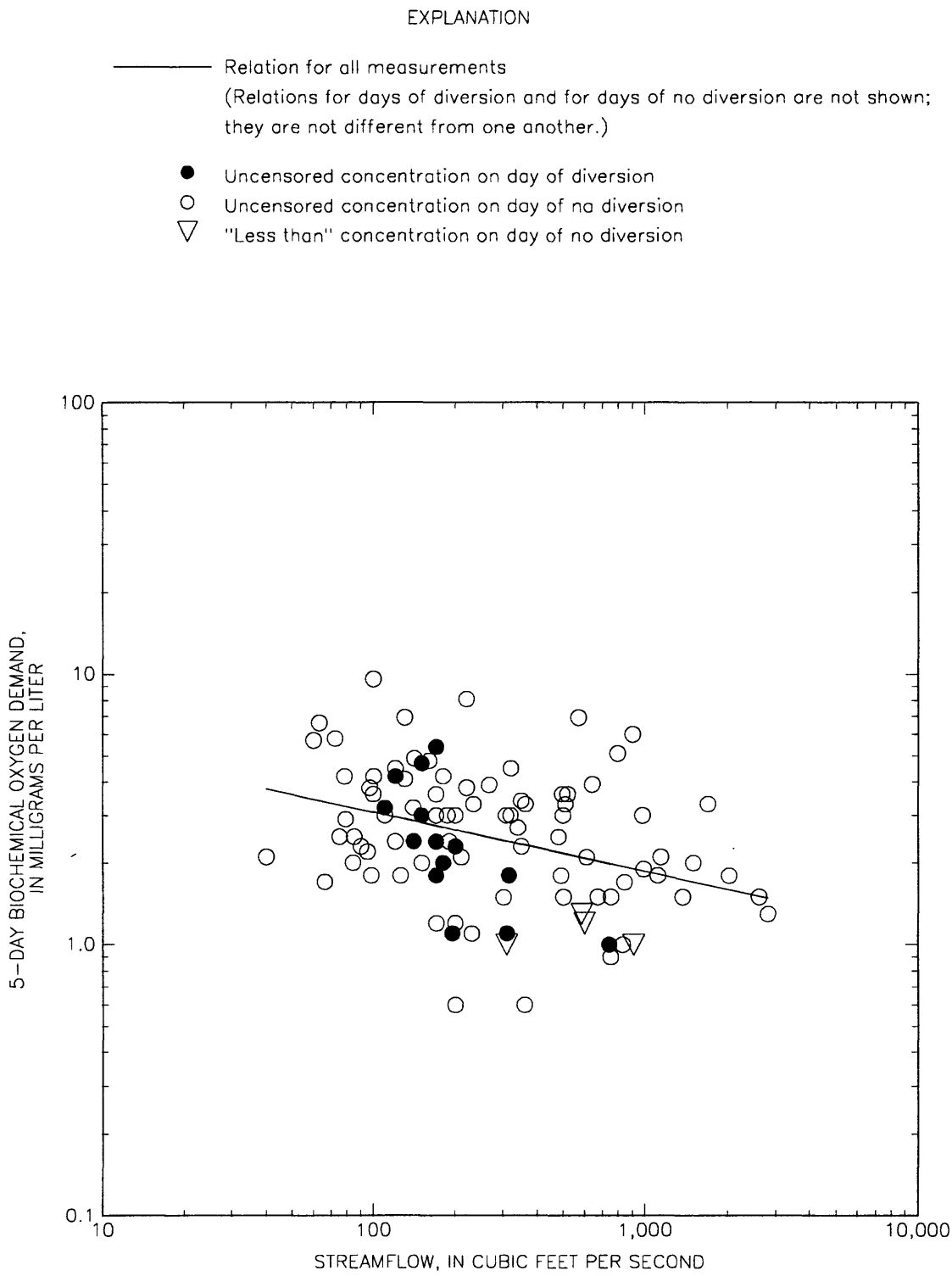

Figure 6B. Relations between 5-day biochemical-oxygen demand and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

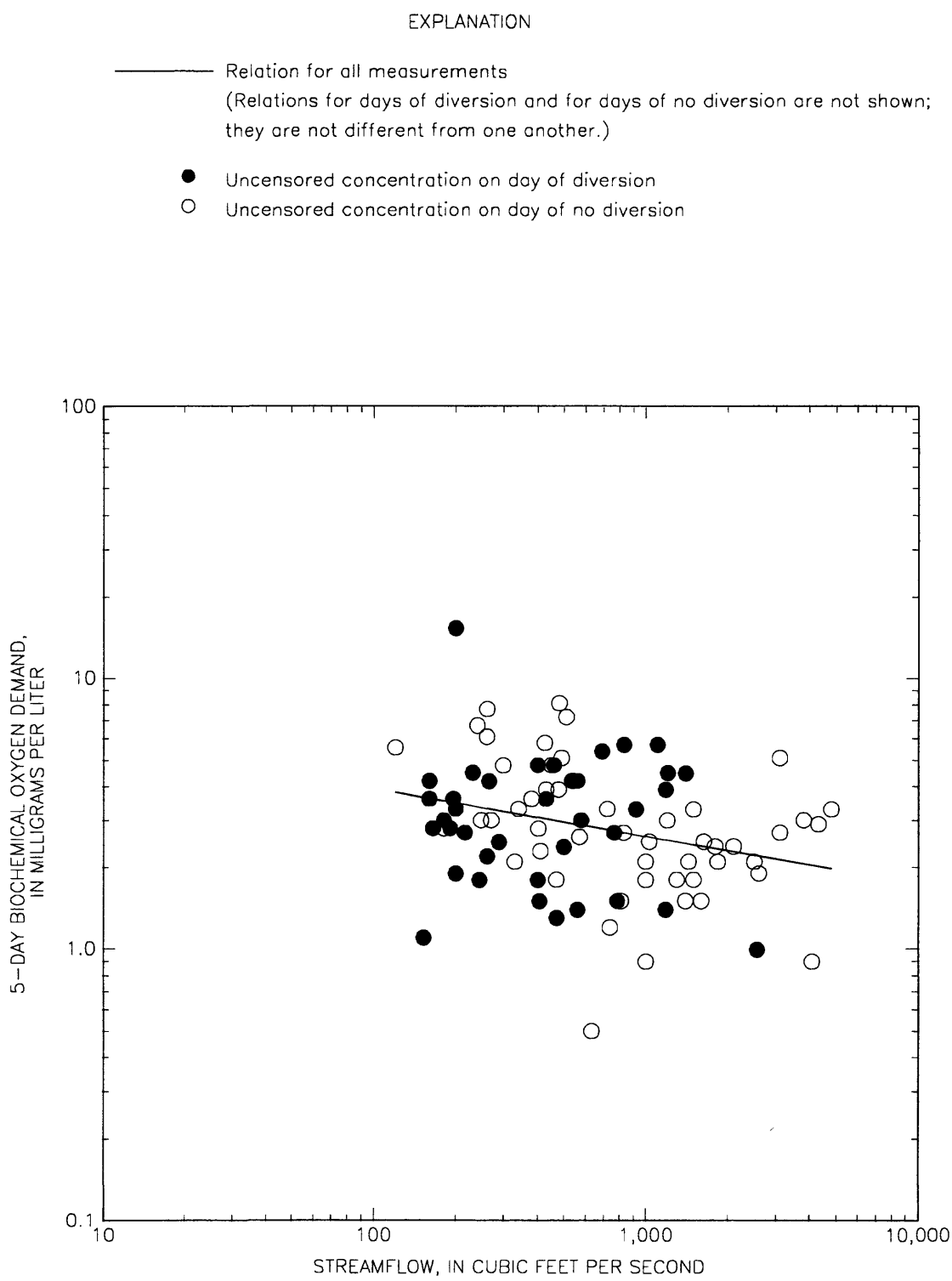

Figure 6C. Relations between 5-day biochemical-oxygen demand and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

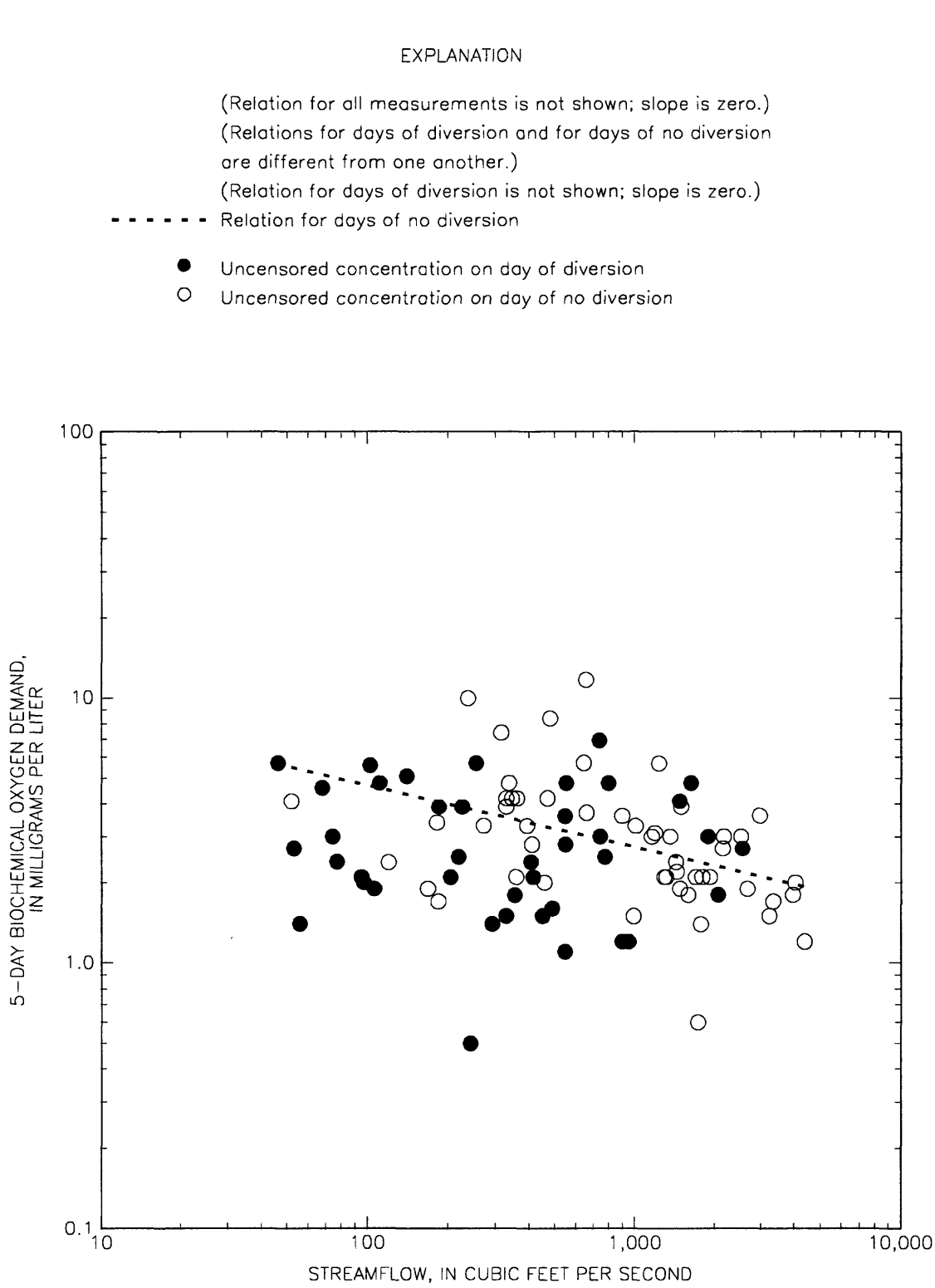

Figure 6D. Relations between 5-day biochemical-oxygen demand and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

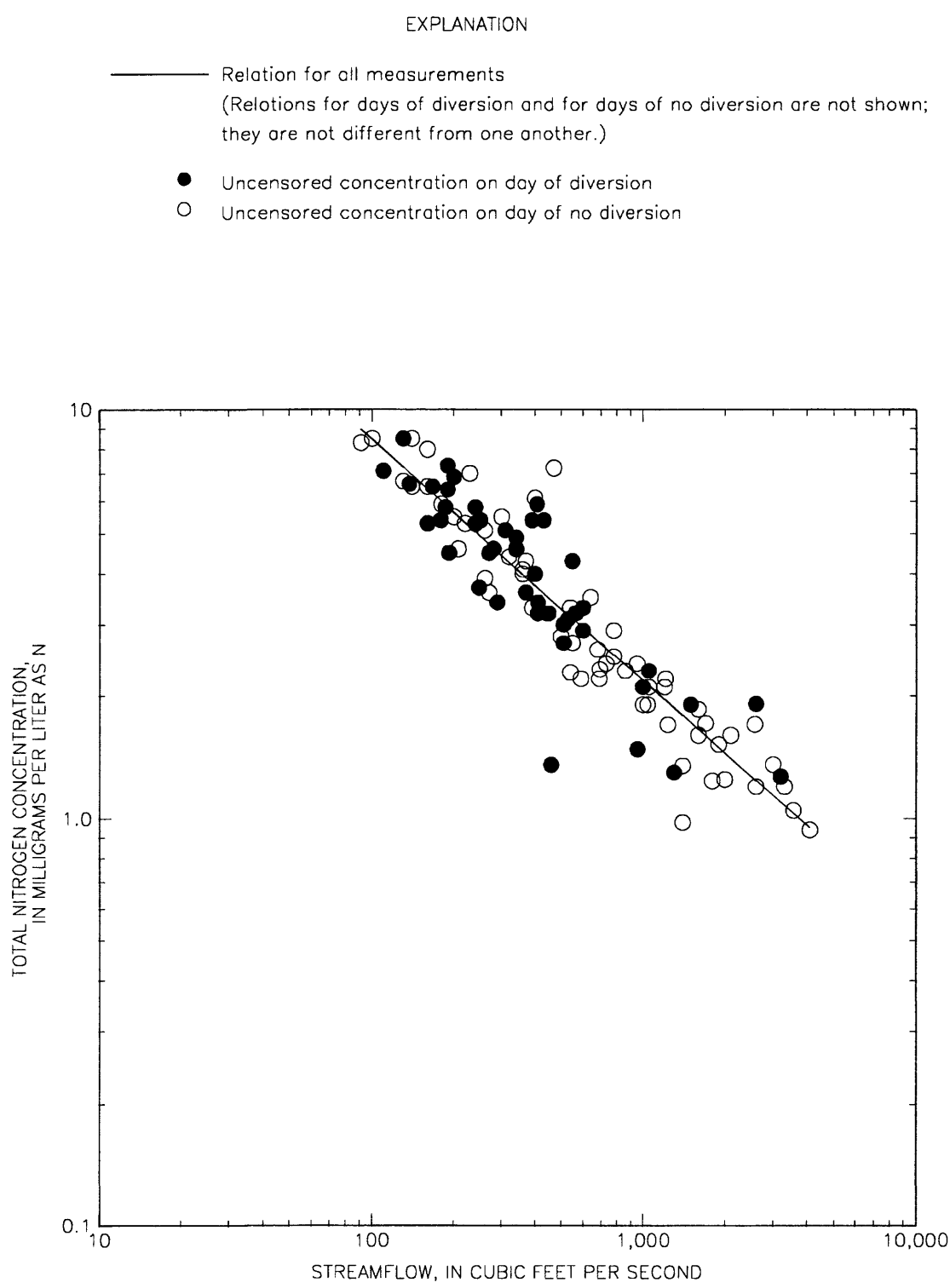

Figure 7A. Relations between total nitrogen concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

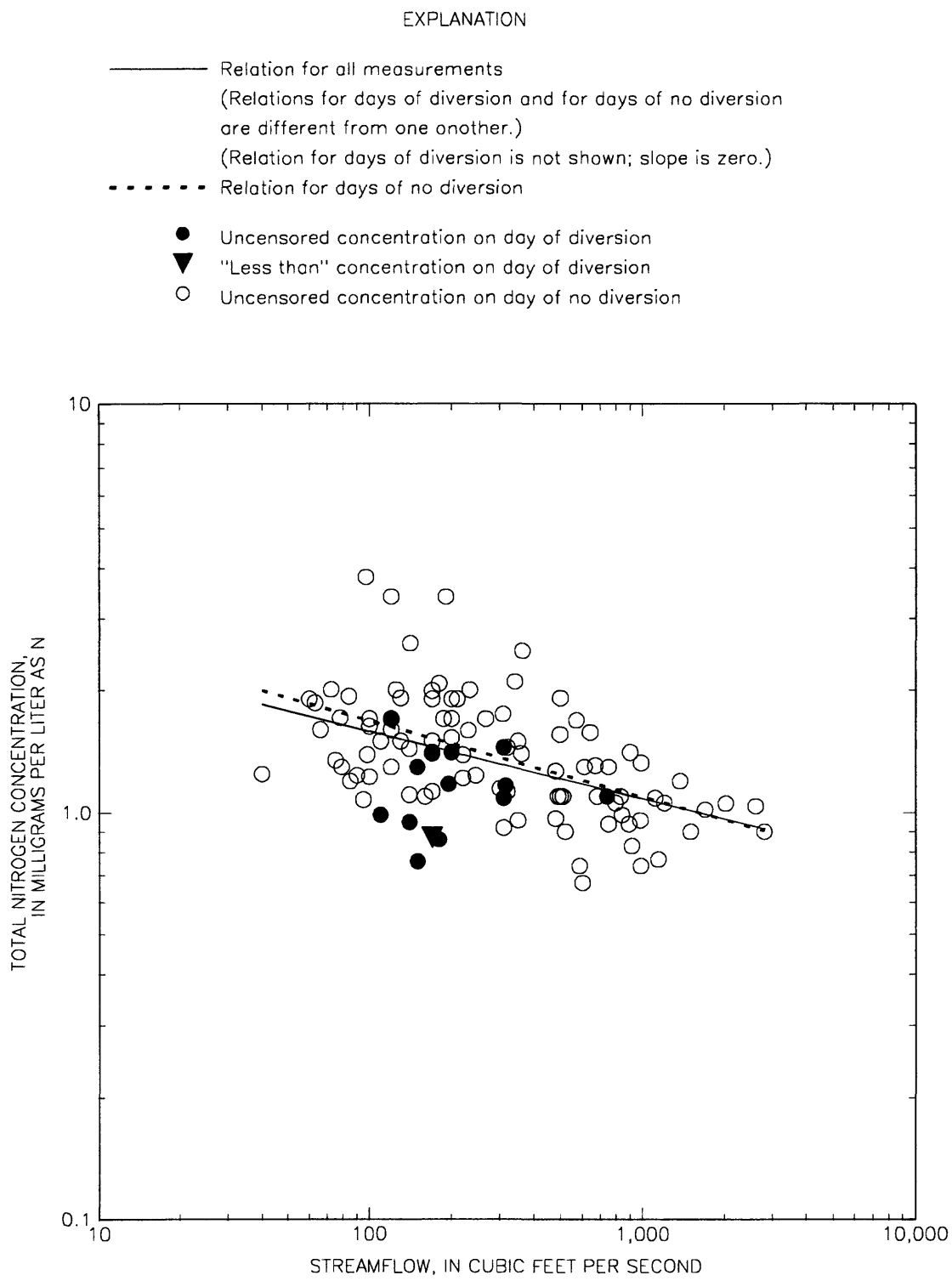

Figure 7B. Relations between total nitrogen concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

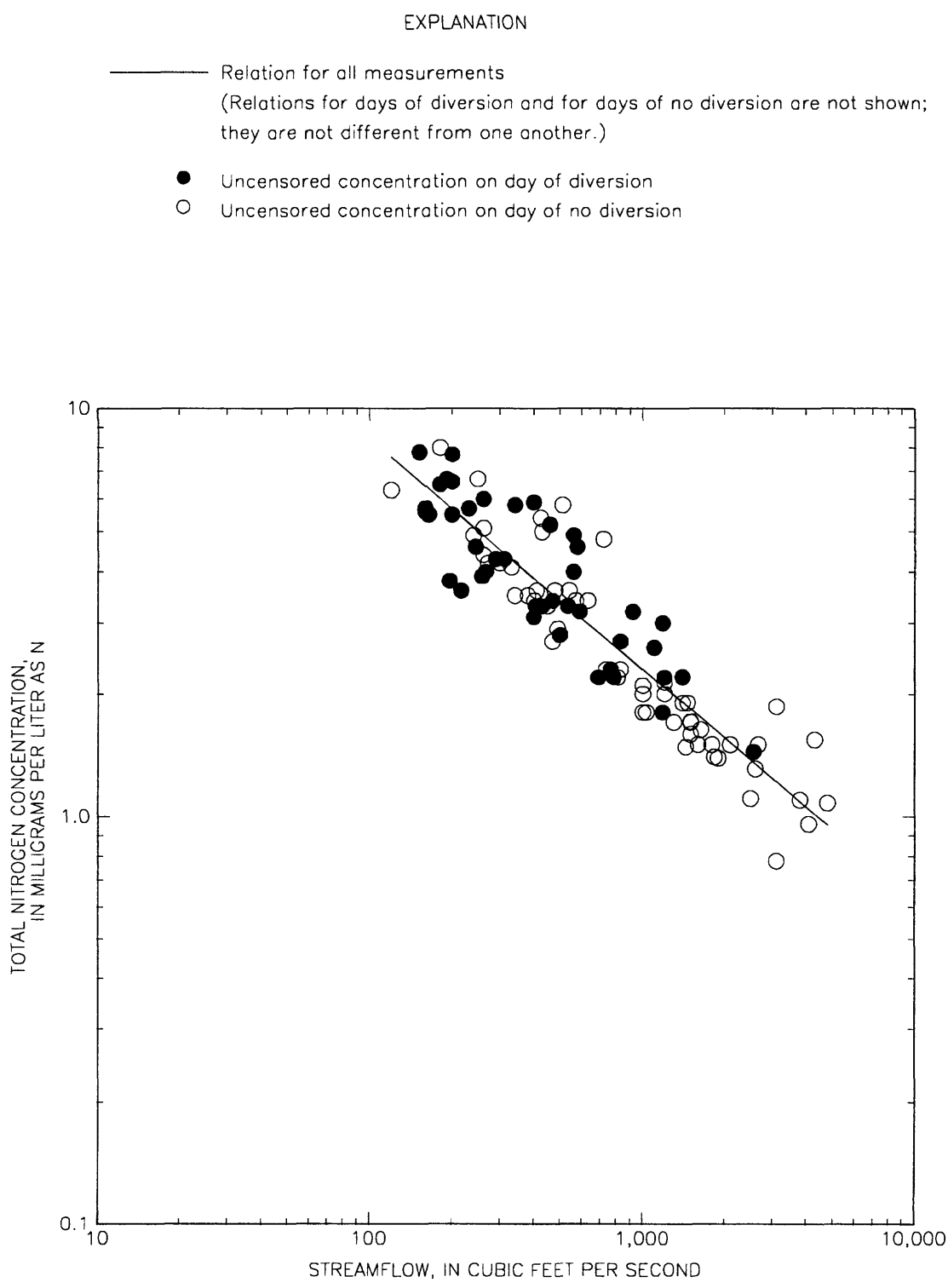

Figure 7C. Relations between total nitrogen concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

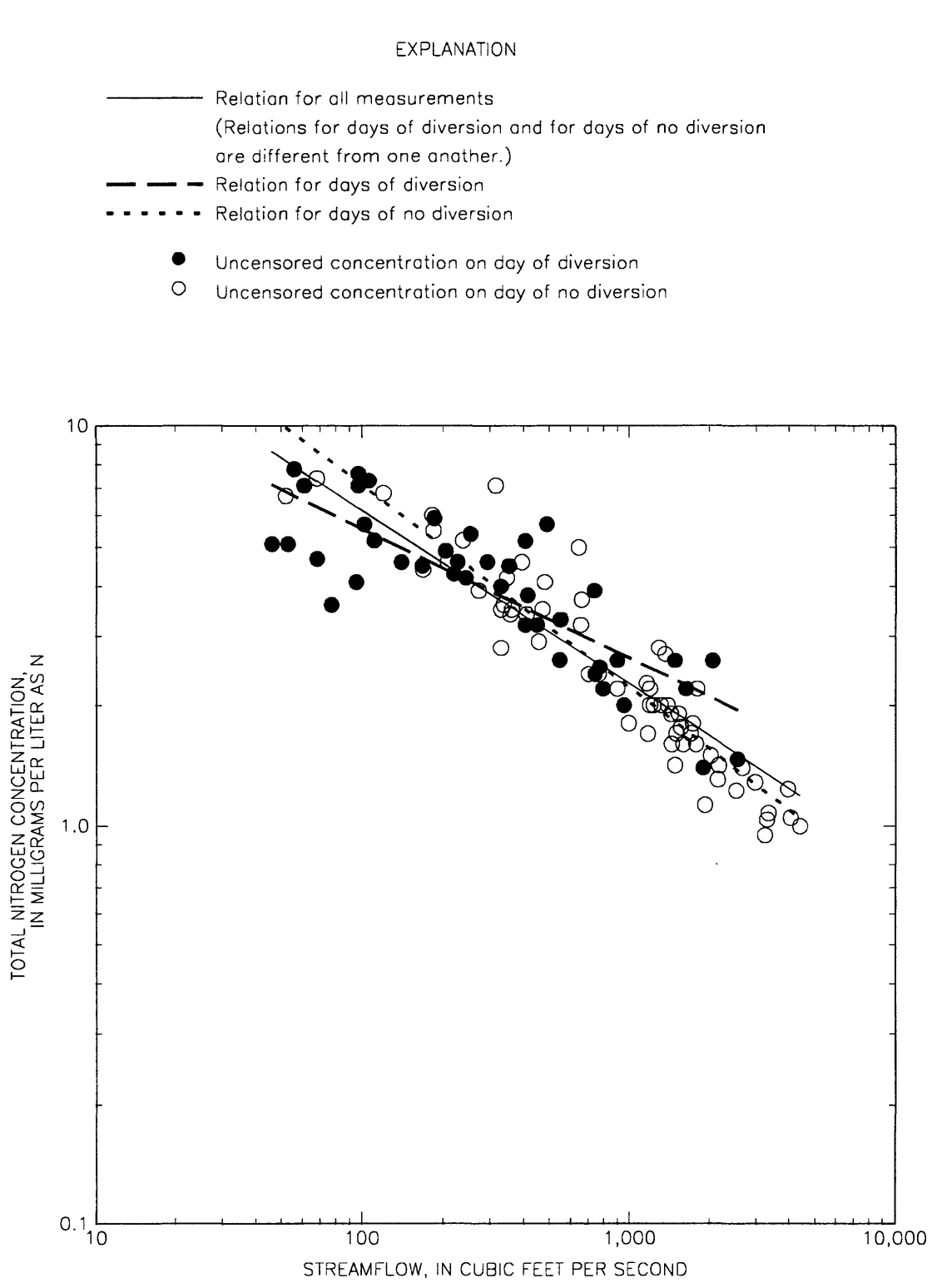

Figure 7D. Relations between total nitrogen concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

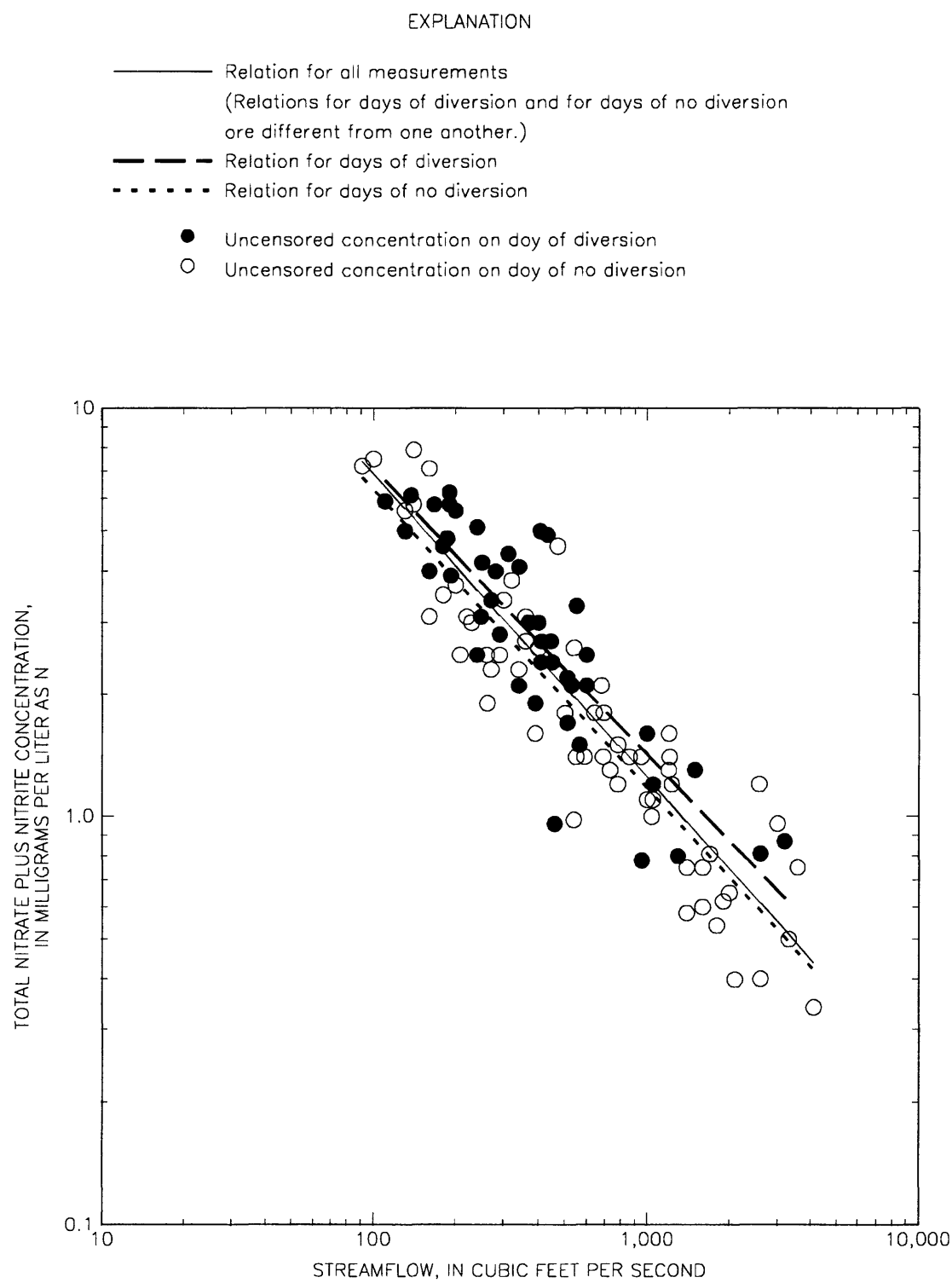

Figure 8A. Relations between total nitrate plus nitrite concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

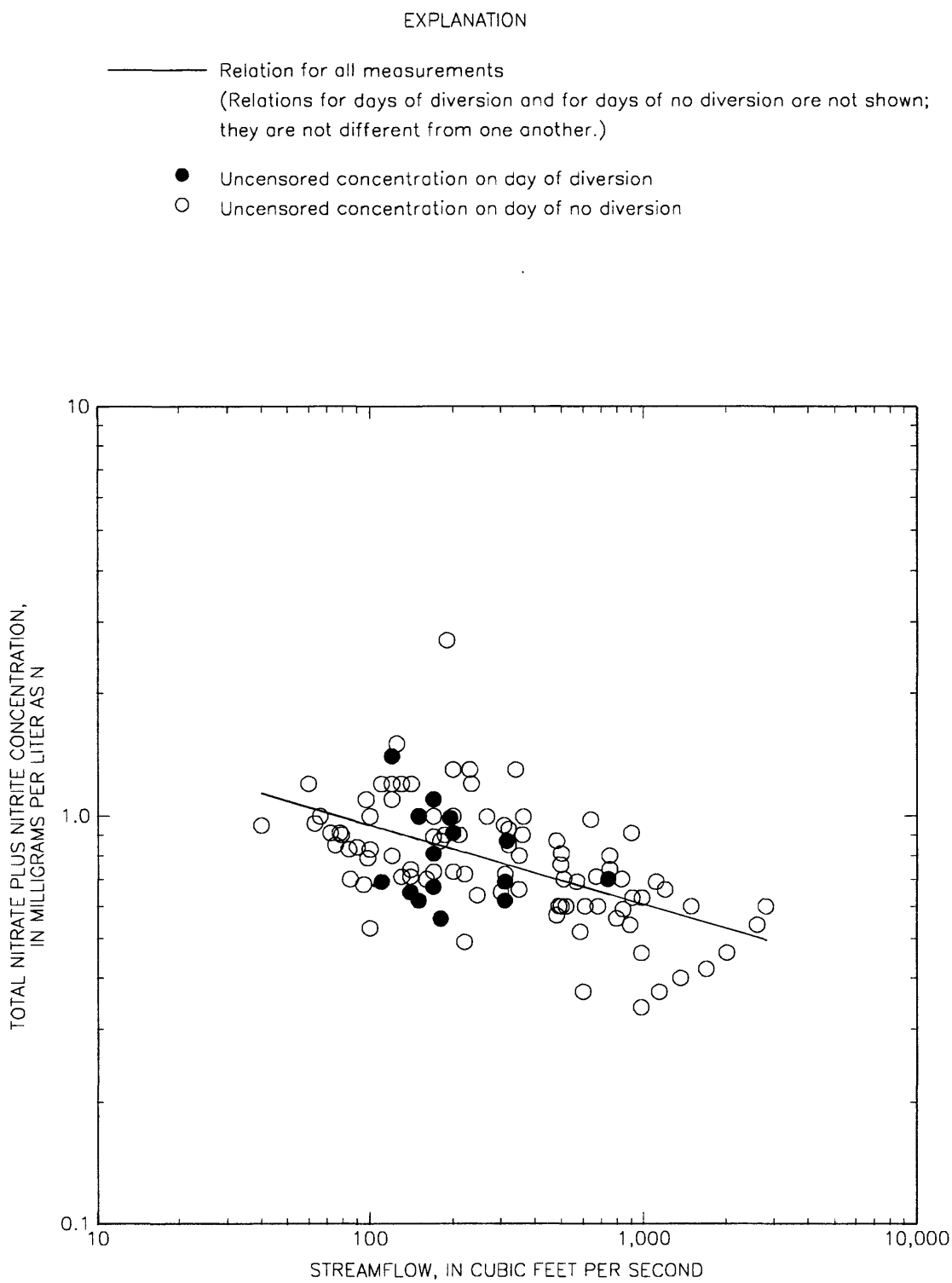

Figure 8B. Relations between total nitrate plus nitrite concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

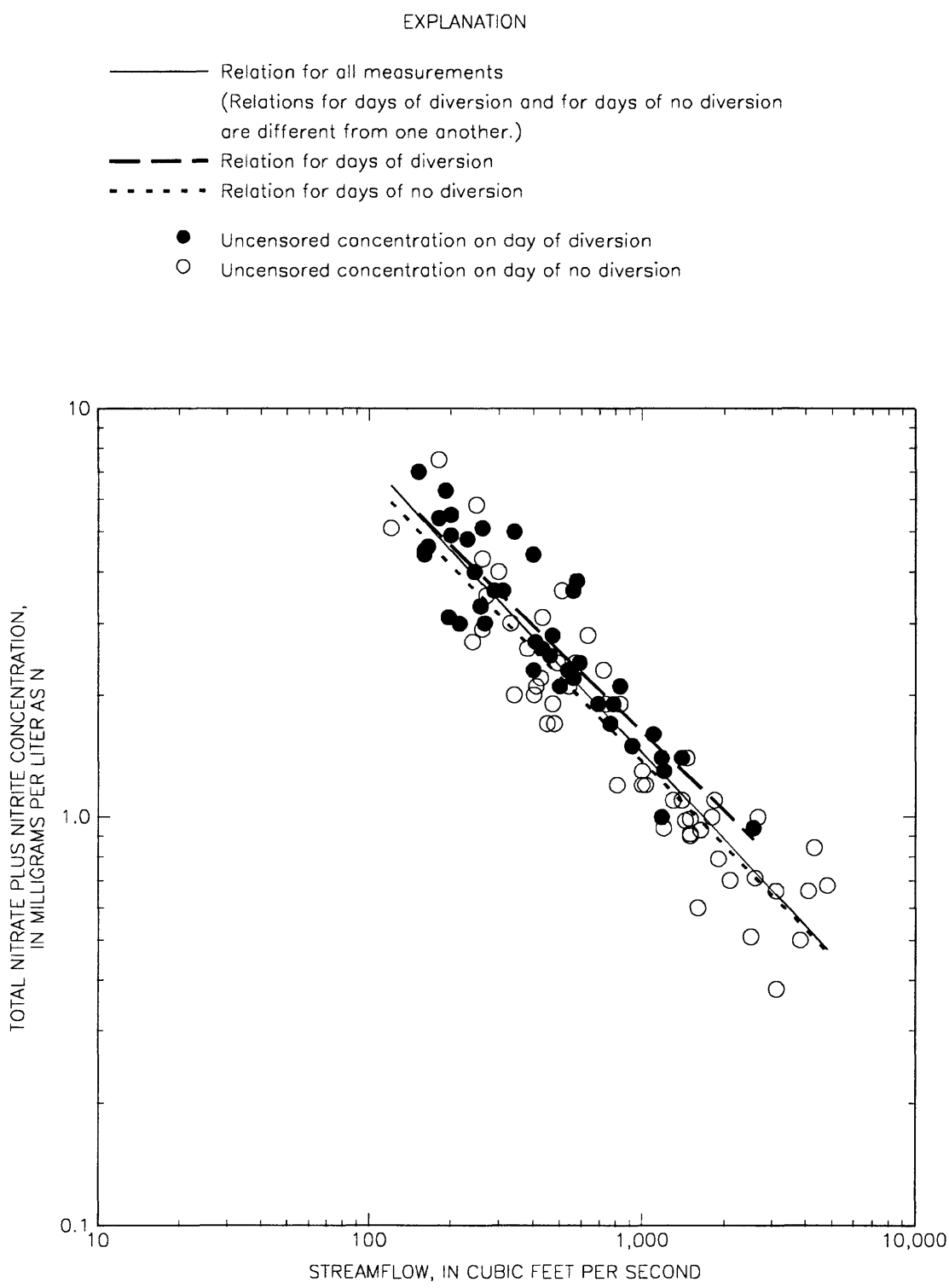

Figure 8C. Relations between total nitrate plus nitrite concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

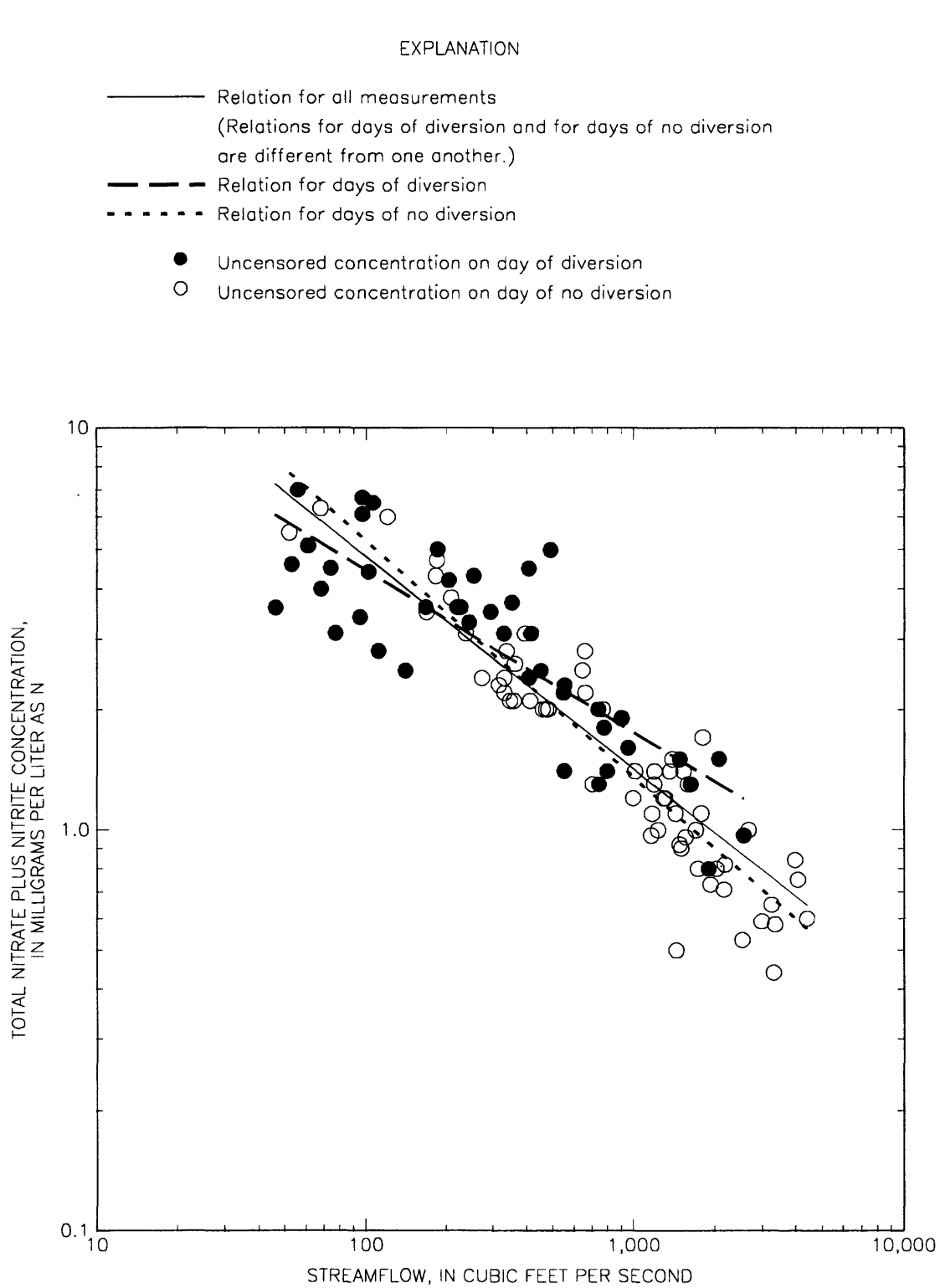

Figure 8D. Relations between total nitrate plus nitrite concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

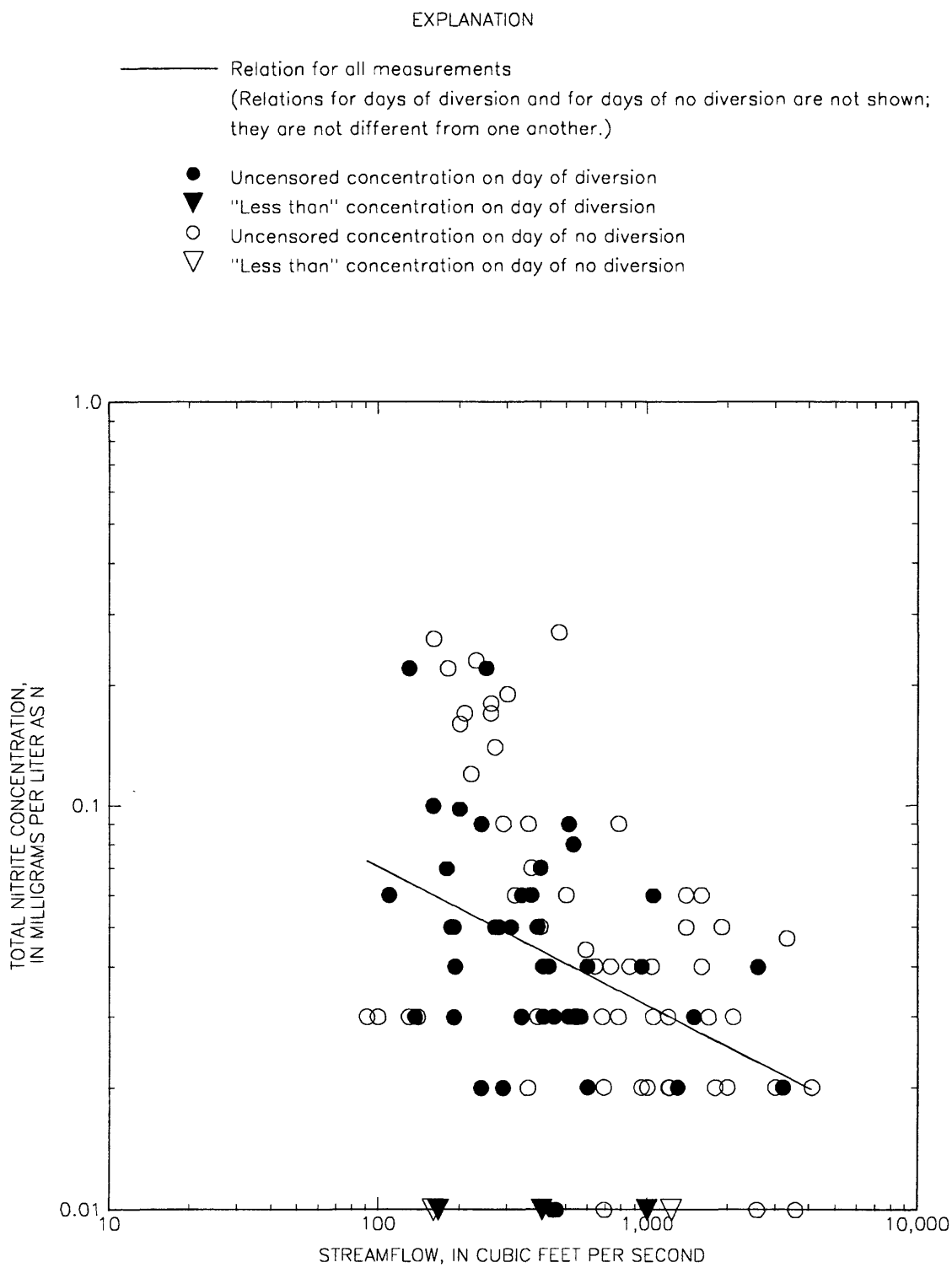

Figure 9A. Relations between total nitrite concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

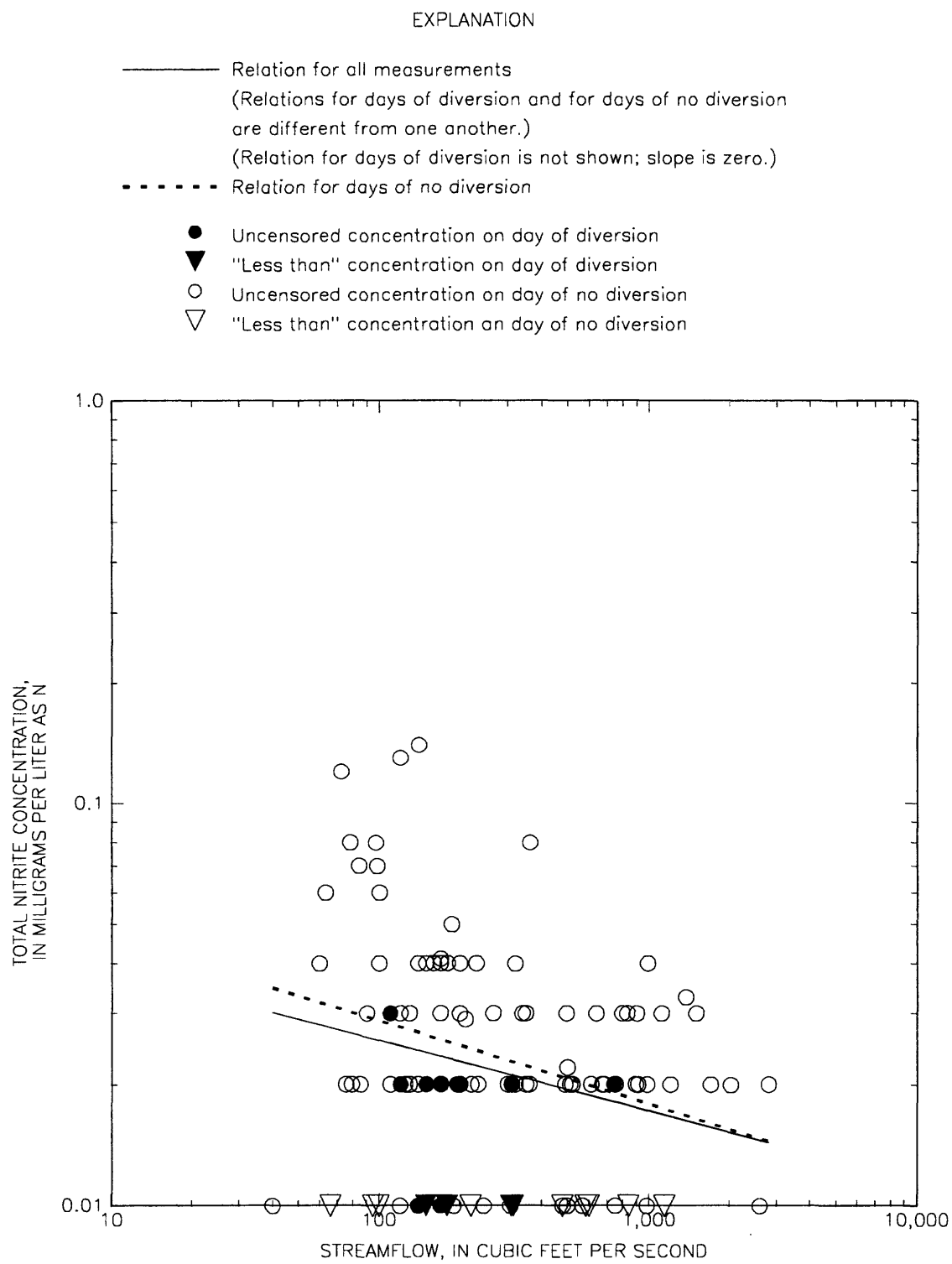

Figure 9B. Relations between total nitrite concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

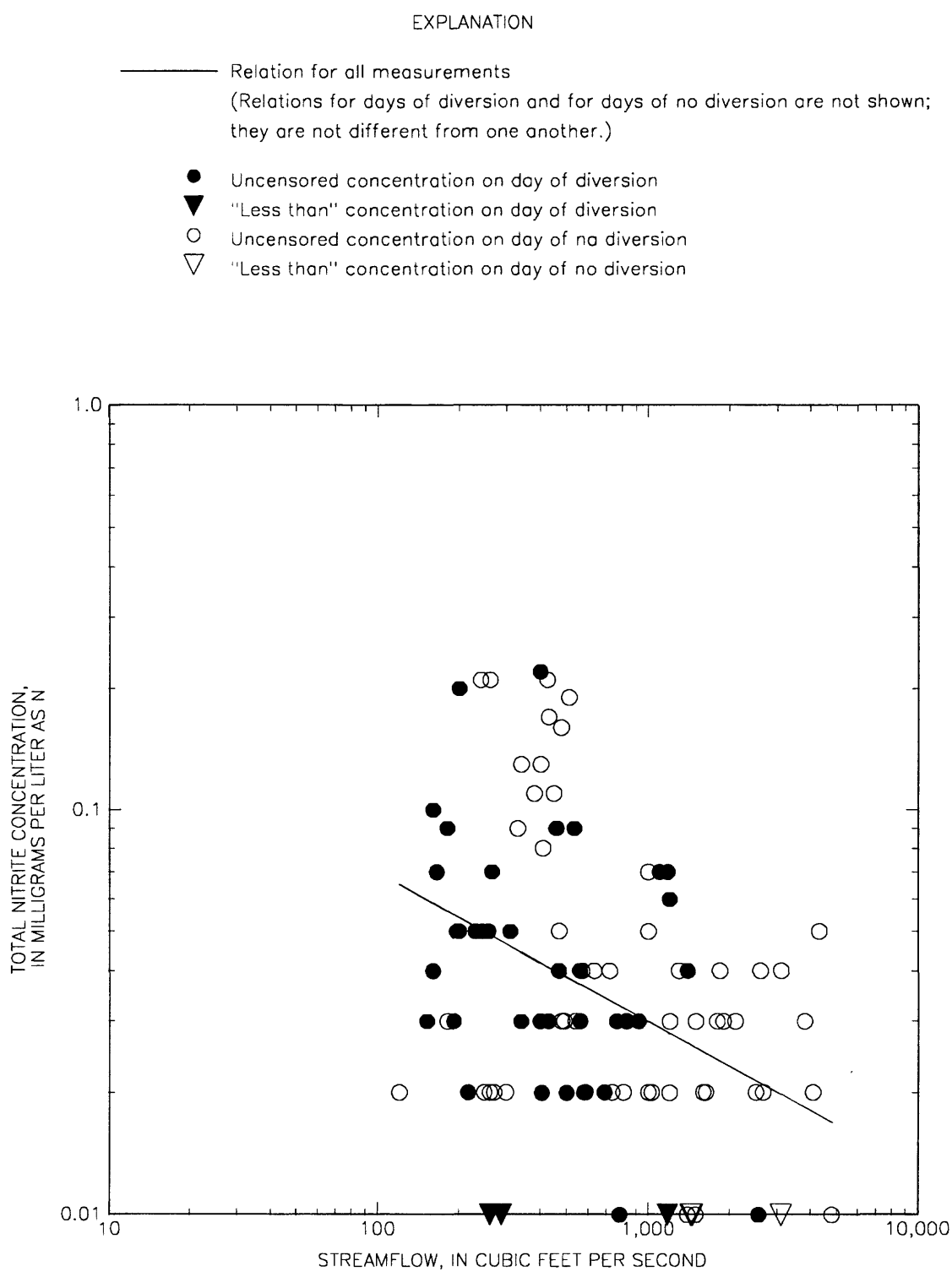

Figure 9C. Relations between total nitrite concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

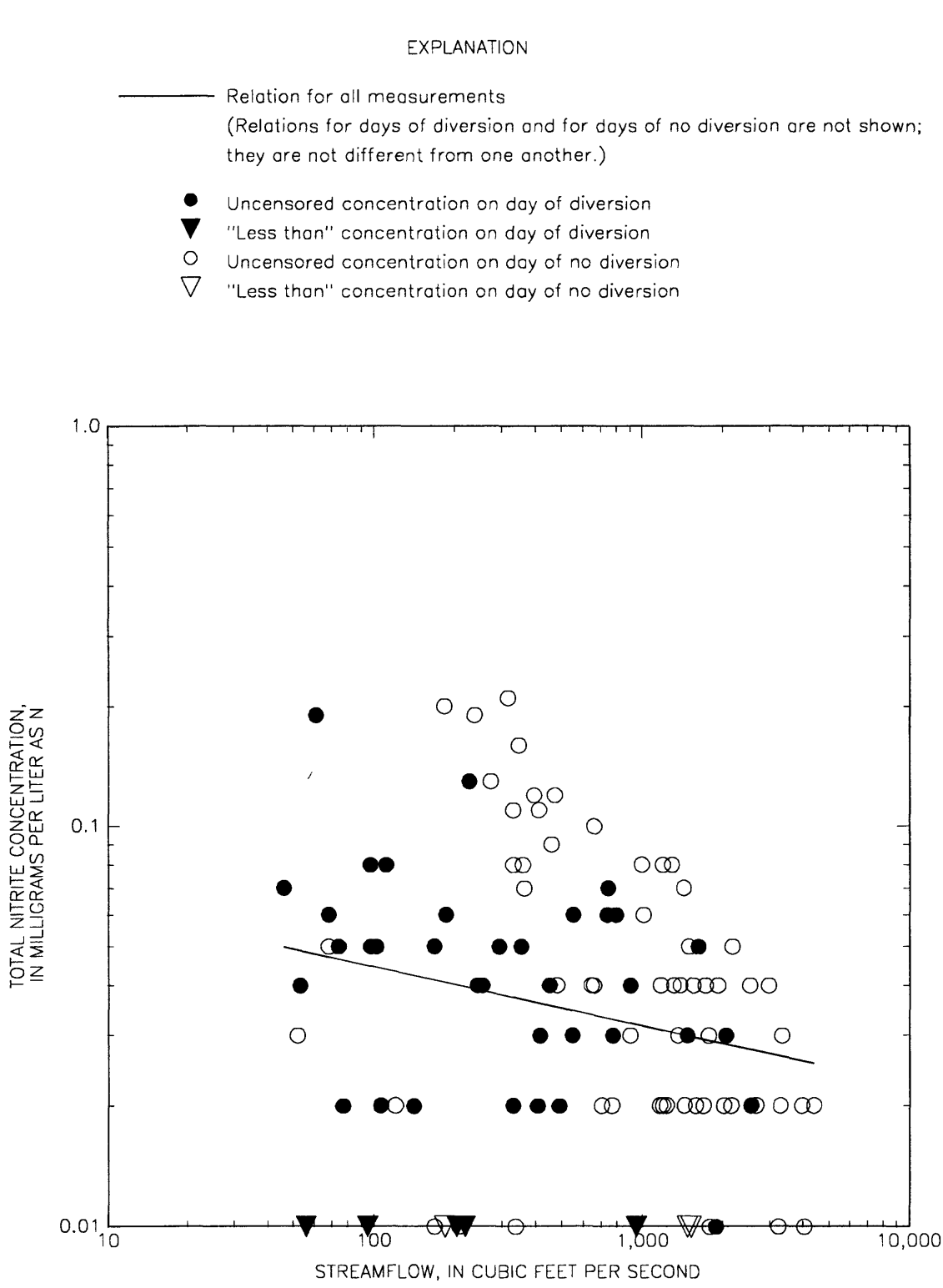

Figure 9D. Relations between total nitrite concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

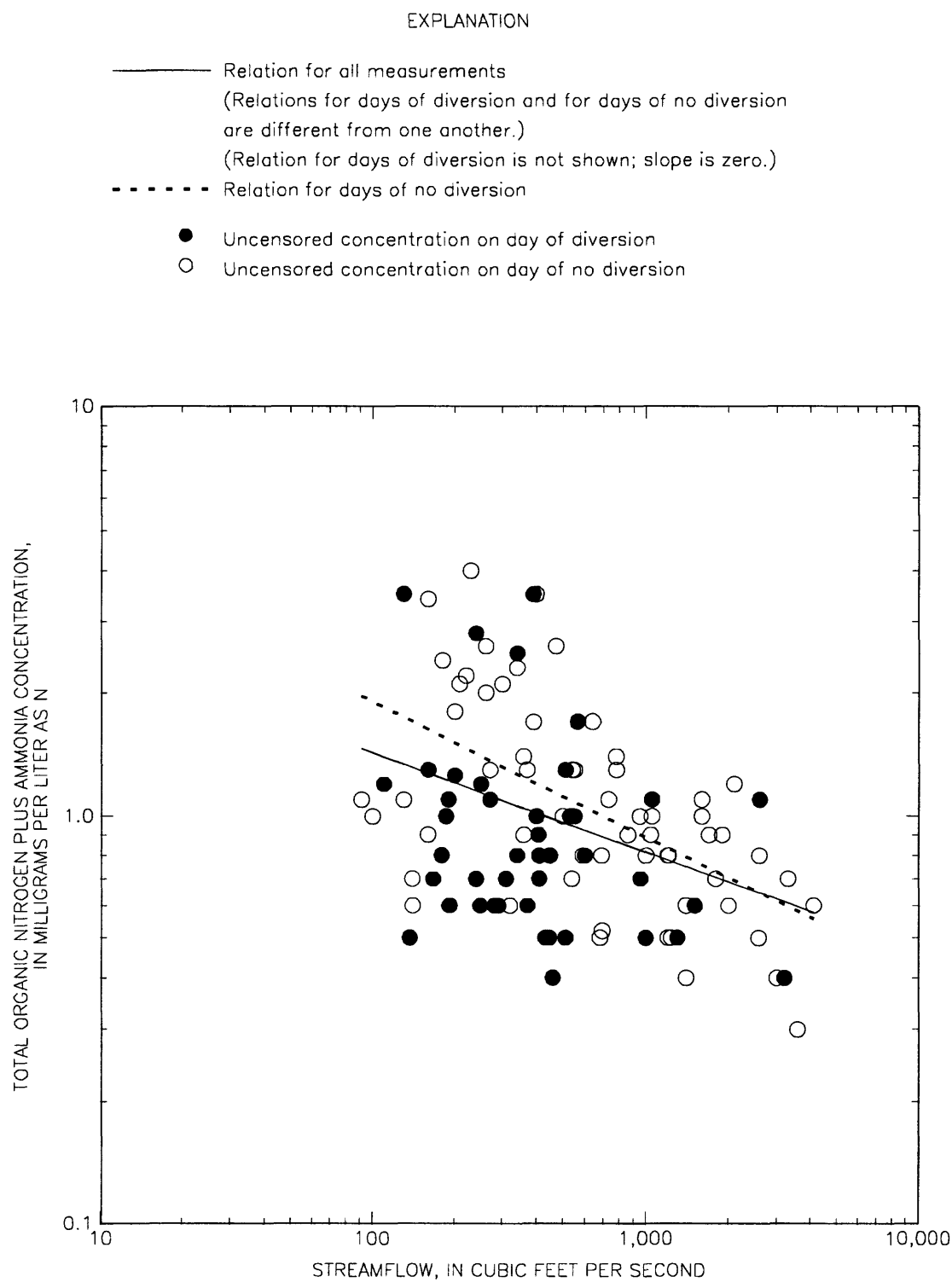

Figure 10A. Relations between total organic nitrogen plus ammonia concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

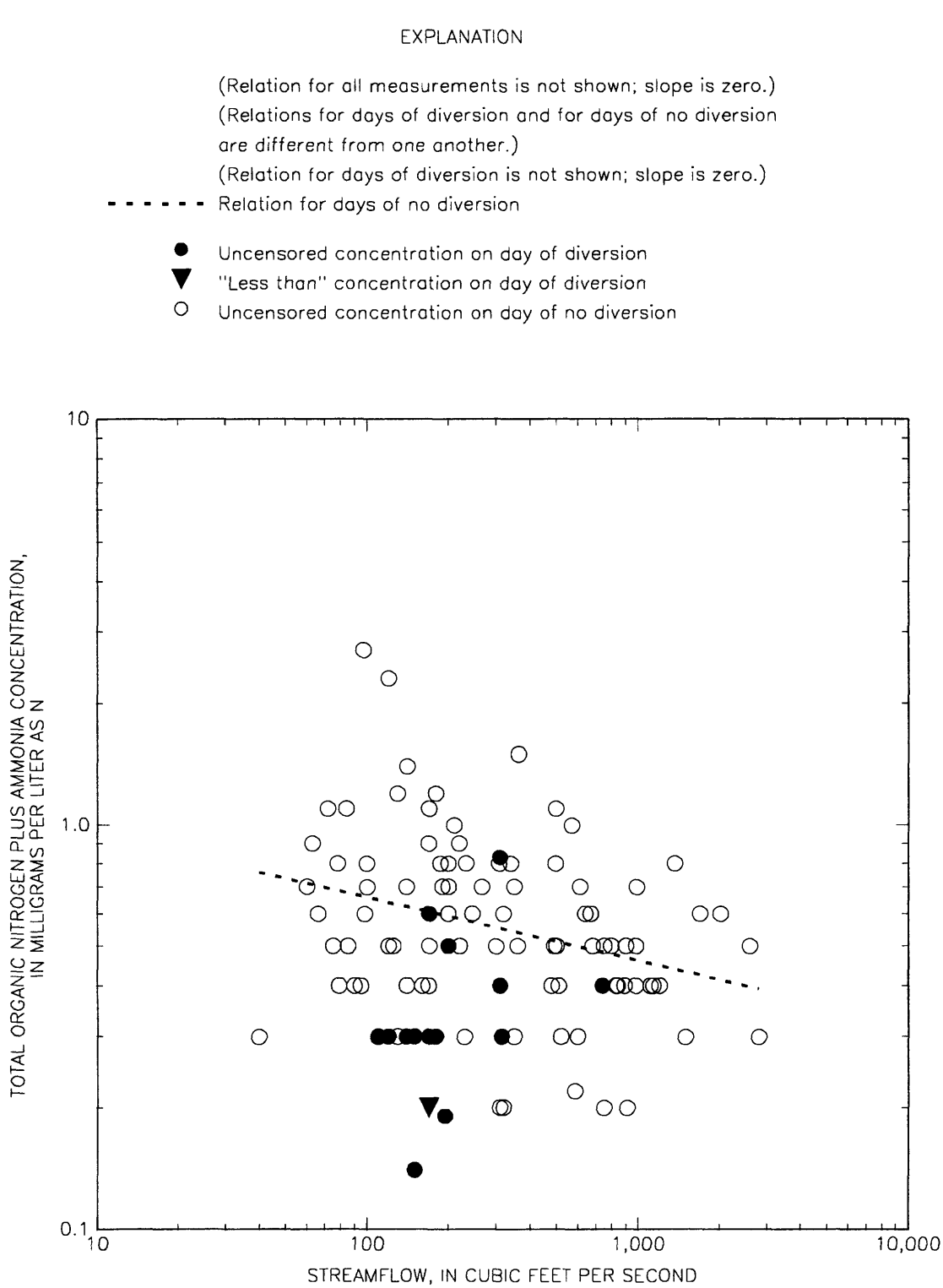

Figure 10B. Relations between total organic nitrogen plus ammonia concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

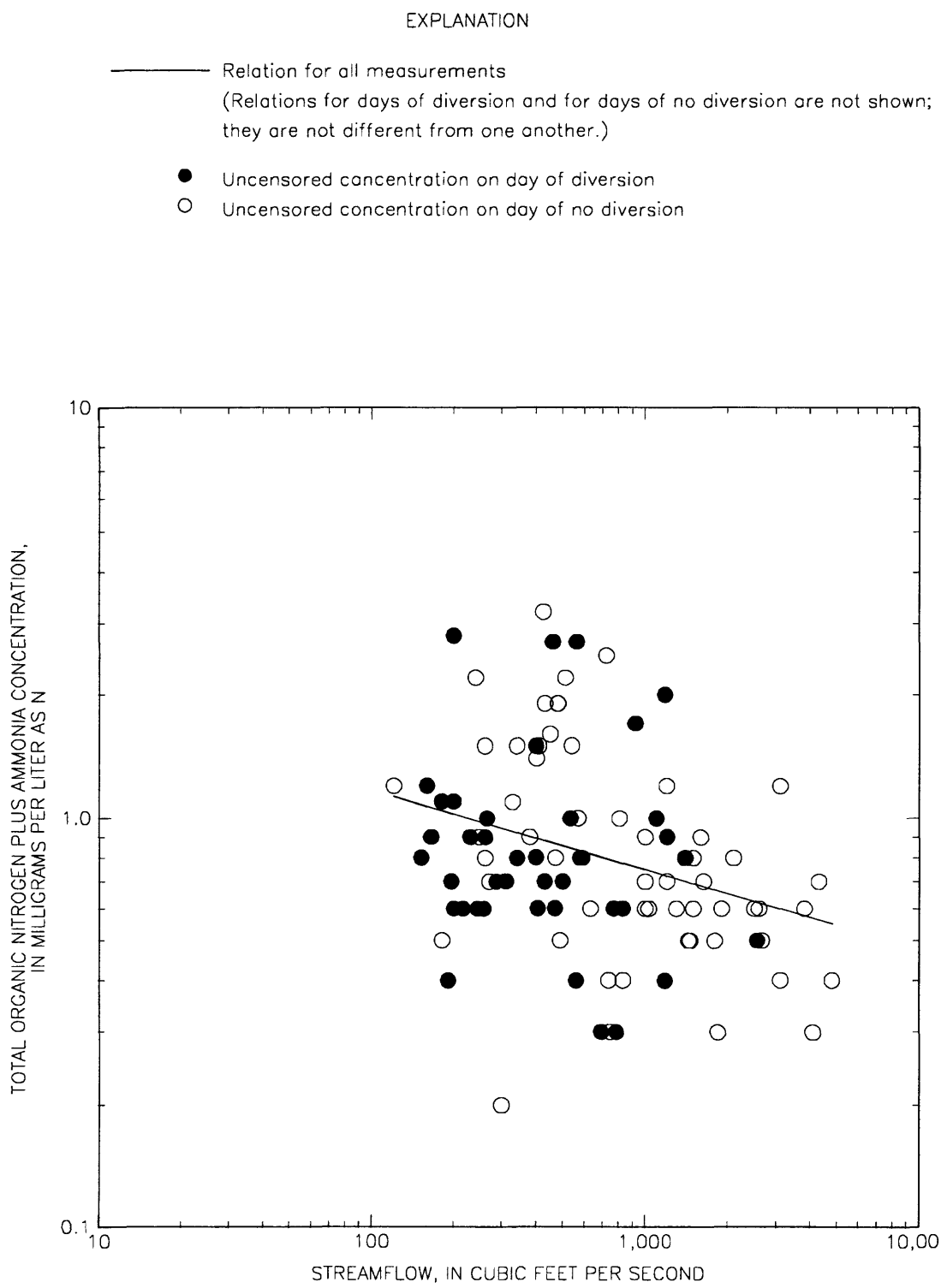

Figure 10C. Relations between total organic nitrogen plus ammonia concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

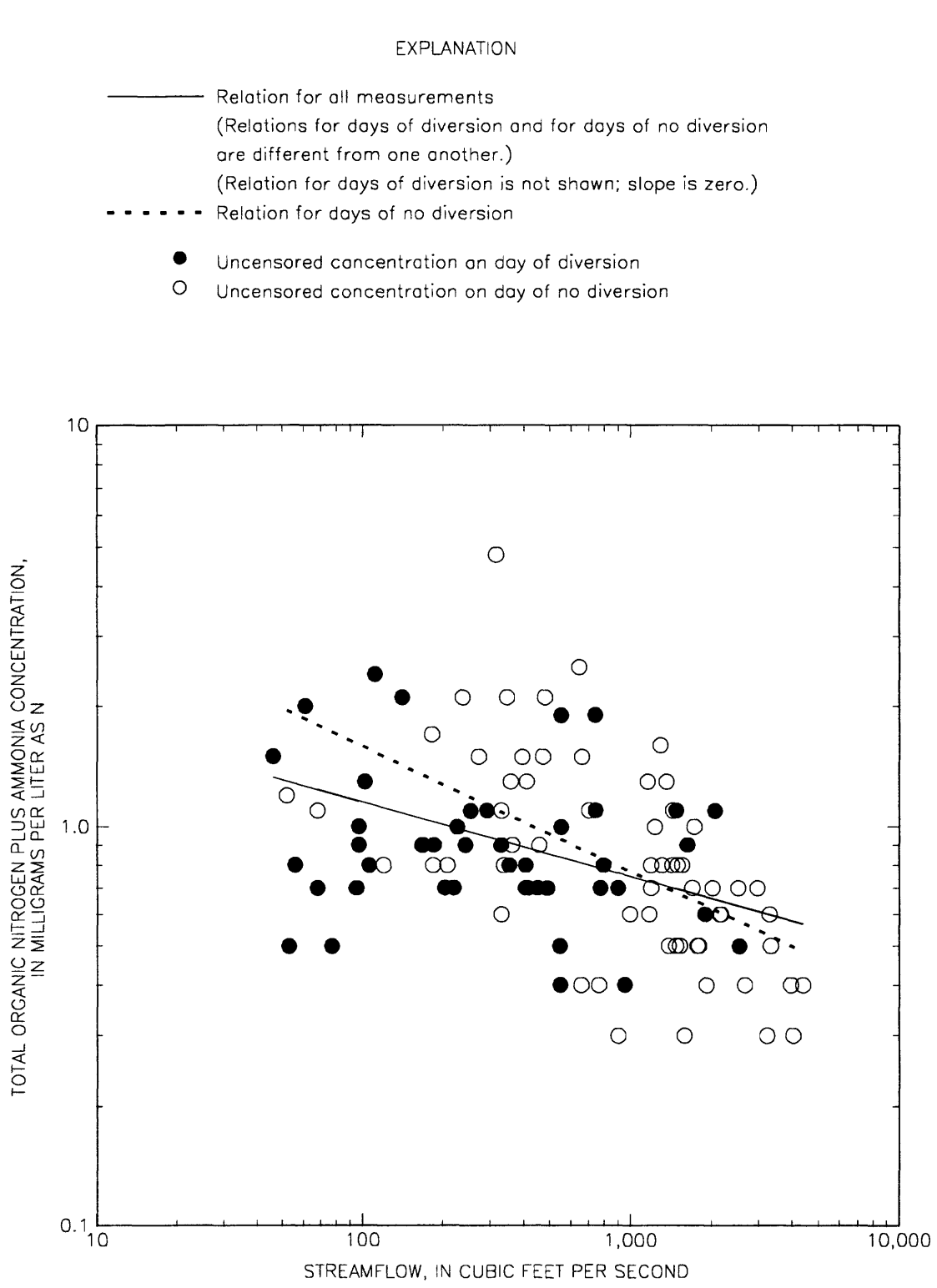

Figure 10D. Relations between total organic nitrogen plus ammonia concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

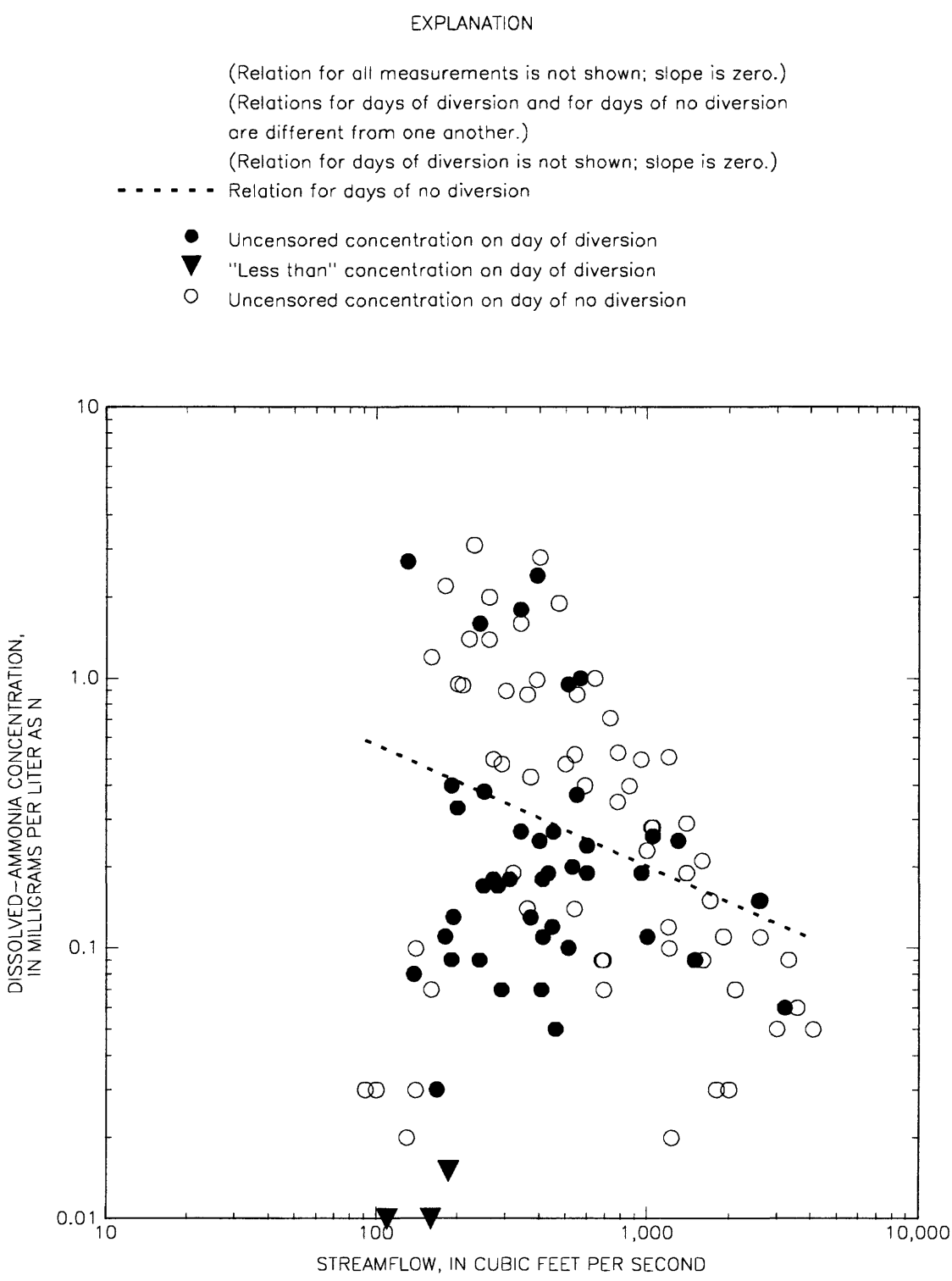

Figure 11A. Relations between dissolved ammonia concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

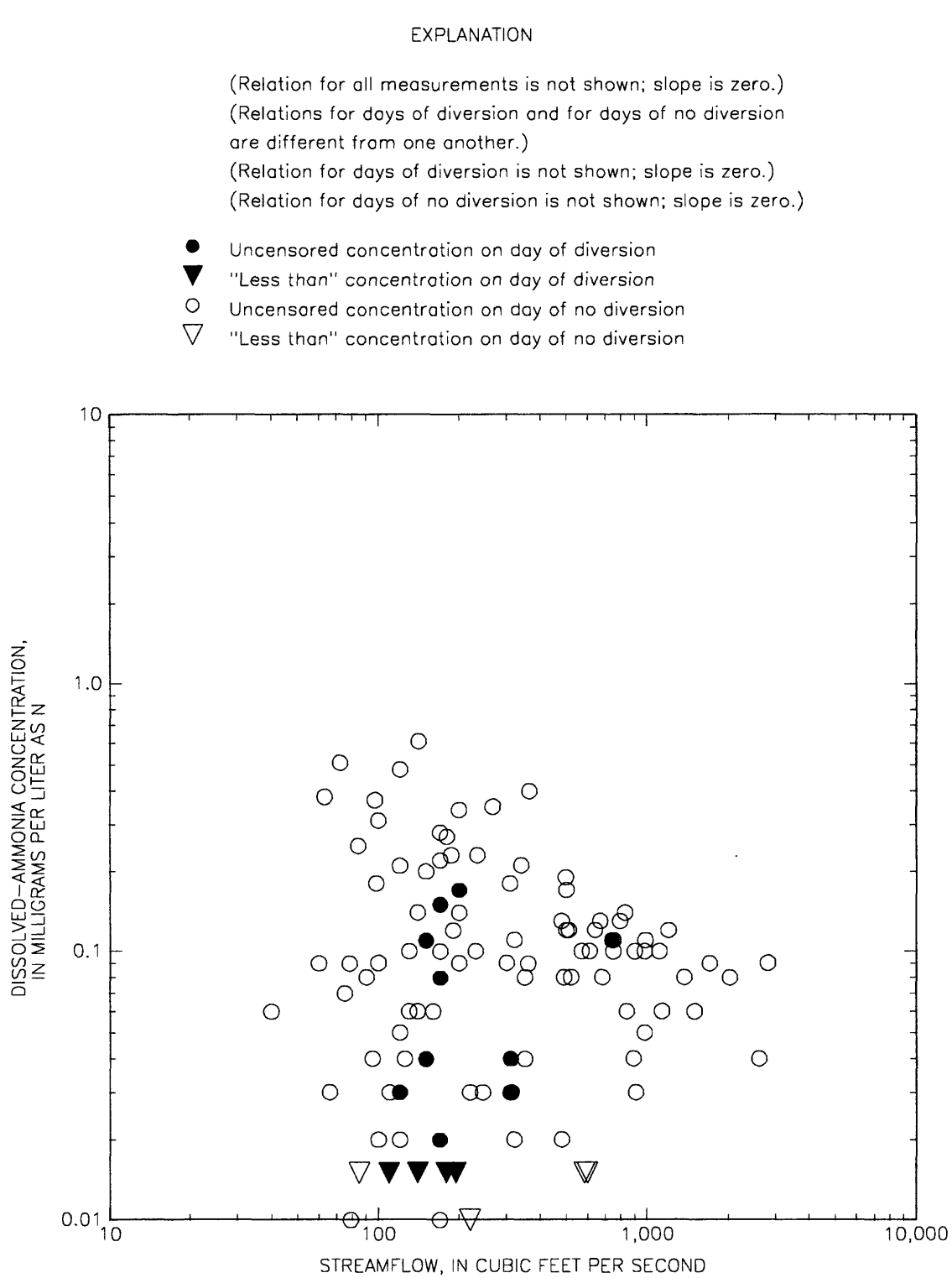

Figure 11B. Relations between dissolved ammonia concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

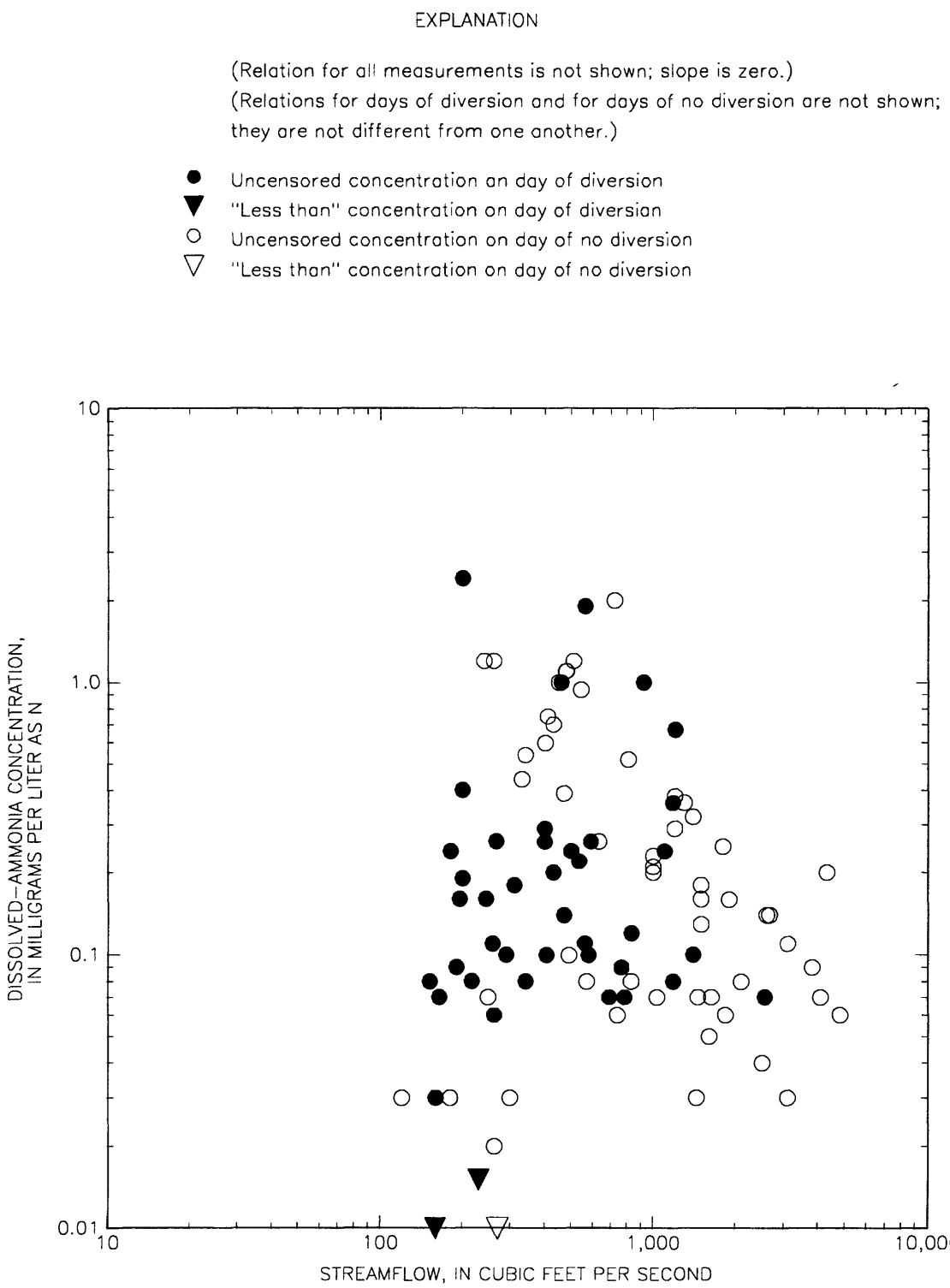

Figure 11C. Relations between dissolved ammonia concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

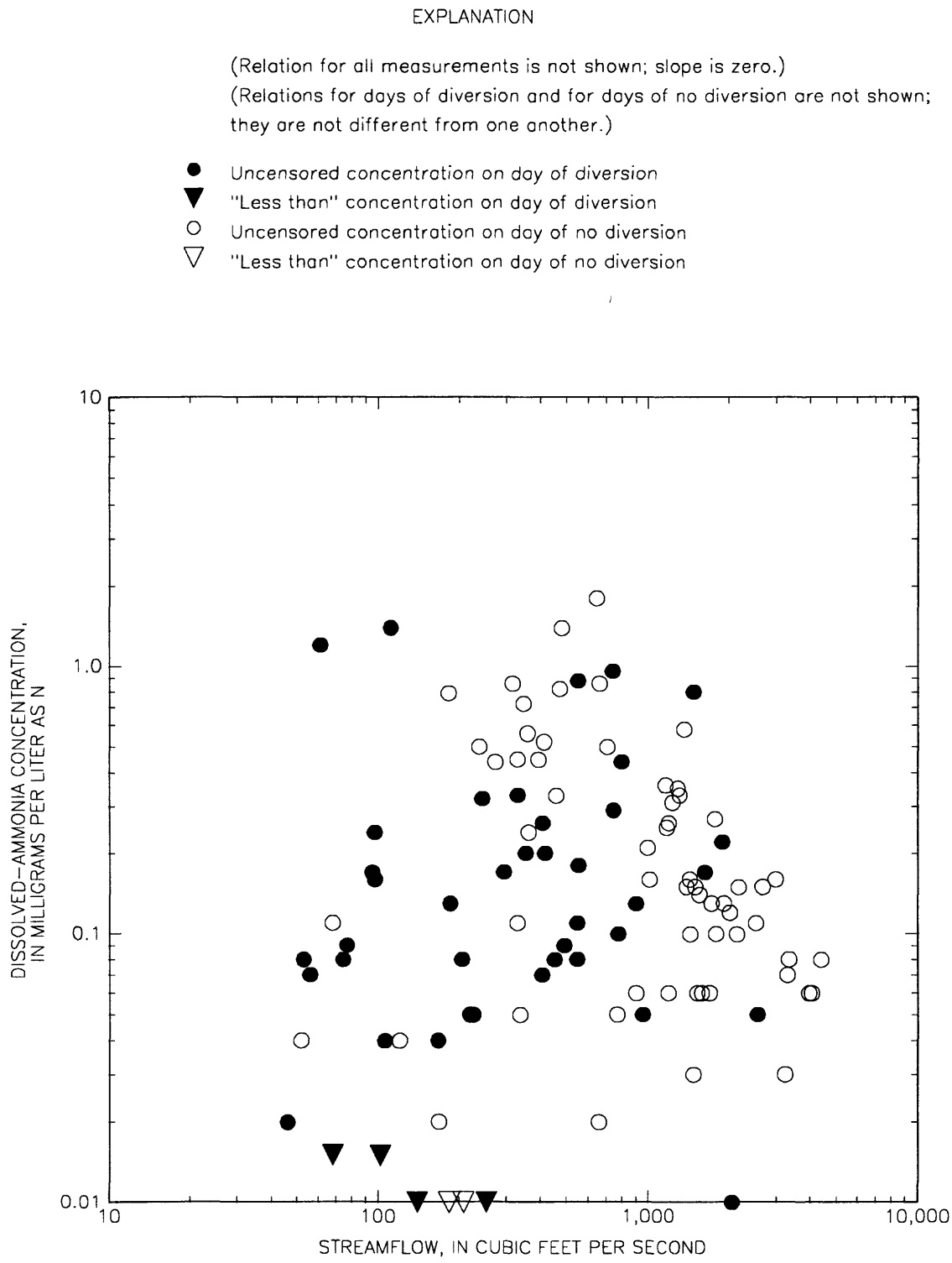

Figure 11D. Relations between dissolved ammonia concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

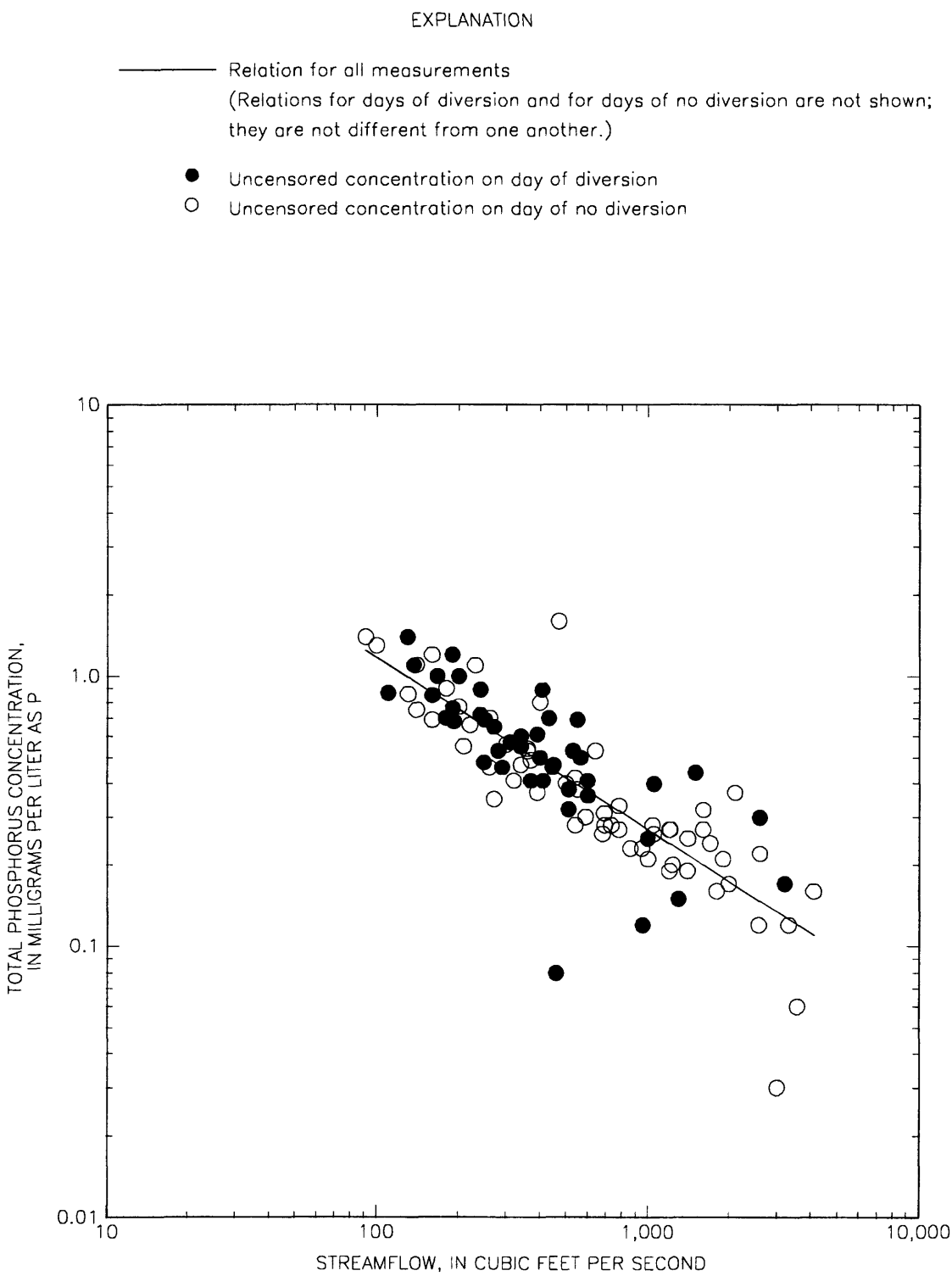

Figure 12A. Relations between total phosphorus concentration and streamflow at station 01382000, Passaic River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

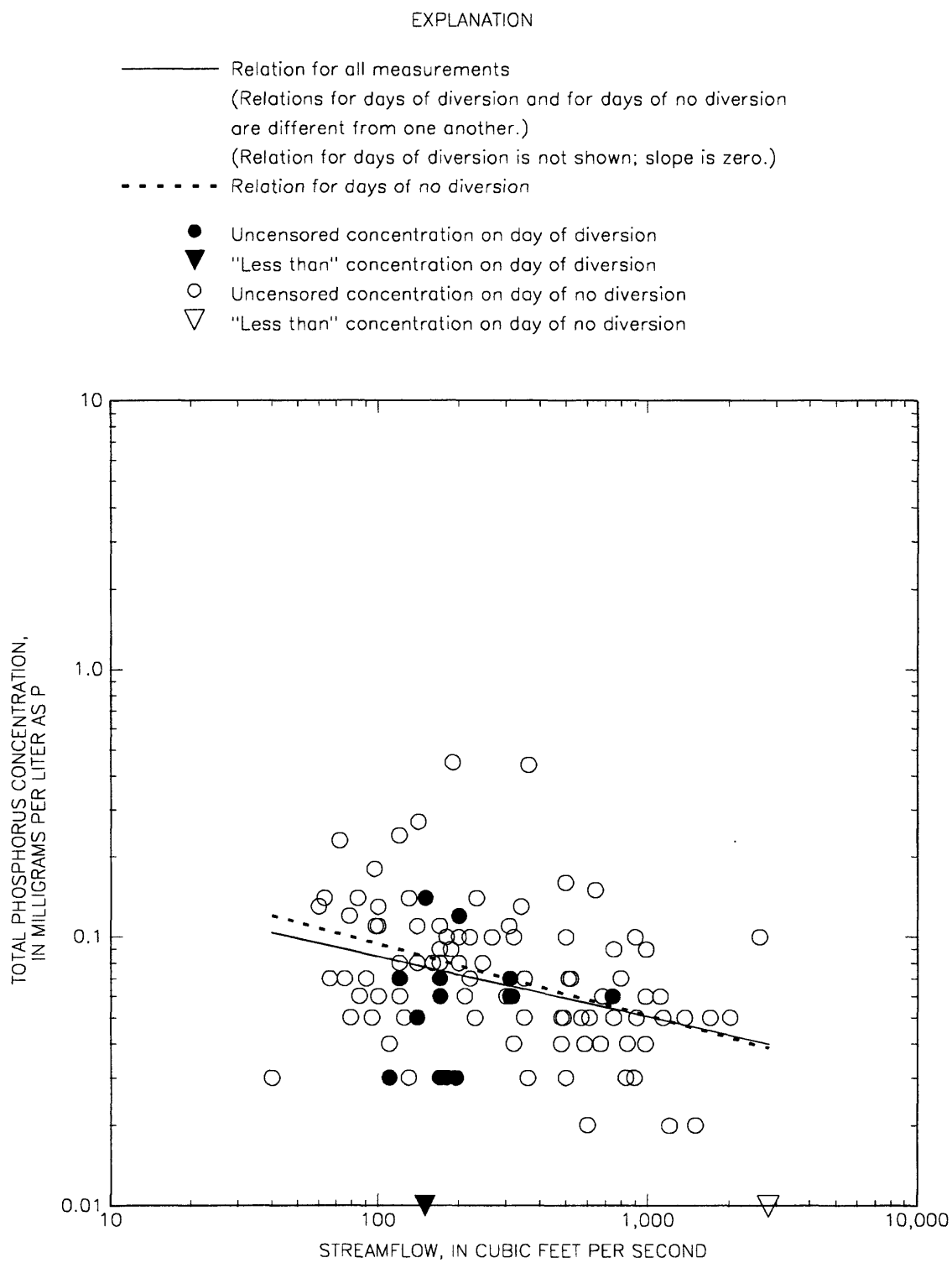

Figure 12B. Relations between total phosphorus concentration and streamflow at station 01388600, Pompton River at Packanack Lake, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

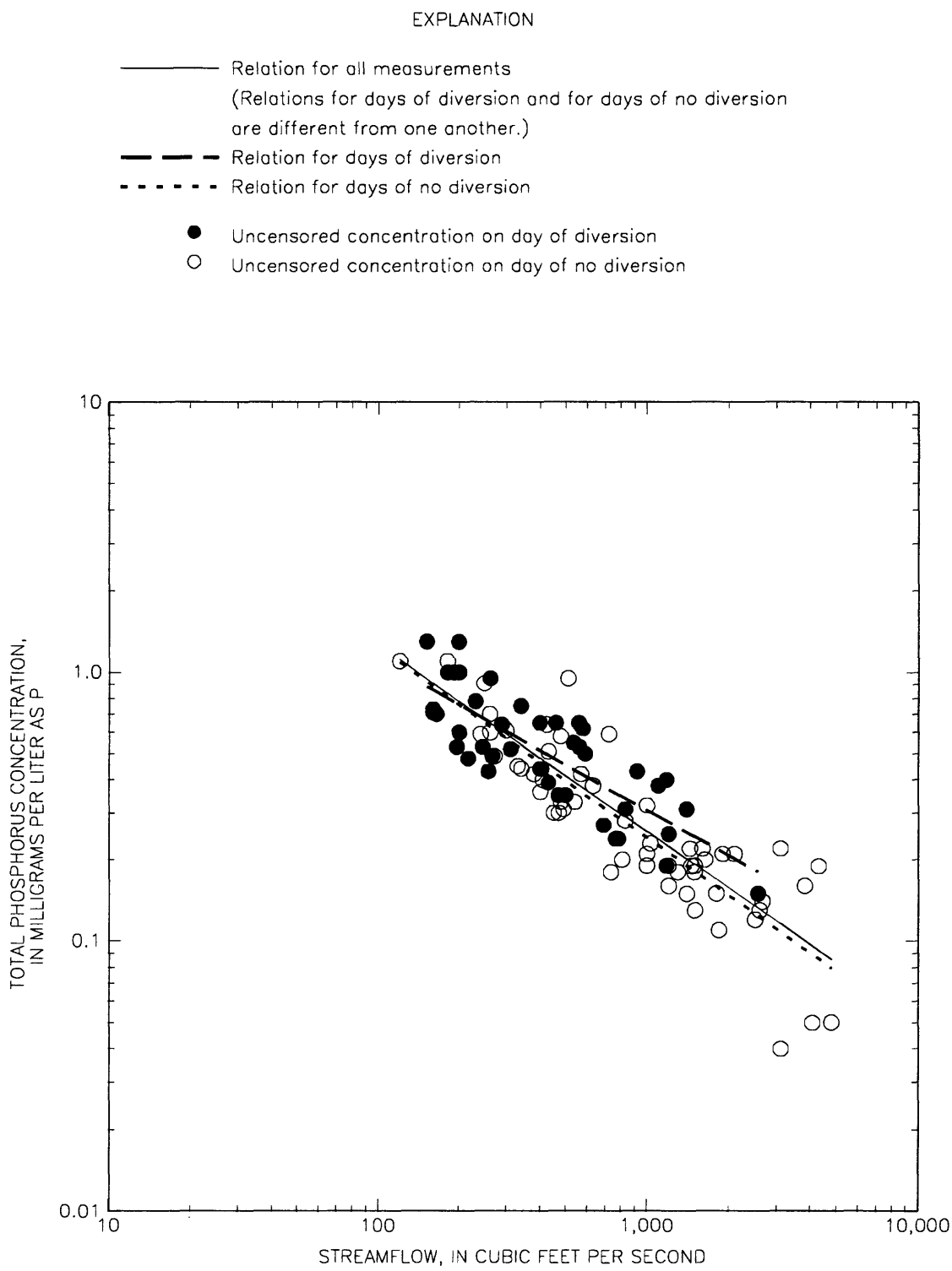

Figure 12C. Relations between total phosphorus concentration and streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

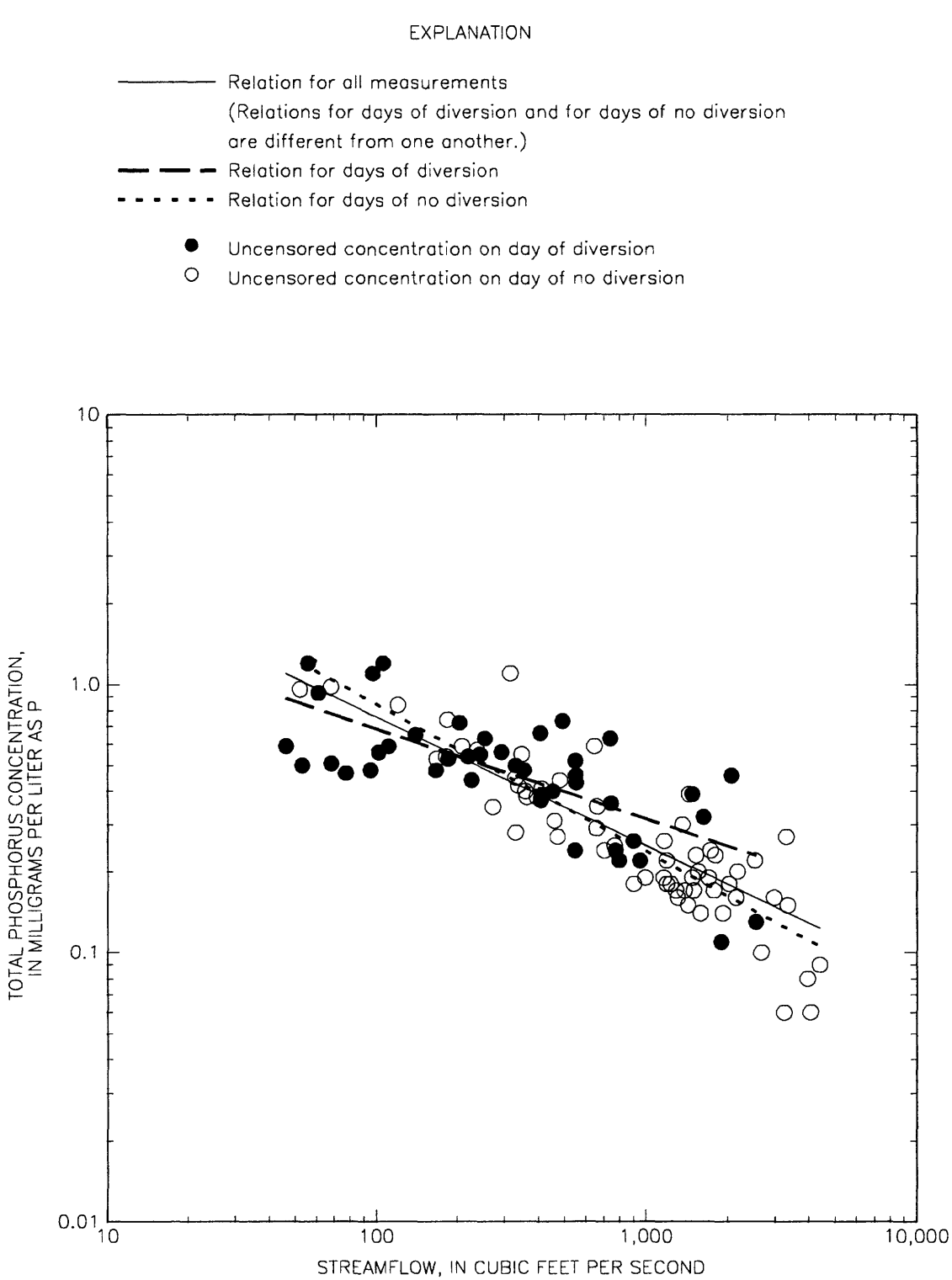

Figure 12D. Relations between total phosphorus concentration and streamflow at station 01389500, Passaic River at Little Falls, N.J., 1987–95. (Measurements shown were made year–round, except during July and August.)

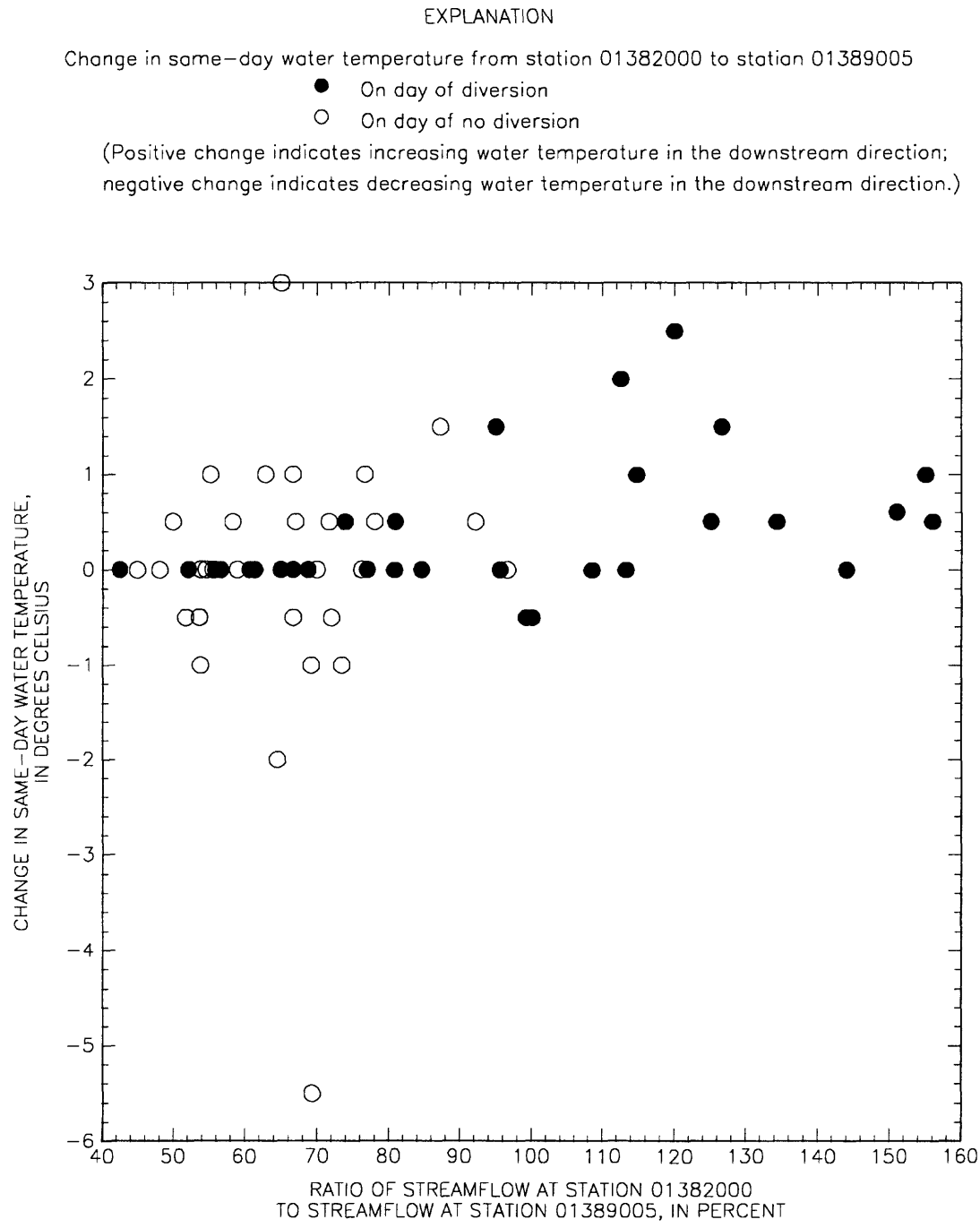

Figure 13. Relation between change in same-day water temperature and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

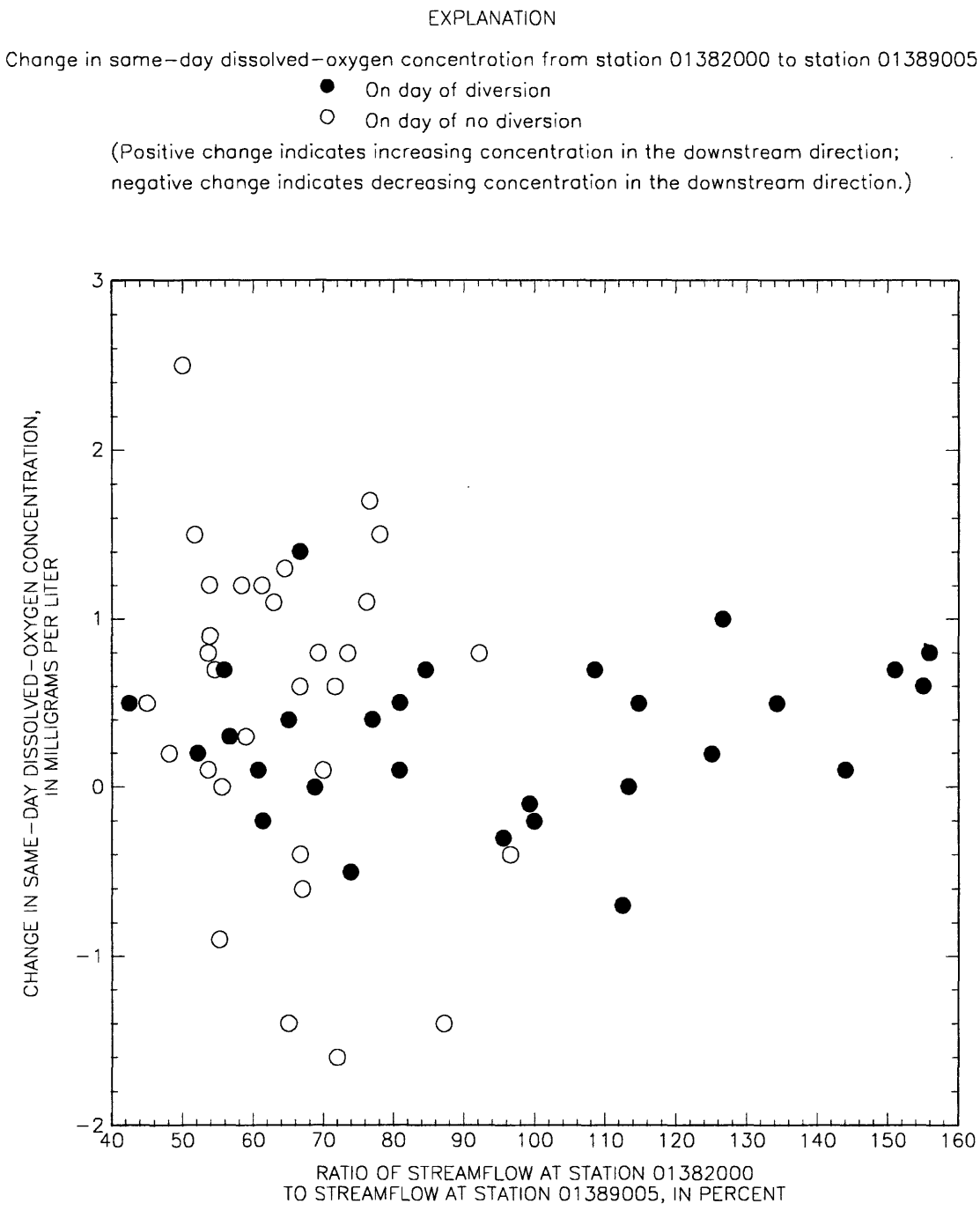

Figure 14. Relation between change in same-day dissolved-oxygen concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

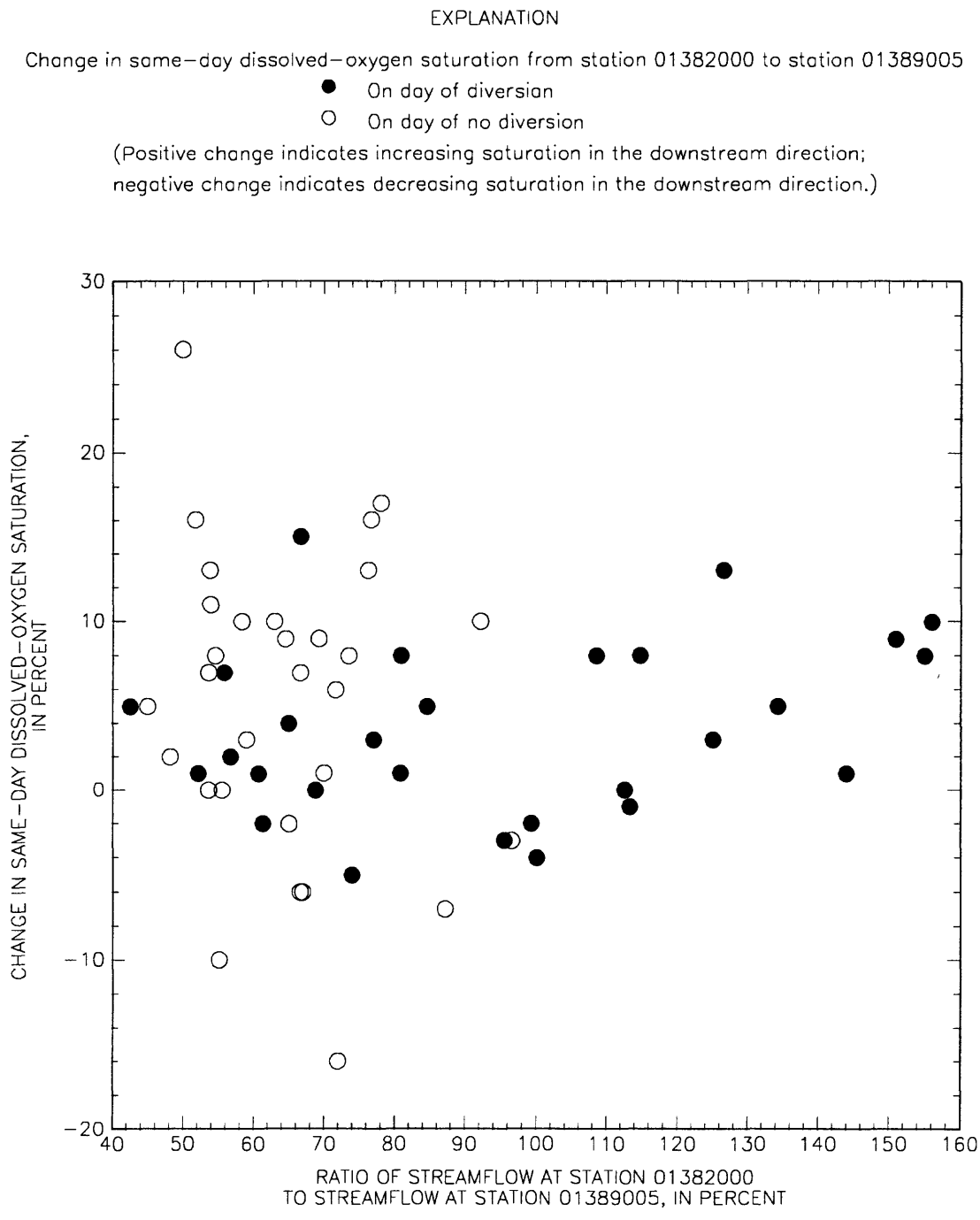

Figure 15. Relation between change in same-day dissolved-oxygen saturation and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

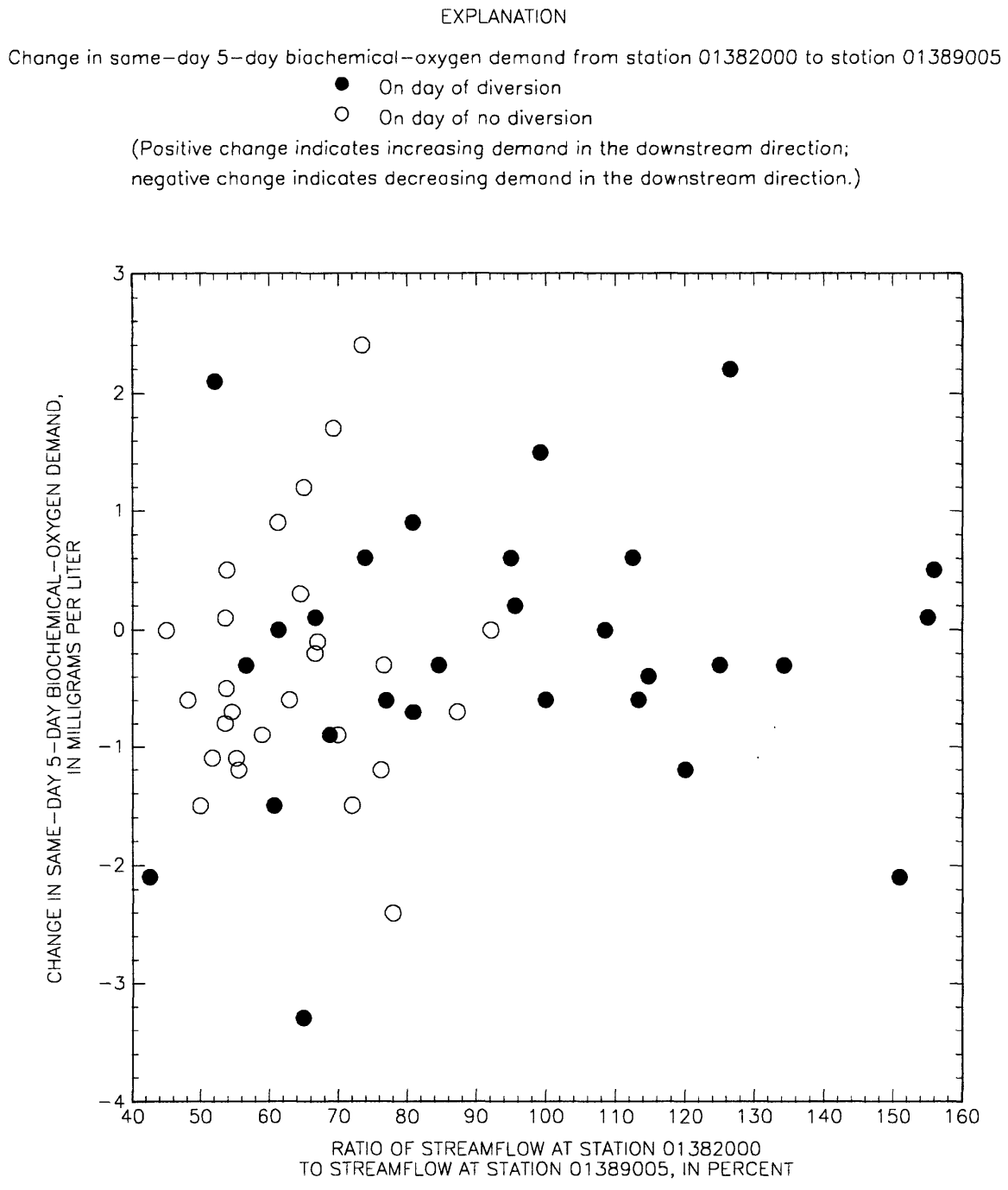

Figure 16. Relation between change in same-day 5-day biochemical-oxygen demand and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

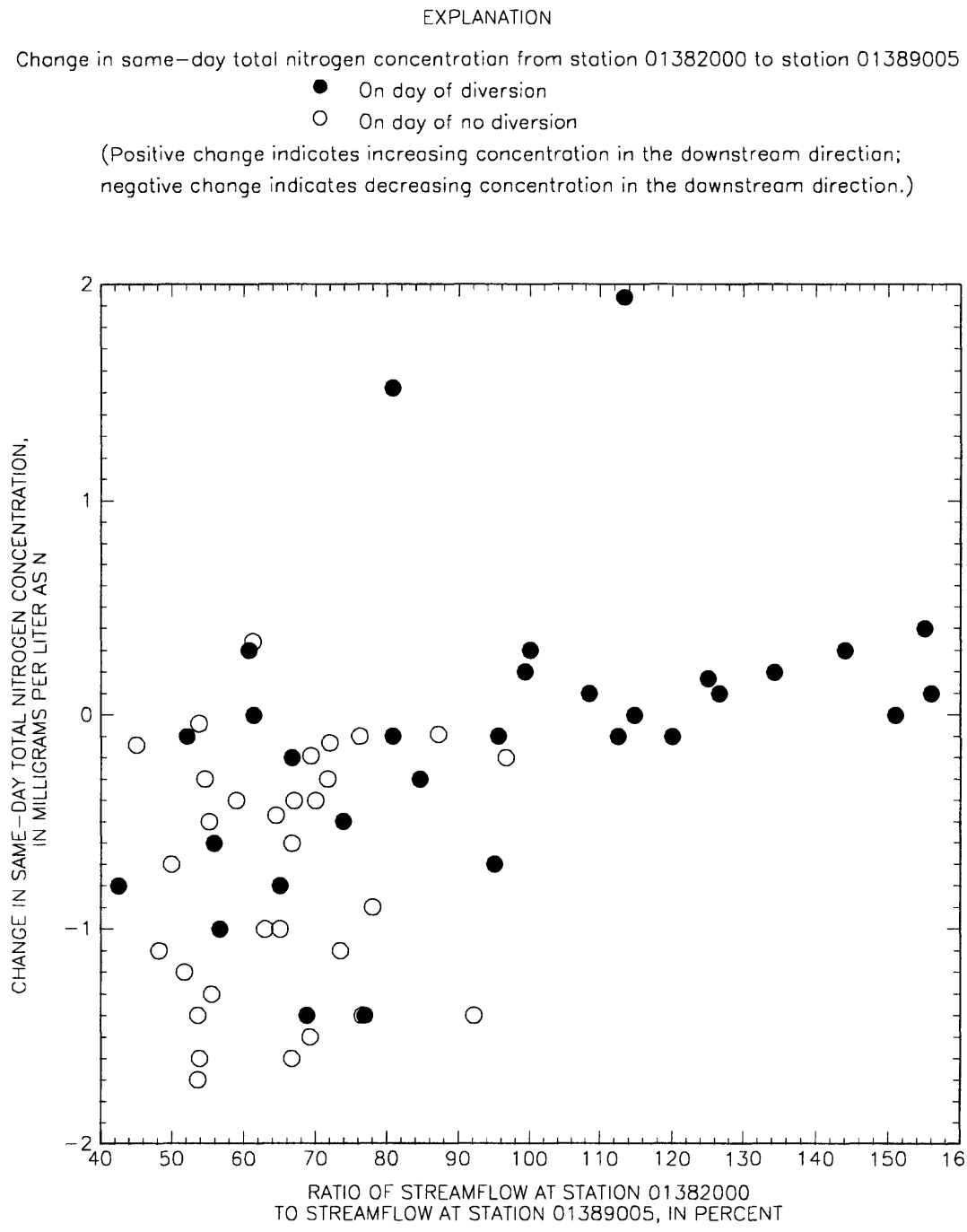

Figure 17. Relation between change in same-day total nitrogen concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

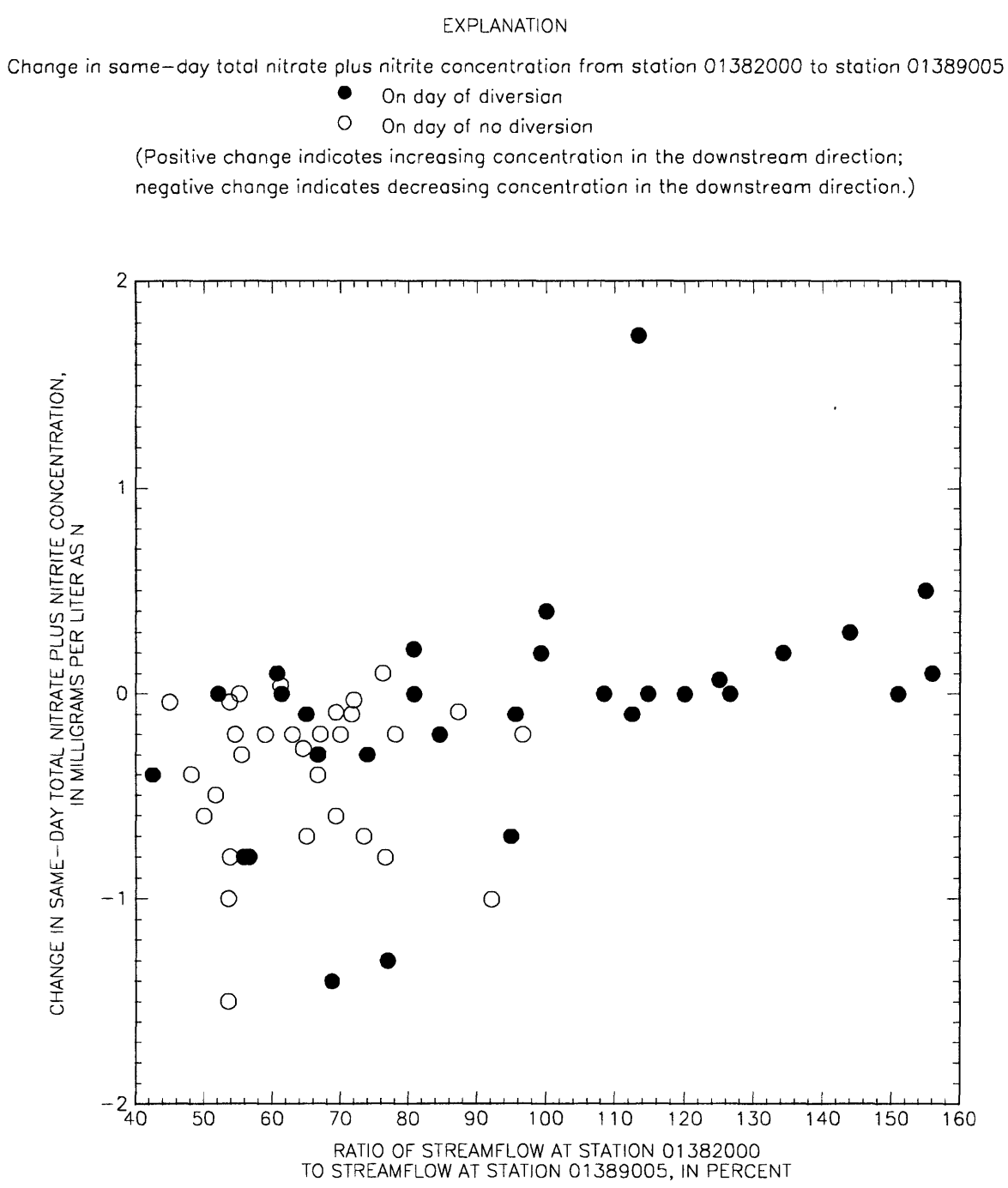

Figure 18. Relation between change in same-day total nitrate plus nitrite concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987–95. (Measurements shown were made year-round, except during July and August.)

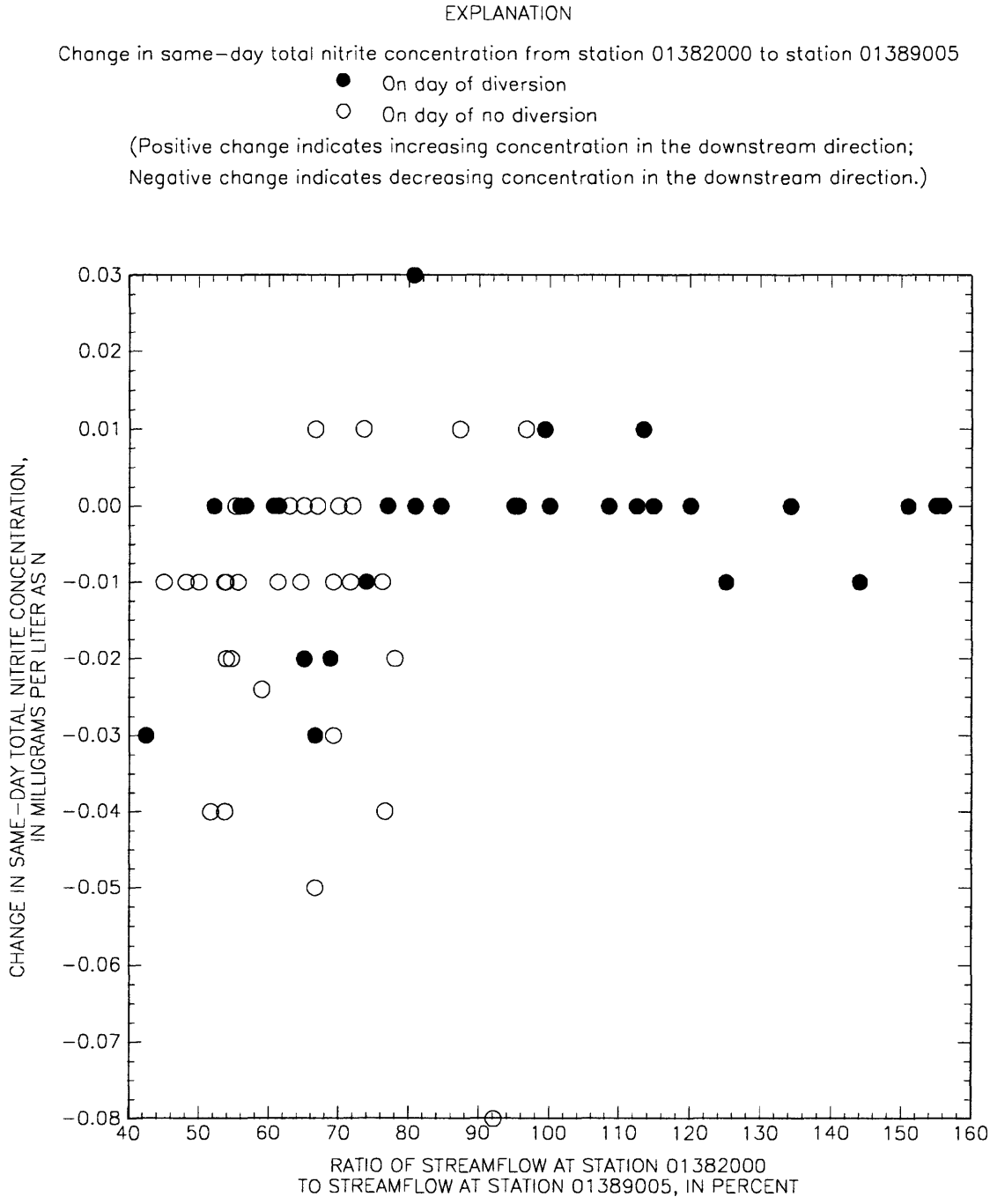

Figure 19. Relation between change in same-day total nitrite concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

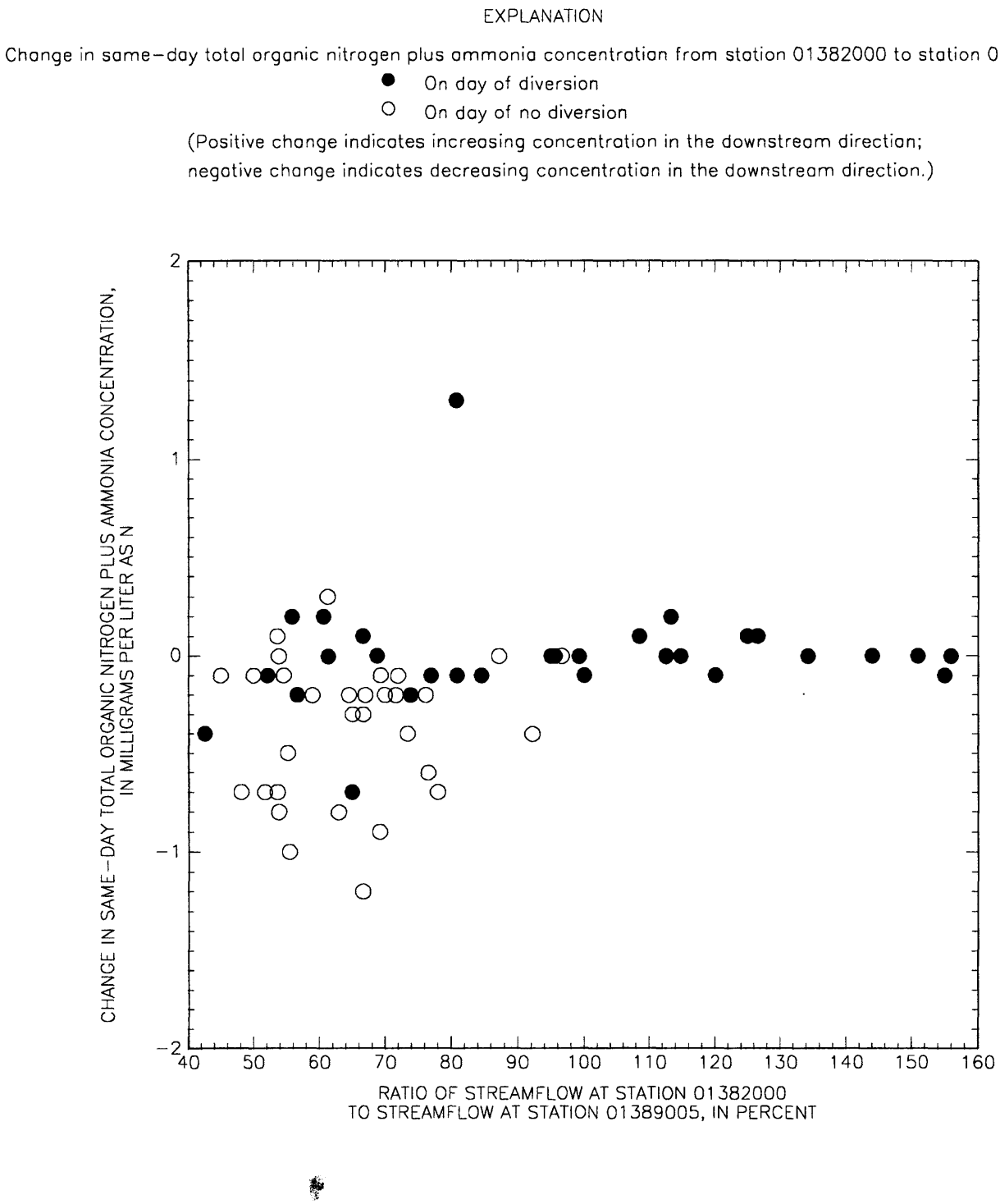

Figure 20. Relation between change in same-day total organic nitrogen plus ammonia concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

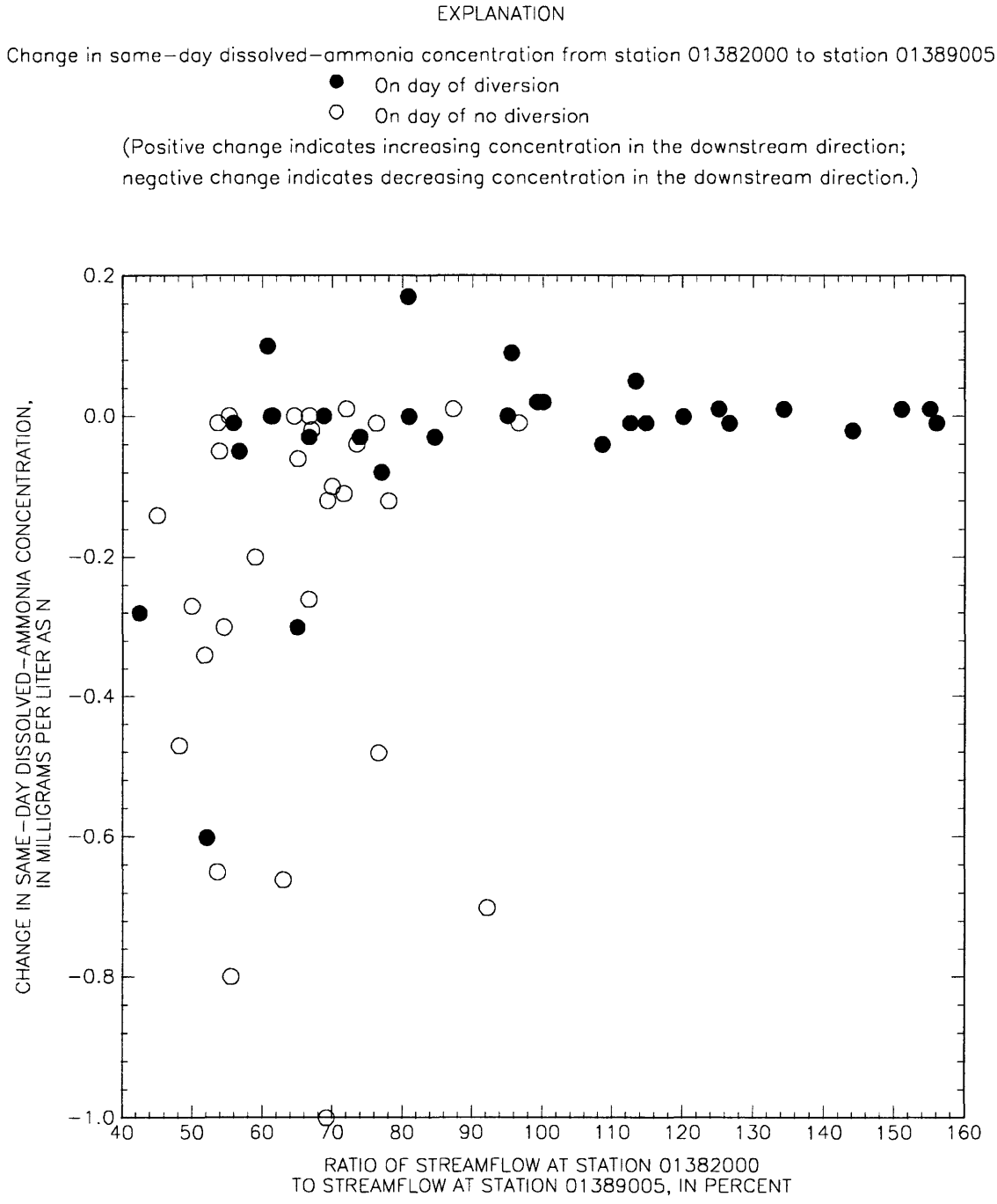

Figure 21. Relation between change in same-day dissolved-ammonia concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)

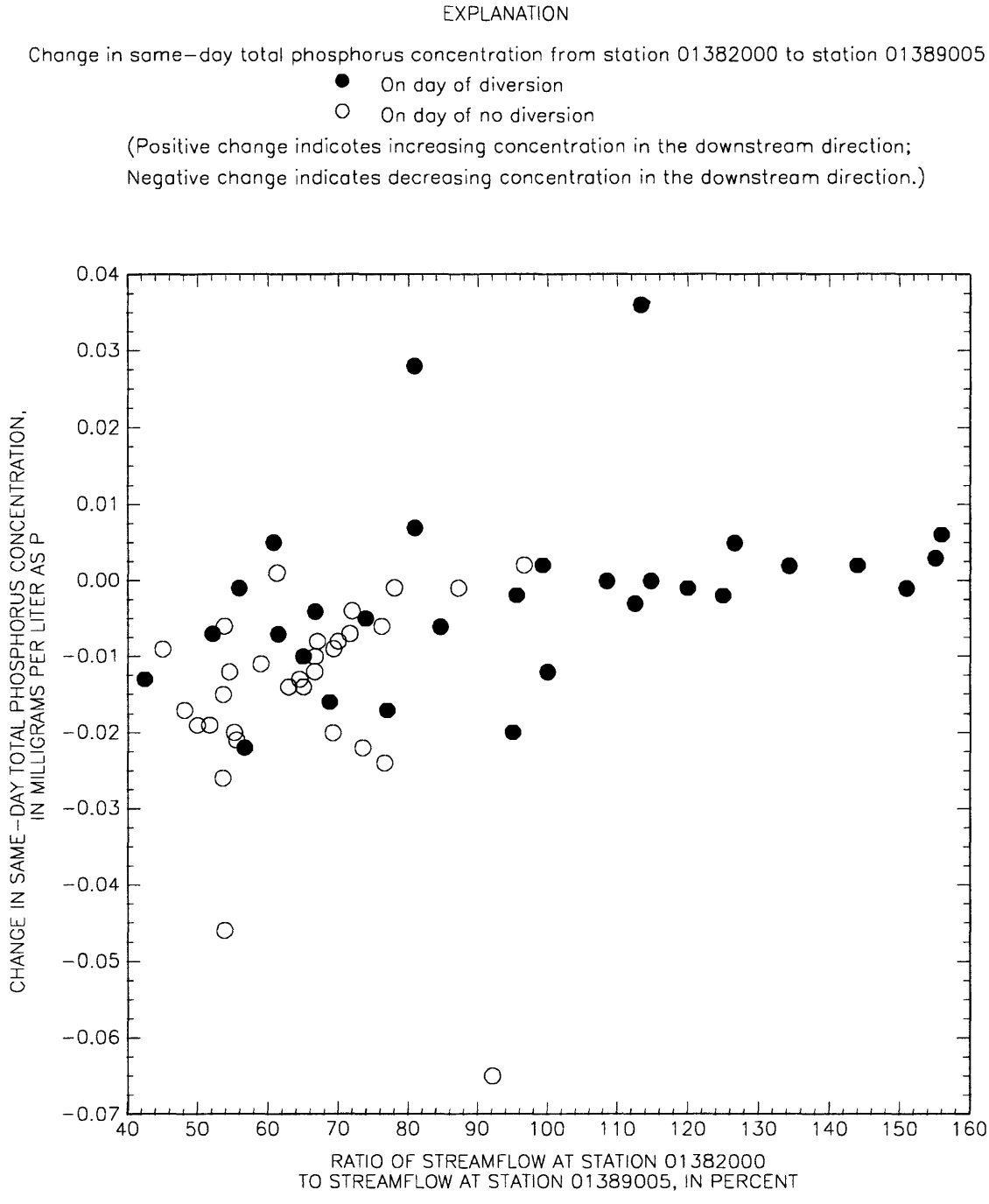

Figure 22. Relation between change in same-day total phosphorus concentration and ratio of streamflow at station 01382000, Passaic River at Two Bridges, to streamflow at station 01389005, Passaic River below Pompton River at Two Bridges, N.J., 1987-95. (Measurements shown were made year-round, except during July and August.)