



# **SELECTED STREAMFLOW STATISTICS FOR STREAMGAGING STATIONS IN DELAWARE, 2003**

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**U.S. GEOLOGICAL SURVEY**

**OPEN FILE REPORT 2004-1313**

Prepared in cooperation with the  
DELAWARE GEOLOGICAL SURVEY

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By Kernell G. Ries III

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Baltimore, Maryland

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# **SELECTED STREAMFLOW STATISTICS FOR STREAMGAGING STATIONS IN DELAWARE, 2003**

By Kernell G. Ries III

## **ABSTRACT**

Flow-duration and low-flow frequency statistics were calculated for 15 streamgaging stations in Delaware, in cooperation with the Delaware Geological Survey. The flow-duration statistics include the 1-, 2-, 5-, 10-, 20-, 30-, 40-, 50-, 60-, 70-, 80-, 90-, 95-, 98-, and 99-percent duration discharges. The low-flow frequency statistics include the average discharges for 1, 7, 14, 30, 60, 90, and 120 days that recur, on average, once in 1.01, 2, 5, 10, 20, 50, and 100 years. The statistics were computed using U.S. Geological Survey computer programs that can be downloaded from the World Wide Web at no cost. The computer programs automate standard U.S. Geological Survey methods for computing the statistics. Documentation is provided at the Web sites for the individual programs. The computed statistics are presented in tabular format on a separate page for each station, along with the station name, station number, the location, the period of record, and remarks.

## **INTRODUCTION**

Engineers, planners, land managers, biologists, and many others use streamflow statistics in their everyday work to help guide decision-making. Some uses of streamflow statistics include (1) flood-plain mapping for insurance underwriting and zoning, (2) bridge, culvert, and road design, (3) setting of water-quality standards, (4) water-supply planning and management, (5) wastewater discharge permitting, and (6) protection of endangered fish habitat.

Streamflow statistics are computed for U.S. Geological Survey (USGS) streamgaging stations using the time series of discharge developed for the stations. Although the statistics are computed from actual data, they are considered estimates when they are used to represent long-term and future conditions for planning, management, and engineering purposes. This is because the statistics change over time as more data become available for use in the computations, and as extreme events influence

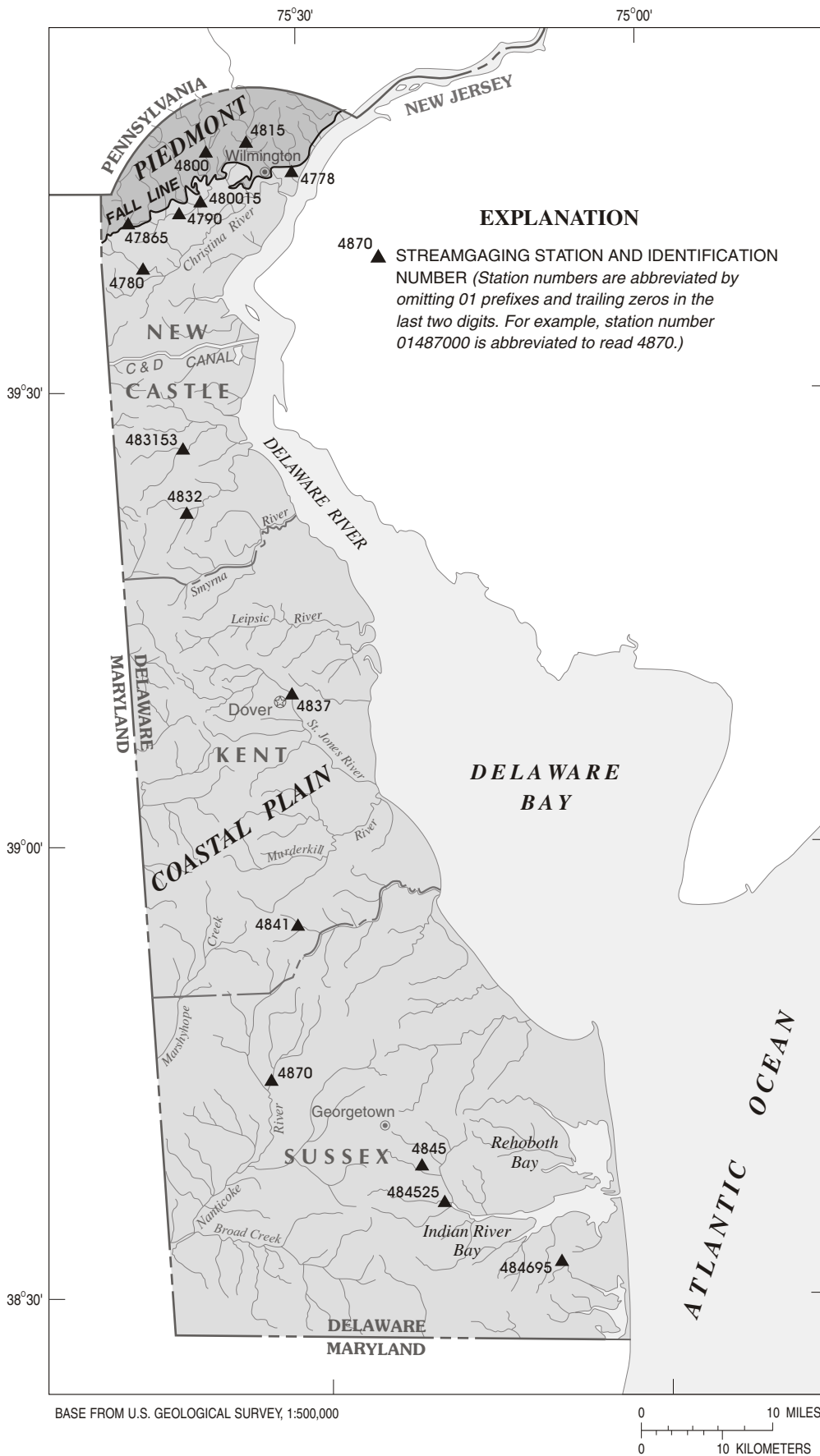
those statistics. As a result, streamflow statistics for streamgaging stations should be updated periodically to reflect the increasing record lengths available for the stations.

Low-flow and peak-flow statistics for streamgaging stations in Delaware were published previously in separate reports. Low-flow statistics for Delaware were last published by Carpenter and Hayes (1996). The statistics they published included the average 7-, 14-, and 30-consecutive-day low-flow discharges for recurrence intervals of 2, 10, and 20 years. Peak-flow statistics for Delaware were last published by Dillow (1996). The statistics published included the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence interval flood discharges. A USGS study is currently underway to update the flood-frequency statistics in cooperation with the Delaware Geological Survey (DGS).

The purpose of this report is to provide updated streamflow statistics for 15 streamgaging stations in Delaware, and to describe the methods used to determine the statistics. Flow-duration and low-flow frequency statistics are provided. The flow-duration statistics include the 1-, 2-, 5-, 10-, 20-, 30-, 40-, 50-, 60-, 70-, 80-, 90-, 95-, 98-, and 99-percent duration discharges. The low-flow frequency statistics include the average discharges for 1, 7, 14, 30, 60, 90, and 120 days that recur, on average, once in 1.01, 2, 5, 10, 20, 50, and 100 years. This report, and the analyses required to determine the streamflow statistics presented in it, were done in cooperation with the DGS.

## **PHYSICAL SETTING**

The State of Delaware is in the Mid-Atlantic coastal region of the United States. It is bordered on the west and south by the State of Maryland, on the north by the State of Pennsylvania, and on the east by the Delaware River and Delaware Bay (fig. 1). Delaware has a total area of 1,978 mi<sup>2</sup> (square miles), including land and inland water. The State is approximately 90 miles north to south and ranges from about 10 to 15 mi (miles) east to west in northern areas to about 40 mi east to west in southern areas.



**Figure 1.** Physiographic provinces and locations of streamgaging stations in Delaware for which streamflow statistics were computed.

Delaware has two major physiographic provinces, the Coastal Plain and the Piedmont (Fenneman, 1938). The provinces are separated by the Fall Line, which crosses diagonally from the northeast corner of the State, roughly through Wilmington to the western State boundary (fig. 1). The Piedmont province, north of the Fall Line, consists of approximately 112 mi<sup>2</sup> (about 6 percent of Delaware) of gently rolling landscape with maximum elevations generally less than 400 ft (feet) above sea level. Streams in this province have fairly steep gradients, and drain to the Delaware River (Dillow, 1996). The Coastal Plain consists of an area of 1,866 mi<sup>2</sup> (about 94 percent of Delaware) of low relief, with elevations ranging from sea level to less than 100 ft. Streams are generally small with low gradients, and drain to the Delaware River, Delaware Bay, the Atlantic Ocean, or Chesapeake Bay.

## DATA COLLECTION AND ANALYSIS

The 15 stations for which streamflow statistics are presented in this report were selected by the DGS, and include all active (2002) streamgaging stations in the State, except those for which data collection first began after October 1, 2000. The stations are located geographically throughout the State, and have periods of record ranging from 4 to 62 years, with an average of 39 years. The streamflow statistics included in this report also were selected by the DGS. The analyses were done using data for only complete water years (October 1 of the previous year to September 30 of the noted water year).

Computer programs used to calculate the statistics were developed by the USGS, and can be downloaded from the Web at no cost. The programs included ANNIE, which was used for binary database management; IOWDM, which was used for input and output of data to the database; and SWSTAT, which was used to compute the statistics presented in this report. The ANNIE program and accompanying documentation can be downloaded at <http://water.usgs.gov/software/annie.html>. The IOWDM program and accompanying documentation can be downloaded at <http://water.usgs.gov/software/iowdm.html>. The SWSTAT program and documentation for it can be downloaded at <http://water.usgs.gov/software/swstat.html>.

The SWSTAT program incorporates standard USGS methods for computing flow-duration and low-flow frequency. Standard methods for computing flow-duration statistics were described in Searcy (1959). Standard methods for computing low-flow frequency statistics were described in Riggs (1972).

The flow-duration statistics were computed for stations from daily mean streamflow data for the periods of record through the 2002 water year, which ended Sept. 30, 2002. These statistics indicate the percentage of time that daily mean streamflows are equaled or exceeded at the stations. For example, if the flow at the 90-percent duration is given for a station as 5 ft<sup>3</sup>/s (cubic feet per second), then the flow at that station was greater than or equal to 5 ft<sup>3</sup>/s 90 percent of the time during the period of record analyzed.

Low-flow frequency statistics were computed for the stations with at least 10 years of record from annual series of minimum n-day average flows, where n = 1, 7, 14, 30, 60, 90, and 120 days. The logarithms of these annual series were fit to a log-Pearson, Type III frequency distribution to determine recurrence intervals (1.01, 2, 5, 10, 20, 50, and 100 years) for the n-day flows at the stations. The streamflows equal to or less than



those given for a specific recurrence interval can be expected to occur, on average, once during the time interval. For instance, the 7-day, 2- and 10-year recurrence interval flows were computed from annual series of minimum 7-day average flows. Flows equal to or less than the 7-day, 2-year flow occur on average once every 2 years, whereas flows equal to or less than the 7-day, 10-year flow occur on average once every 10 years. These flows have a 50 percent  $[(1 \text{ year}/2 \text{ years}) \times 100]$  and 10 percent  $[(1 \text{ year}/10 \text{ years}) \times 100]$  chance of not being exceeded in any given year, respectively.

Table 1 presents the computed streamflow statistics on a separate page for each of the 15 streamgaging stations. In addition to the noted statistics, station names, identification numbers, locations, periods of record, and remarks are provided. Note from the remarks that 14 of the 15 stations are affected to some extent by regulations, diversions, or both. As a result, the streamflow statistics computed for the affected stations do not reflect natural conditions. No attempt was made to adjust the streamflow records for the regulation patterns or to limit the periods of record for the analyses to unregulated periods.

Two stations, Christina River at Coochs Bridge (01478000) and Blackbird Creek at Blackbird (01483200), had estimated 1-day, 1.01-year recurrence interval low flows that were higher than their estimated 7-day, 1.01-year recurrence interval low flows. In theory, the 1-day, 1.01-year value should always be lower than the 7-day, 1.01-year value. The fact that this was not the case for these two stations can be attributed to the uncertainty of the fit of the data for the stations to the log-Pearson frequency distribution.

## **SUMMARY**

Flow-duration and low-flow frequency statistics were calculated for 15 streamgaging stations in Delaware, in cooperation with the Delaware Geological Survey. The flow-duration statistics include the 1-, 2-, 5-, 10-, 20-, 30-, 40-, 50-, 60-, 70-, 80-, 90-, 95-, 98-, and 99-percent duration discharges. The low-flow frequency statistics include the average discharges for 1, 7, 14, 30, 60, 90, and 120 days that recur, on average, once in 1.01, 2, 5, 10, 20, 50, and 100 years. The statistics were computed using USGS ANNIE, IOWDM, and SWSTAT computer programs. These programs can be downloaded by the public at no cost through links to the Web site [http://water.usgs.gov/software/surface\\_water.html](http://water.usgs.gov/software/surface_water.html). The software automates standard USGS methods for computing the statistics. Documentation is provided at the Web sites for the individual programs. The computed statistics are presented in tabular format on a separate page for each station, along with the station name, station number, the location, the period of record, and remarks given.

## **REFERENCES CITED**

Carpenter, D.H., and Hayes, D.C, 1996, Low-flow characteristics of streams in Maryland and Delaware: U.S. Geological Survey Water-Resources Investigations Report 94-4020, 113 p.

- Dillow, J.J.A., 1996, Technique for estimating magnitude and frequency of peak flows for Delaware: U.S. Geological Survey Water-Resources Investigations Report 95-4153, 26 p.
- Fenneman, N.M., 1938, Physiography of the Eastern United States: New York, McGraw-Hill, 714 p.
- Riggs, H.C., 1972, Low-flow investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. B3, 15 p.
- Searcy, J.K., 1959, Flow-duration curves, manual of hydrology—part 2. Low flow techniques: U.S. Geological Survey Water-Supply Paper 1542-A, p. 1-33.

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003

[ft, foot; mi, mile; mi<sup>2</sup>, square mile; gal., gallon]

**STATION.**--01477800 SHELLPOT CREEK AT WILMINGTON, DE.

**LOCATION.**--Lat 39°45'39.5", long 75°31'07.3", New Castle County, Hydrologic Unit 02040205, on right bank 100 ft east of intersection of 44th and Pine Streets in Clifton Park, 700 ft downstream from bridge on North Market Street in Wilmington, 0.2 mi downstream from Matson Run, and 2.3 mi upstream from mouth.

**DRAINAGE AREA.**--7.46 mi<sup>2</sup>.

**PERIOD OF RECORD.**--December 1945 to current year. (water years 1947-2002 analyzed)

**REMARKS.**-- Occasional regulation at low flow from unknown source upstream from station. U.S. Geological Survey gage-height telemeter at station.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	1.19	0.46	0.26	0.19	0.14	0.09	0.07
7	1.49	.58	.34	.25	.19	.13	.10
14	1.74	.74	.44	.31	.23	.16	.12
30	3.56	1.21	.67	.46	.34	.23	.17
60	6.95	2.03	1.27	.99	.81	.64	.54
90	9.50	2.81	1.79	1.41	1.15	.92	.79
120	11.2	3.48	2.29	1.85	1.55	1.27	1.11

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	144	60	2.2
2	92.2	70	1.7
5	40.6	80	1.2
10	18.4	90	0.8
20	8.0	95	.5
30	5.1	98	.4
40	3.8	99	.3
50	2.9		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01478000 CHRISTINA RIVER AT COOCHS BRIDGE, DE

**LOCATION.**--Lat 39°38'14.6", long 75°43'40.4", New Castle County, Hydrologic Unit 02040205, on right bank 60 ft downstream from highway bridge, 0.5 mi southeast of Coochs Bridge, 3.3 mi south of Newark, 3.6 mi upstream from Belltown Run, and 22.6 mi upstream from mouth.

**DRAINAGE AREA.**--20.5 mi<sup>2</sup>.

**PERIOD OF RECORD.**--April 1943 to current year. (water years 1944-2002 analyzed)

**REMARKS.**--Low and medium flow regulated by mill upstream from station. U.S. Geological Survey satellite data-collection platform at station. Water-quality records for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	10.9	1.86	0.88	0.58	0.40	0.27	0.20
7	10.1	3.60	2.07	1.48	1.10	0.77	0.59
14	11.2	4.05	2.46	1.85	1.43	1.06	0.86
30	14.2	5.02	3.14	2.41	1.91	1.46	1.21
60	21.9	6.72	4.40	3.53	2.94	2.40	2.10
90	28.4	8.45	5.38	4.24	3.48	2.78	2.39
120	33.3	10.3	6.56	5.15	4.21	3.34	2.86

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	357	60	10.4
2	212	70	8.3
5	99.8	80	6.3
10	49.2	90	4.3
20	26.8	95	3.0
30	20.1	98	2.0
40	16.0	99	1.4
50	13.1		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01478650 WHITE CLAY CREEK AT NEWARK, DE

**LOCATION.**--Lat 39°41'21.2", long 75°44'55.5", New Castle County, Hydrologic Unit 02040205, on right bank 200 ft upstream from highway bridge on Paper Mill Road, at Newark, and 10.3 mi upstream from mouth.

**DRAINAGE AREA.**--69.0 mi<sup>2</sup>.

**PERIOD OF RECORD.**--March 1994 to current year. (water years 1995-2002 analyzed)

**REMARKS.**-- Low-flow frequency statistics were not computed for this station because record length is less than 10 years. Flow affected by City of Newark municipal water plant upstream from station. Records do not include a negligible diversion upstream from station by MBNA America. U.S. Geological Survey satellite data-collection platform at station.

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	516	60	41.7
2	351	70	33.8
5	205	80	26.8
10	146	90	20.9
20	101	95	15.6
30	75.5	98	8.4
40	60.3	99	7.1
50	50.7		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01479000 WHITE CLAY CREEK NEAR NEWARK, DE

**LOCATION.**--Lat 39°41'57.2", long 75°40'30.1", New Castle County, Hydrologic Unit 02040205, on left bank 35 ft downstream from bridge on private road at Delaware Park Race Track, 0.4 mi downstream from the Baltimore and Ohio Railroad bridge, 1.1 mi downstream from Pike Creek, 3.8 mi east of Newark, and 5.0 mi upstream from mouth.

**DRAINAGE AREA.**--89.1 mi<sup>2</sup>.

**PERIOD OF RECORD.**--October 1931 to September 1936, June 1943 to September 1957, October 1959 to current year. Monthly discharge only for some periods, published in Water-Supply Paper 1302. (water years 1932-36, and 1944-2002 analyzed)

**REMARKS.**--Flow affected by City of Newark municipal water plant upstream from station. Slight diurnal fluctuation at low flow caused by mills upstream from station. Records do not include a negligible diversion upstream from station by MBNA America. U.S. Geological Survey satellite data-collection platform at station.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	67.1	27.6	17.2	13.0	10.1	7.47	6.03
7	73.4	30.3	19.0	14.4	11.3	8.37	6.78
14	77.0	32.8	20.8	15.8	12.3	9.15	7.41
30	90.7	36.7	23.9	18.7	15.1	11.7	9.77
60	120	42.9	29.5	24.2	20.6	17.1	15.2
90	138	48.7	34.0	28.3	24.3	20.6	18.4
120	151	54.8	38.4	31.9	27.5	23.2	20.8

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	855	60	63.7
2	535	70	53.1
5	293	80	42.8
10	196	90	32.3
20	136	95	26.1
30	109	98	19.4
40	90.9	99	15.3
50	76.1		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01480000 RED CLAY CREEK AT WOODDALE, DE

**LOCATION.**--Lat 39°45'46.1", long 75°38'11.4", New Castle County, Hydrologic Unit 02040205, on right bank 12 ft upstream from bridge on State Highway 48, 0.3 mi south of Wooddale, 2.3 mi north of Marshallton, and 4.9 mi upstream from mouth.

**DRAINAGE AREA.**--47.0 mi<sup>2</sup>.

**PERIOD OF RECORD.**--April 1943 to current year. (water years 1944-2002 analyzed)

**REMARKS.**-- Low flows augmented at times by inflow from Hoopes Reservoir located 1.7 miles upstream from gage on unnamed tributary to Red Clay Creek, capacity 2,000,000,000 gal. Water from Brandywine Creek is pumped into Hoopes Reservoir and is released into Red Clay Creek during periods of low flow. Water from Red Clay Creek is used for municipal supply. U.S. Geological Survey satellite data-collection platform at station. Water-quality records for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	40.7	15.6	10.5	8.4	6.96	5.60	4.82
7	42.7	17.6	12.0	9.73	8.11	6.56	5.67
14	45.4	18.8	13.0	10.6	8.94	7.32	6.38
30	53.5	21.0	15.0	12.6	10.9	9.22	8.27
60	69.5	24.2	17.9	15.6	14.0	12.5	11.6
90	77.0	27.1	20.3	17.8	16.1	14.5	13.6
120	87.7	30.0	22.2	19.3	17.3	15.5	14.4

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	421	60	35.7
2	278	70	29.8
5	158	80	24.6
10	108	90	19.4
20	76.5	95	16.7
30	61.5	98	13.5
40	51.6	99	11.4
50	43.2		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01480015 RED CLAY CREEK NEAR STANTON, DE

**LOCATION.**--Lat 39°42'56.7", long 75°38'23.8", New Castle County, Hydrologic Unit 02040205, on right bank at downstream side of westbound lane of bridge on State Highway 4, near Stanton, and 0.9 mi upstream from mouth.

**DRAINAGE AREA.**--52.4 mi<sup>2</sup>.

**PERIOD OF RECORD.**--October 1988 to current year. (water years 1989-2002 analyzed)

**REMARKS.**--Low flows augmented at times by inflow from Hoopes Reservoir located 5.7 miles upstream from gage on unnamed tributary to Red Clay Creek, capacity 2,000,000,000 gal. Water from Brandywine Creek is pumped into Hoopes Reservoir and is released into Red Clay Creek during periods of low flow. Water from Red Clay Creek is used for municipal supply. U.S. Geological Survey satellite-collection platform at station.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years								
Period of Consecutive Days	Recurrence Interval, in Years							
	1.01	2	5	10	20	50	100	
1	62.3	16.7	10.9	8.82	7.44	5.17	5.47	
7	65.0	18.9	13.2	11.1	9.76	8.49	7.78	
14	69.2	20.5	14.7	12.6	11.3	10.0	9.30	
30	79.6	23.2	17.3	15.3	14.0	12.8	12.2	
60	108	26.3	20.2	18.3	17.2	16.3	15.9	
90	131	29.3	21.9	19.8	18.5	17.5	17.1	
120	137	31.6	23.6	21.1	19.6	18.4	17.8	

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	432	60	38.3
2	285	70	31.9
5	169	80	26.1
10	114	90	21.1
20	80.8	95	18.1
30	65.1	98	14.7
40	54.6	99	12.0
50	45.9		



**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01481500 BRANDYWINE CREEK AT WILMINGTON, DE

**LOCATION.**--Lat 39°46'09.9", long 75°34'25.0", New Castle County, Hydrologic Unit 02040205, on right bank in Rockford Park, 0.2 mi downstream from Rising Sun Bridge, in Wilmington, and 4.2 mi upstream from mouth.

**DRAINAGE AREA.**--314 mi<sup>2</sup>.

**PERIOD OF RECORD.**--October 1946 to current year. Prior to December 1946 monthly discharge only, published in WSP 1302. (water years 1947-2002 analyzed)

**REMARKS.**-- Some diurnal fluctuation at low flow caused by mills upstream from station. Flow regulated since November 1973 by Marsh Creek Reservoir, capacity 7,230,000,000 gal, about 27 mi upstream. No diversion just upstream from station by plant of E. I. Du Pont de Nemours & Co. since June 13, 1960. National Weather Service gage-height telemeter at station. U.S. Geological Survey satellite data-collection platform at station. Several measurements of water temperature were made during the year. Water-quality records for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years								
Period of Consecutive Days	Recurrence Interval, in Years							
	1.01	2	5	10	20	50	100	
1	292	110	80	68	60	51.7	47	
7	311	120	86.8	73.5	64.1	55.2	49.9	
14	337	129	92.5	78.2	68.2	58.5	53	
30	382	144	104	87.7	76.6	65.9	59.7	
60	523	168	122	105	93.8	83.3	77.3	
90	591	186	137	120	108	97.9	92	
120	637	210	152	130	116	103	94.8	

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	2800	60	268
2	2000	70	214
5	1240	80	173
10	884	90	132
20	628	95	109
30	500	98	88.4
40	404	99	74.2
50	330		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01483153 NOXONTOWN LAKE OUTLET NEAR MIDDLETOWN, DE  
**LOCATION.**--Lat 39°26'00.4", long 75°41'59.8", New Castle County, Hydrologic Unit 02040205, on right bank just upstream from Noxontown Lake Dam, 15 ft upstream from bridge on State Road 38, 2.0 mi southwest of Odessa, 2.4 mi southeast of Middletown, and 10.1 mi upstream from mouth of Appoquinimink River.

**DRAINAGE AREA.**--8.85 mi<sup>2</sup>.

**PERIOD OF RECORD.**--October 1992 to September 1994, November 1999 to current year. (water years 1993-94, 2001-02 analyzed)

**REMARKS.**-- Low-flow frequency statistics were not computed for this station because record length is less than 10 years. Outflow of lake controlled by stop logs at outlet.

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	79.7	60	5.9
2	48.6	70	4.6
5	26.5	80	3.1
10	19.5	90	1.7
20	13.3	95	1.1
30	10.6	98	0.5
40	8.4	99	0.3
50	7.1		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01483200 BLACKBIRD CREEK AT BLACKBIRD, DE

**LOCATION.**--Lat 39°21'58.6", long 75°40'09.8", New Castle County, Hydrologic Unit 02040205, on left bank 15 ft downstream from highway culverts, 0.5 mi upstream from Barlow Branch, 0.6 mi southwest of Blackbird, 5.6 mi northwest of Smyrna, and 13.8 mi upstream from mouth.

**DRAINAGE AREA.**—3.85 mi<sup>2</sup>.

**PERIOD OF RECORD.**--Annual maximum, water years 1952-56, and occasional low-flow measurements, water years 1952-53, 1955-56. October 1956 to current year. (water years 1957-2002 analyzed)

**REMARKS.**--Occasional regulation at low and medium flow by Blackbird Lake Dam upstream from station. Water-quality records for some prior periods have been collected at this site.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	2.56	0.23	0.09	0.04	0.00	0.00	0.00
7	2.25	.32	.10	.05	.02	.00	.00
14	2.91	.38	.14	.07	.04	.00	.00
30	4.10	.54	.23	.14	.09	.00	.00
60	2.37	1.04	.39	.19	.09	.04	.02
90	5.52	1.11	.51	.33	.22	.14	.10
120	8.16	1.28	.69	.50	.39	.30	.25

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	36.8	60	2.0
2	25.8	70	1.5
5	15.5	80	1.0
10	9.8	90	0.5
20	6.4	95	.3
30	4.8	98	.2
40	3.7	99	.1
50	2.8		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01483700 ST. JONES RIVER AT DOVER, DE

**LOCATION.**--Lat 39°09'49.4", long 75°31'08.7", Kent County, Hydrologic Unit 02040207, on left bank 150 ft upstream from Division Street Bridge in Dover, 1,950 ft downstream from Silver Lake, and 12.5 mi upstream from mouth.

**DRAINAGE AREA.**--31.9 mi<sup>2</sup>.

**PERIOD OF RECORD.**--January 1958 to current year. (water years 1959-2002 analyzed)

**REMARKS.**--Flow affected by Silver Lake. Flow occasionally affected by tide and wind effect. U.S. Geological Survey gage-height telemeter at station. Water-quality data for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	12.3	1.21	0.48	0.27	0.10	0.00	0.00
7	14.2	2.16	1.02	.68	.48	.32	.25
14	16.1	2.91	1.36	.89	.61	.40	.29
30	23.9	4.36	1.91	1.19	.78	.47	.33
60	32.3	6.77	3.44	2.35	1.70	1.16	.89
90	45.0	9.16	4.91	3.50	2.64	1.90	1.53
120	60.9	10.5	5.81	4.31	3.38	2.59	2.17

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	276	60	14.5
2	204	70	10.0
5	126	80	6.7
10	83.2	90	3.6
20	51.4	95	2.1
30	37.1	98	1.0
40	27.5	99	0.6
50	20.2		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01484100 BEAVERDAM BRANCH AT HOUSTON, DE

**LOCATION.**--Lat 38°54'20.8", long 75°30'45.9", Kent County, Hydrologic Unit 02040207, on left bank 15 ft upstream from culverts on State Highway 384, 0.8 mi south of Houston, and 1.2 mi upstream from Blairs Pond and mouth.

**DRAINAGE AREA.**--2.83 mi<sup>2</sup>.

**PERIOD OF RECORD.**--May 1958 to current year. (water years 1959-2002 analyzed)

**REMARKS.**--Diversion for irrigation of about 150 acres upstream from station during some years. Water-quality data for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	2.31	0.78	0.37	0.22	0.13	0.00	0.00
7	2.35	.89	.46	.30	.21	.13	.09
14	3.16	.90	.51	.37	.28	.20	.16
30	3.75	.96	.58	.44	.35	.27	.23
60	4.61	1.07	.66	.52	.42	.34	.29
90	5.10	1.22	.74	.57	.46	.36	.31
120	5.36	1.37	.82	.63	.50	.39	.33

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	20.3	60	2.3
2	14.1	70	1.8
5	9.0	80	1.3
10	6.9	90	0.8
20	5.1	95	.6
30	4.1	98	.5
40	3.3	99	.4
50	2.8		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01484500 STOCKLEY BRANCH AT STOCKLEY, DE

**LOCATION.**--Lat 38°38'19.9", long 75°20'31.1", Sussex County, Hydrologic Unit 02060010, on left bank at highway bridge in Stockley, 1.6 mi upstream from mouth, and 4.4 mi southeast of Georgetown.

**DRAINAGE AREA.**--5.24 mi<sup>2</sup>

**PERIOD OF RECORD.**--April 1943 to current year. (water years 1944-2002 analyzed)

**REMARKS.**--Natural flow of stream affected by inflow from upstream sand mine dewatering process. U.S. Geological Survey gage-height telemeter at station. Water-quality records for some prior periods have been collected at this location.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	3.30	1.46	0.85	0.60	0.43	0.29	0.22
7	3.87	1.74	.98	.68	.48	.31	.23
14	4.66	1.82	1.04	.74	.54	.37	.28
30	6.45	1.96	1.15	.85	.66	.48	.39
60	8.48	2.19	1.32	1.02	.81	.63	.54
90	9.97	2.45	1.48	1.14	.92	.72	.61
120	10.9	2.75	1.65	1.26	1.01	.79	.66

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	35.5	60	4.1
2	26.7	70	3.2
5	19.3	80	2.4
10	14.6	90	1.6
20	10.2	95	1.2
30	8.1	98	0.9
40	6.6	99	.8
50	5.3		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01484525 MILLSBORO POND OUTLET AT MILLSBORO, DE

**LOCATION.**--Lat 38°35'40.4", long 75°17'27.7", Sussex County, Hydrologic Unit 02060010, on right bank just upstream from Millsboro Pond Dam, 10 ft upstream from bridge on State Highway 24, at Millsboro.

**DRAINAGE AREA.**--66.0 mi<sup>2</sup>.

**PERIOD OF RECORD.**--May 1986 to September 1988. March 1991 to current year. (water years 1987-88, 1992-2002 analyzed)

**REMARKS.**--Outflow from lake controlled by sluice gate at outlet. Natural flow of stream affected by inflow from upstream sand mine dewatering process. U.S. Geological Survey gage-height telemeter at station.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	66.5	24	15.7	10.8	0.00	0.00	0.00
7	70.7	26.8	19.6	16.8	14.9	13.0	11.9
14	77.0	28.7	21.1	18.1	16.0	14.0	12.9
30	88.7	32.1	23.7	20.4	18.2	16.1	14.9
60	101	36.8	26.5	22.5	19.7	17.1	15.6
90	99.1	39.6	29.2	25.0	22.1	19.2	17.6
120	108	43.5	31.7	27.0	23.6	20.3	18.4

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	388	60	61.1
2	283	70	48.9
5	203	80	36.8
10	161	90	27.9
20	121	95	22.6
30	95.3	98	18.0
40	80.5	99	15.8
50	69.6		

**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01484695 BEAVERDAM DITCH NEAR MILLVILLE, DE

**LOCATION.**--Lat 38°31'17.2", long 75°08'00.2", Sussex County, Hydrologic Unit 02060010, at culverts on road No. 368, 2.1 mi southwest of Millville, and 1.6 mi upstream from mouth.

**DRAINAGE AREA.**--2.25 mi<sup>2</sup>.

**PERIOD OF RECORD.**--August 1998 to current year. (water years 1999-2002 analyzed)

**REMARKS.**-- Low-flow frequency statistics not computed for this station because record length is less than 10 years. Flow occasionally affected by releases from sand pits located upstream from station. U.S. Geological Survey gage-height telemeter at station.

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	27.2	60	0.7
2	19.6	70	.3
5	11.3	80	.2
10	7.0	90	.1
20	4.6	95	.1
30	3.2	98	.0
40	2.0	99	.0
50	1.2		



**Table 1.** Summary of streamflow statistics for selected streamgaging stations in Delaware, 2003, continued

**STATION.**--01487000 NANTICOKE RIVER NEAR BRIDGEVILLE, DE

**LOCATION.**--Lat 38°43'42.0", long 75°33'42.7", Sussex County, Hydrologic Unit 02060008, on left bank at downstream side of highway bridge, 800 ft downstream from Gum Branch, 2.5 mi southeast of Bridgeville, and 50.5 mi upstream from mouth.

**DRAINAGE AREA.**--75.4 mi<sup>2</sup>.

**PERIOD OF RECORD.**--April 1943 to current year. Prior to October 1955, published as Gravelly Fork near Bridgeville. (water years 1944-2002 analyzed)

**REMARKS.**--U.S. Geological Survey gage-height telemeter at station.

Magnitude and Frequency of Low-Flow Discharges, in Cubic Feet per Second, for Indicated Recurrence Intervals, in Years							
Period of Consecutive Days	Recurrence Interval, in Years						
	1.01	2	5	10	20	50	100
1	54.6	23.5	16.8	14.0	12.0	10.0	8.89
7	62.4	24.5	17.8	15.1	13.2	11.4	10.3
14	67.9	25.8	18.7	15.9	13.9	12.1	11.0
30	78.8	27.5	20.0	17.1	15.2	13.3	12.3
60	93.5	30.9	22.0	18.7	16.5	14.4	13.1
90	108	34.1	24.0	20.3	17.8	15.5	14.1
120	116	37.4	26.5	22.4	19.6	17.0	15.5

Flow-Duration Statistics Discharges, in Cubic Feet per Second, That Were Equaled or Exceeded for the Indicated Percent of Time			
Percent	Discharge	Percent	Discharge
1	440	60	54.1
2	339	70	43.5
5	235	80	35.0
10	178	90	26.9
20	129	95	22.3
30	103	98	18.8
40	83.5	99	16.9
50	67.4		