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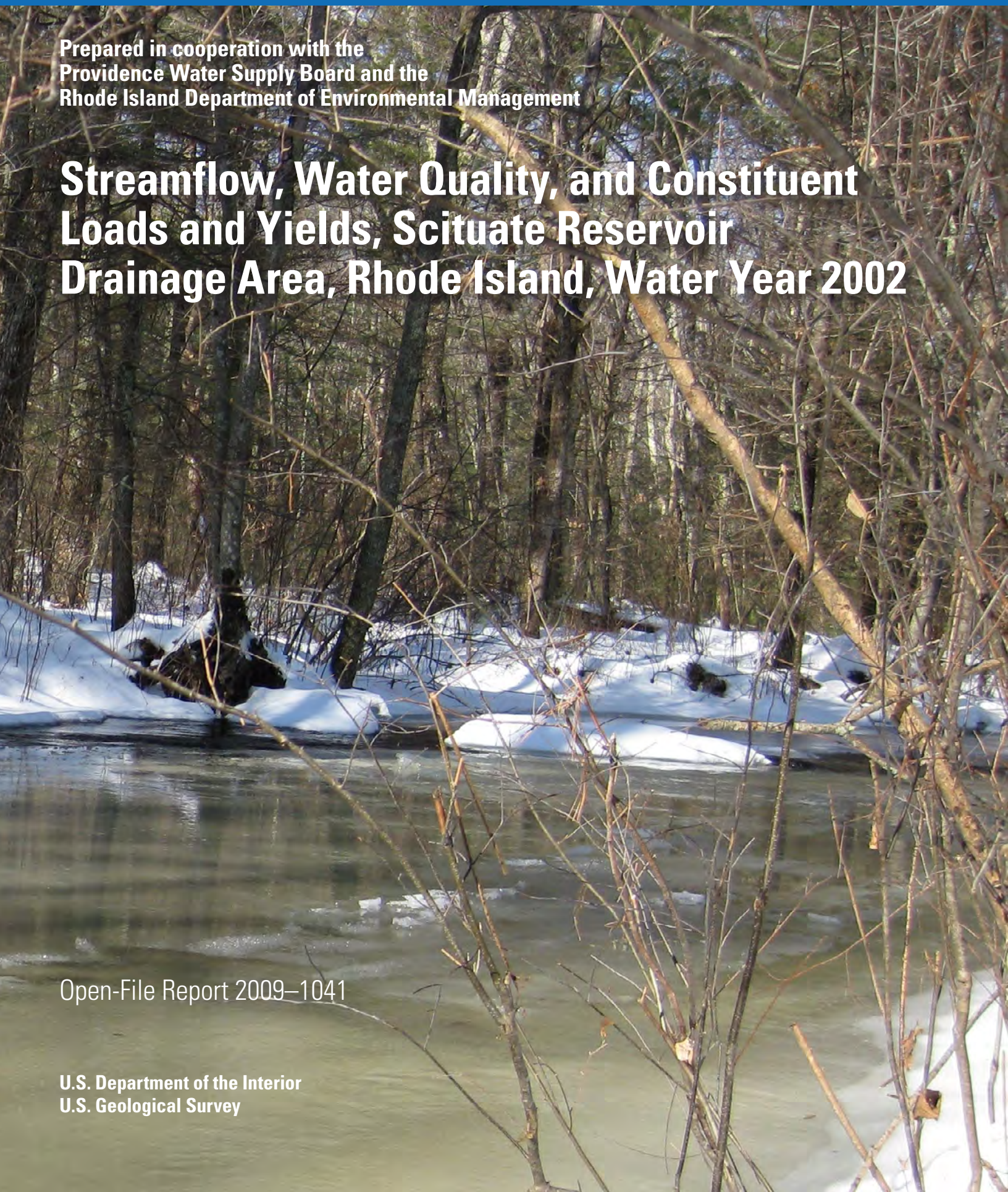
Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2002



Open-File Report 2009–1041

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

Cover. Photograph shows Ponaganset River at South Foster, Rhode Island. (Photograph by Kimberly Campo, U.S. Geological Survey)

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Conversion Factors

Multiply	By	To obtain
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Mass	
ton, short (2,000 lb)	907.2	kilogram (kg)

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or colony forming units per 100 milliliters (CFU/100 mL).

Loads of chemical constituents in water are given in kilograms (or millions of colony forming units for bacteria) per day, month, or year, and yields are given in kilograms (or millions of colony forming units for bacteria) per day, month, or year per square mile.

Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2002

By Robert F. Breault

Abstract

Streamflow and water-quality data were collected by the U.S. Geological Survey (USGS) or the Providence Water Supply Board, Rhode Island's largest drinking-water supplier. Streamflow was measured or estimated by the USGS following standard methods at 23 streamgage stations; 10 of these stations were also equipped with instrumentation capable of continuously monitoring specific conductance. Streamflow and concentrations of sodium and chloride estimated from records of specific conductance were used to calculate instantaneous (15-minute) loads of sodium and chloride during water year (WY) 2002 (October 1, 2001, to September 30, 2002). Water-quality samples were also collected at 35 of 37 sampling stations in the Scituate Reservoir drainage area by the Providence Water Supply Board during WY 2002 as part of a long-term sampling program. Water-quality data are summarized by using values of central tendency and are used, in combination with measured (or estimated) streamflows, to calculate loads and yields (loads per unit area) of selected water-quality constituents for WY 2002.

The largest tributary to the reservoir (the Ponaganset River, which was monitored by the USGS) contributed about 13 cubic feet per second (ft^3/s) to the reservoir during WY 2002. For the same time period, annual mean[1] streamflows measured (or estimated) for the other monitoring stations in this study ranged from about 0.14 to 8.1 ft^3/s. Together, tributary streams (equipped with instrumentation capable of continuously monitoring specific conductance) transported about 530,000 kilograms (kg) of sodium and 850,000 kg of chloride to the Scituate Reservoir during WY2002; sodium and chloride yields for the tributaries ranged from 2,900 to 42,000 kilograms per square mile (kg/mi^2) and from 4,100 to 70,000 kg/mi^2, respectively.

At the stations where water-quality samples were collected by the Providence Water Supply Board, the median of the median chloride concentrations was 16.8 milligrams per liter (mg/L), median nitrite concentration was 0.002 mg/L as N, median nitrate concentration was 0.02 mg/L as N, median orthophosphate concentration was 0.03 mg/L as P, and median concentrations of total coliform and *Escherichia coli (E. coli)* bacteria were 22 and 14 colony forming units per 100 milliliters (CFU/100 mL), respectively. The medians of the median daily loads (and yields) of chloride, nitrite, nitrate, orthophosphate, and total coliform and *E. coli* bacteria were 21 kg/d (12 $kg/d/mi^2$), 5.1 g/d (3.2 $g/d/mi^2$), 53 g/d (24 $g/d/mi^2$), 85 g/d (41 $g/d/mi^2$), and 370 million colony forming units per day ($CFU\times10^6/d$) (120 $CFU\times10^6/d/mi^2$) and 300 $CFU\times10^6/d$ (88 $CFU\times10^6/d/mi^2$), respectively.

[1] The arithmetic mean of the individual daily mean discharges for the year noted or for the designated period.

Introduction

The Scituate Reservoir is the primary source of drinking water for more than 60 percent of the population of Rhode Island. It covers about 94 mi^2 in parts of the towns of Cranston, Foster, Glocester, Johnston, and Scituate, R.I. (fig. 1). Information about the water quality of the reservoir and its tributary streams is important for management of the water supply and for the protection of human health. The Providence Water Supply Board (Providence Water), the agency responsible for the management and distribution of the Scituate Reservoir water supply, has been monitoring and assessing water quality in the reservoir and reservoir drainage area for more than 50 years.

Since 1993, the U.S. Geological Survey (USGS) has been cooperating with Providence Water and the Rhode Island Department of Environmental Management (RIDEM) to measure streamflow in tributaries to the Scituate Reservoir. Streamflow has been continuously measured at 2 streamgage stations in the drainage area and has been periodically measured at 21 additional stations on tributaries in the drainage area. At these 21 partial-record stations, continuous streamflow records have been estimated by using methods developed by the USGS (Hirsch, 1982). More recently (since 2000), the USGS also has been continuously measuring specific conductance at 10 monitoring stations. Equations that relate specific conductance to concentrations of sodium and chloride in streamwater also were developed as part of a previous USGS/Providence Water cooperative study (Nimiroski and Waldron, 2002). These equations, updated here and used together with measured (or estimated) streamflows, allow for nearly continuous estimation of sodium and chloride loads to the reservoir (Nimiroski and Waldron, 2002).

Currently (2008), Providence Water regularly collects water-quality samples from 37 tributary streams, either monthly or quarterly. Occasionally, samples are collected from other streams or stations as needed. Water-quality results are summarized by monitoring station and constituent or parameter in annual reports published by Providence Water. In addition, over the past 10 years, USGS reports have compiled and tabulated streamflow (measured or estimated by USGS) and water-quality data (collected by Providence Water; Breault and others, 2000; Nimiroski and others, 2008).

This report presents data on streamflow, water quality, and loads and yields of selected constituents for water year[2] (WY) 2002 in the Scituate Reservoir drainage area. These data were collected as part of studies done by the USGS in cooperation with Providence Water and the RIDEM. A summary of measured and estimated streamflows is presented for the 2 continuous-record and 21 partial-record streamgage stations in the drainage area. Estimated monthly loads and annual loads (and yields) of sodium and chloride are presented for the 10 stations at which specific conductance is continuously monitored by the USGS. Summary statistics for water-quality data collected by Providence Water at 35 sampling stations during WY 2002 also are presented, and these data were used to calculate loads and yields of selected water-quality constituents (table 1).

[2] October 1, 2001, to September 30, 2002.

Streamflow Data Collection and Estimation

Streamflow and water-quality data were collected by the USGS or Providence Water. Streamflow was measured or estimated by the USGS at 23 streamgage stations. Measured and estimated streamflows are necessary to estimate water volume and water-quality constituent loads and yields from tributary basins. At continuous-record streamgage stations, stream stage is measured every 15 minutes. Streamflow is computed with a stage-discharge relation (or rating), which is developed on the basis of periodic manual measurements. Daily mean streamflow at a station is calculated by dividing the total volume of water that passes the station each day by 86,400, the number of seconds in a day. Periodic manual streamflow measurements at partial-record gaging stations are used with concurrent continuous-record measurements from stations in hydrologically similar drainage areas to estimate a continuous record at the partial-record site. Specifically, continuous streamflow records for the 21 partial-record sites in the Scituate Reservoir drainage area were estimated by using the Maintenance of Variance Extension type 1 (MOVE.1) method, as described by Ries and Friesz (2000); data needed to estimate streamflows at partial-record sites were retrieved from the USGS National Water Inventory System (NWIS; http://waterdata.usgs.gov/nwis/) and formatted. Streamflows were estimated by MOVE.1 method by using a suite of USGS-developed computer programs (Granato, 2008). Errors for estimated streamflows are expressed as the upper and lower 90-percent confidence limits, as described by Tasker and Driver (1988) (table 2); there is a 90-percent chance that streamflow is somewhere between the upper and lower 90-percent confidence limits.

Continuous-record streamgage stations were operated and maintained by the USGS during WY 2002 on Peeptoad Brook (USGS station number 01115098 and Providence Water station number 16, in cooperation with RIDEM) and on the Ponaganset River (USGS station number 01115187 and Providence Water station number 35, in cooperation with Providence Water; fig. 1 and table 1). Streamflow data for these two gaging stations were collected at 15-minute intervals (near-real-time streamflow data), were updated at 2-hour intervals on the World Wide Web (WWW), and are available through the NWIS Web Interface (NWIS Web; U.S. Geological Survey, 2006). Error associated with measured streamflows in Peeptoad Brook and Ponaganset River was generally within about 15 percent (Socolow and others, 2003); upper and lower 90-percent confidence limits calculated by methods described by the National Institute of Standards and Technology/SEmiconductor MAnufacturing TECHnology (2003) for Peeptoad Brook and Ponaganset River are shown in table 2.

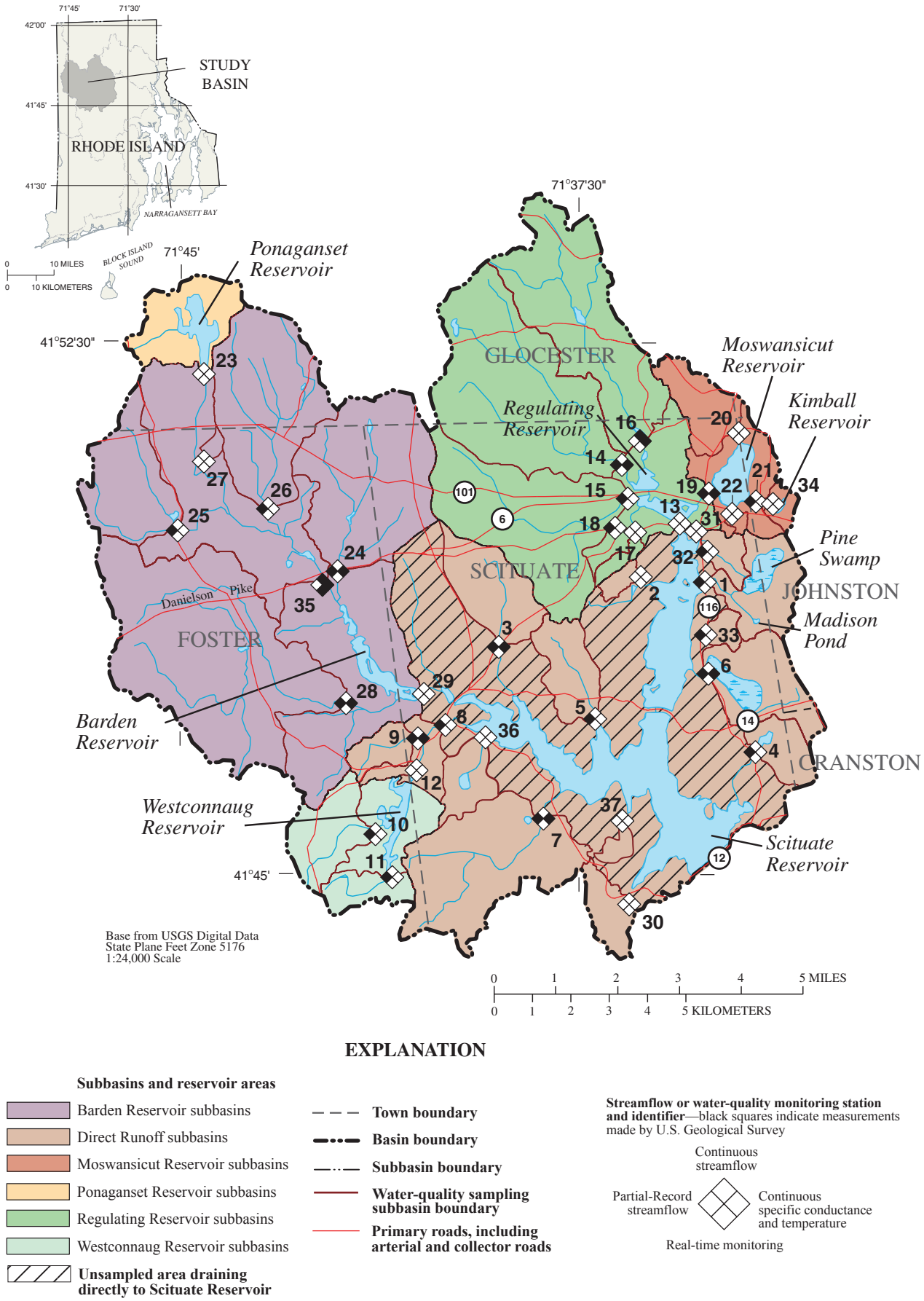

Figure 1. Locations of tributary-reservoir subbasins and streamgage and water-quality monitoring stations in the Scituate Reservoir drainage area, Rhode Island.

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous monitoring stations by tributary reservoir subbasin, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, to September 30, 2002.

[PW, Providence Water; USGS, U.S. Geological Survey; no., number; mi^2, square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; Alternate station names given for stations where different historical names were used for the same sampling location by Providence Water.]

PW station no.	USGS station no.	Station name	Drainage area (mi^2)	Station active during study period	Frequency of QW sample collection	Number of samples collected by Providence Water[1]	Daily estimated Na and Cl loads	Estimated streamflow calculated
		Barden Reservior subbasin						
24	01115190	Dolly Cole Brook	4.90	Y	M	12	Y	Y
25	01115200	Shippee Brook	2.35	Y	Q	4	N	Y
26	01115185	Windsor Brook	4.32	Y	Q	4	N	Y
27	011151845	Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook)	0.10	Y	Q	2	N	N
28	01115265	Barden Reservoir (Hemlock Brook)	8.72	Y	M	12	Y	Y
29	01115271	Ponaganset River (Barden Stream)	33.0	N	M	--	N	N
35	01115187	Ponaganset River	14.0	Y	M	12	Y	N
		Direct Runoff subbasin						
1	01115180	Brandy Brook	1.57	Y	M	12	N	Y
2	01115181	Unnamed Tributary #2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)	0.15	Y	Q	2	N	N
3	01115280	Cork Brook	1.79	Y	M	11	Y	Y
4	01115400	Kent Brook (Betty Pond Stream)	0.85	Y	M	11	N	Y
5	01115184	Spruce Brook	1.22	Y	Q	4	N	Y
6	01115183	Quonapaug Brook	1.96	Y	M	9	Y	Y
7	01115297	Wilbur Hollow Brook	4.32	Y	M	12	Y	Y
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	5.18	Y	M	8	N	Y
9	01115275	Bear Tree Brook	0.62	Y	Q	4	Y	Y
30	01115350	Unnamed Tributary #4 to Scituate Reservoir (Coventry Brook, Knight Brook)	0.78	Y	Q	3	N	N
31	01115177	Toad Pond	0.04	N	Q	--	N	N
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	0.45	Y	Q	4	N	Y
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	0.28	Y	Q	3	N	Y
36	--	Outflow from King Pond	0.77	Y	Q	3	N	N
37	--	Fire Tower Stream	0.15	Y	Q	4	N	N

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous monitoring stations by tributary reservoir subbasin, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, to September 30, 2002.—Continued

[PW, Providence Water; USGS, U.S. Geological Survey; no., number; mi^2, square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; Alternate station names given for stations where different historical names were used for the same sampling location by Providence Water.]

PW station no.	USGS station no.	Station name	Drainage area (mi^2)	Station active during study period	Frequency of QW sample collection	Number of samples collected by Providence Water[1]	Daily estimated Na and Cl loads	Estimated streamflow calculated
		Moswansicut Reservoir subbasin						
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	3.25	Y	M	7	Y	Y
20	01115160	Unnamed Tributary #1 to Moswansicut Reservoir (Blanchard Brook)	1.18	Y	M	8	N	N
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	0.29	Y	Q	3	N	Y
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	0.22	Y	M	7	N	N
34	01115164	Kimball Stream	0.27	Y	Q	3	N	N
		Ponaganset Reservoir subbasin						
23	011151843	Ponaganset Reservoir	1.92	Y	M	6	N	N
		Regulating Reservoir subbasin						
13	01115176	Regulating Reservoir	22.1	Y	M	9	N	N
14	01115110	Huntinghouse Brook	6.23	Y	M	12	Y	Y
15	01115114	Regulating Reservoir (Rush Brook)	4.70	Y	M	10	N	Y
16	01115098	Peeptoad Brook (Harrisdale Brook)	4.96	Y	M	11	Y	N
17	01115119	Dexter Pond (Paine Pond)	0.22	Y	Q	2	N	N
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	0.28	Y	Q	3	N	Y
		Westconnaug Reservoir subbasin						
10	01115274	Westconnaug Brook	1.48	Y	M	8	N	Y
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	0.72	Y	Q	3	N	Y
12	011152745	Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug reservoir)	0.16	Y	Q	1	N	N

[1] Not all samples were analyzed for all water-quality properties or constituents.

Table 2. Measured or estimated annual mean streamflow for tributary streams in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[USGS, U.S. Geological Survey; PW, Providence Water; no., number; ft^3/s, cubic feet per second; $ft^3/s/mi^2$, cubic feet per second per square mile]

PW station no.	USGS station no.	Station name	Annual mean streamflow (ft^3/s)	Upper 90-percent confidence limit (ft^3/s)	Lower 90-percent confidence limit (ft^3/s)	Normalized annual mean streamflow ($ft^3/s/mi^2$)
		Barden Reservoir subbasin				
24	01115190	Dolly Cole Brook	4.1	14.8	1.1	0.84
25	01115200	Shippee Brook	2.8	9.6	0.82	1.2
26	01115185	Windsor Brook	3.4	12.4	1.0	0.80
28	01115265	Barden Reservoir (Hemock Brook)	8.1	21.1	3.1	0.93
35	01115187	Ponaganset River	13	11.0	14.1	0.90
		Direct Runoff subbasin				
1	01115180	Brandy Brook	1.7	4.1	0.74	1.1
3	01115280	Cork Brook	1.6	3.7	0.68	0.89
4	01115400	Kent Brook (Betty Pond Stream)	0.74	6.5	0.08	0.88
5	01115184	Spruce Brook	1.5	6.1	0.37	1.2
6	01115183	Quonapaug Brook	2.2	6.4	0.75	1.1
7	01115297	Wilbur Hollow Brook	4.5	18.5	1.1	1.0
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	5.5	10.9	2.8	1.1
9	01115275	Bear Tree Brook	0.94	1.7	0.51	1.5
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	0.33	0.59	0.18	0.75
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	0.28	0.73	0.11	1.0
		Moswansicut Reservoir subbasin				
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	3.3	14.0	0.79	1.0
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Blanchard Brook)	0.39	1.7	0.09	1.4
		Regulating Reservoir subbasin				
14	01115110	Huntinghouse Brook	5.1	16.2	1.6	0.81
15	01115115	Regulating Reservoir (Rush Brook)	3.8	12.5	1.2	0.81
16	01115098	Peeptoad Brook (Harrisdale Brook)	5.1	4.5	5.7	1.0
18	01115120	Unnamed Tributary to Regulating Reservoir	0.14	0.35	0.06	0.53
		Westconnaug Reservoir subbasin				
10	01115274	Westconnaug Brook	1.6	5.1	0.51	1.1
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	1.5	4.7	0.45	2.0

Water-Quality Data Collection and Analysis

Water-quality data were collected by the USGS or Providence Water. Concentrations of sodium and chloride were estimated (by USGS) from continuous records of specific conductance from 10 of the 23 streamgage stations. Water-quality samples were collected monthly or quarterly at 35 of 37 sampling stations in the Scituate Reservoir drainage area by Providence Water during WY 2002, as part of a long-term sampling program. Daily loads of chloride, bacteria, nitrate, nitrite, and orthophosphate were calculated at 23 monitoring stations where streamflow data were collected by USGS and water-quality samples were collected by Providence Water. Yields were calculated by dividing load by drainage area.

Data Collected by the U.S. Geological Survey

Water quality was monitored in a periodic water-quality sampling program that included measurements by automatic specific-conductance probes. The USGS collected and analyzed the specific conductance. Specific conductance was measured by the USGS at 15-minute intervals at the 10 monitoring stations, including the 2 continuous streamgage stations and 8 partial-record sites (fig. 1). Measurements were made by using an instream probe and standard USGS methods for continuous streamwater-quality monitoring (Wagner and others, 2006). Specific conductance data for the 10 monitoring stations were published in the USGS Annual Data Report for WY 2002 (Socolow and others, 2003).

Concentrations of sodium and chloride were estimated from continuous measurements of specific conductance by using equations that were developed by the USGS to relate specific conductance to concentrations of sodium and chloride (equations 1 and 2). These regression equations were developed by the MOVE.1 method (also known as the line of organic correlation; Helsel and Hirsch, 1992) on the basis of concurrent measurements of specific conductance along with sodium and chloride concentrations measured in water-quality samples collected from tributary streams in the Scituate Reservoir drainage area (Marcus Waldron, U.S. Geological Survey, written comm., 2008):

$$C_{Na} = \left(Spc^{1.1794}\right) \quad 0.05240 \text{ and} \tag{1}$$

$$C_{Cl} = \left(Spc^{1.2828}\right) \quad 0.05063, \tag{2}$$

where

C_{Na} is the sodium concentration, in milligrams per liter;

C_{Cl} is the chloride concentration, in milligrams per liter; and

Spc is the specific conductance, in microsiemens per centimeter.

MOVE.1 was chosen for regression analysis to maintain variance (Hirsch and Gilroy, 1984). Some missing values of specific conductance were estimated. In these cases, seasonal (July to October; November to June) averages were used for estimated values of specific conductance.

Data Collected by the Providence Water Supply Board

Water-quality samples were collected at 35 of 37 monitoring stations by Providence Water. Sampling was monthly at 18 monitoring stations and quarterly at another 17 stations (table 1) during WY 2002. Water-quality samples were not collected during specific weather conditions; rather, a strictly periodic water-quality sampling schedule was followed so that water-quality samples would be representative of various weather conditions. However, sometimes samples could not be collected because streams at the sampling stations were dry or frozen. When possible, water-quality samples were collected by dipping the sample bottle into the stream at the center of flow (Richard Blodgett, Providence Water Supply Board, written commun., 2005). Samples were transported on ice to the water-quality laboratory of Providence Water at the P.J. Holton Water Purification Plant in Scituate, R.I. Water-quality properties and constituent concentrations were measured by using unfiltered water samples. These water-quality properties included pH, temperature, acidity, alkalinity, color, turbidity, and concentrations of chloride, nitrite, nitrate, orthophosphate, and bacteria (*Escherichia coli (E. coli)* and total coliform). More information on sample-collection, analytical, and quality-control procedures can be found in the Providence Water Quality Assurance Program Manual (Providence Water Supply Board Water Quality Laboratory, 2003).

Providence Water collected samples during a wide range of flow conditions. The daily mean flow-duration curve for the Ponaganset River at South Foster (USGS station number 01115187) for WY2002 is shown in figure 2. The curve represents the percentage of time that each flow was exceeded at this station. The flows at this station on days when water-quality samples were collected at a representative station (Dolly Cole Brook, fig. 2) are represented by the plotted points superimposed on the curve. Samples were collected at flow durations ranging from the 1st percentile to the 90th percentile; this range indicates that water-quality samples collected in WY 2002 represent a wide range of flow conditions during that water year.

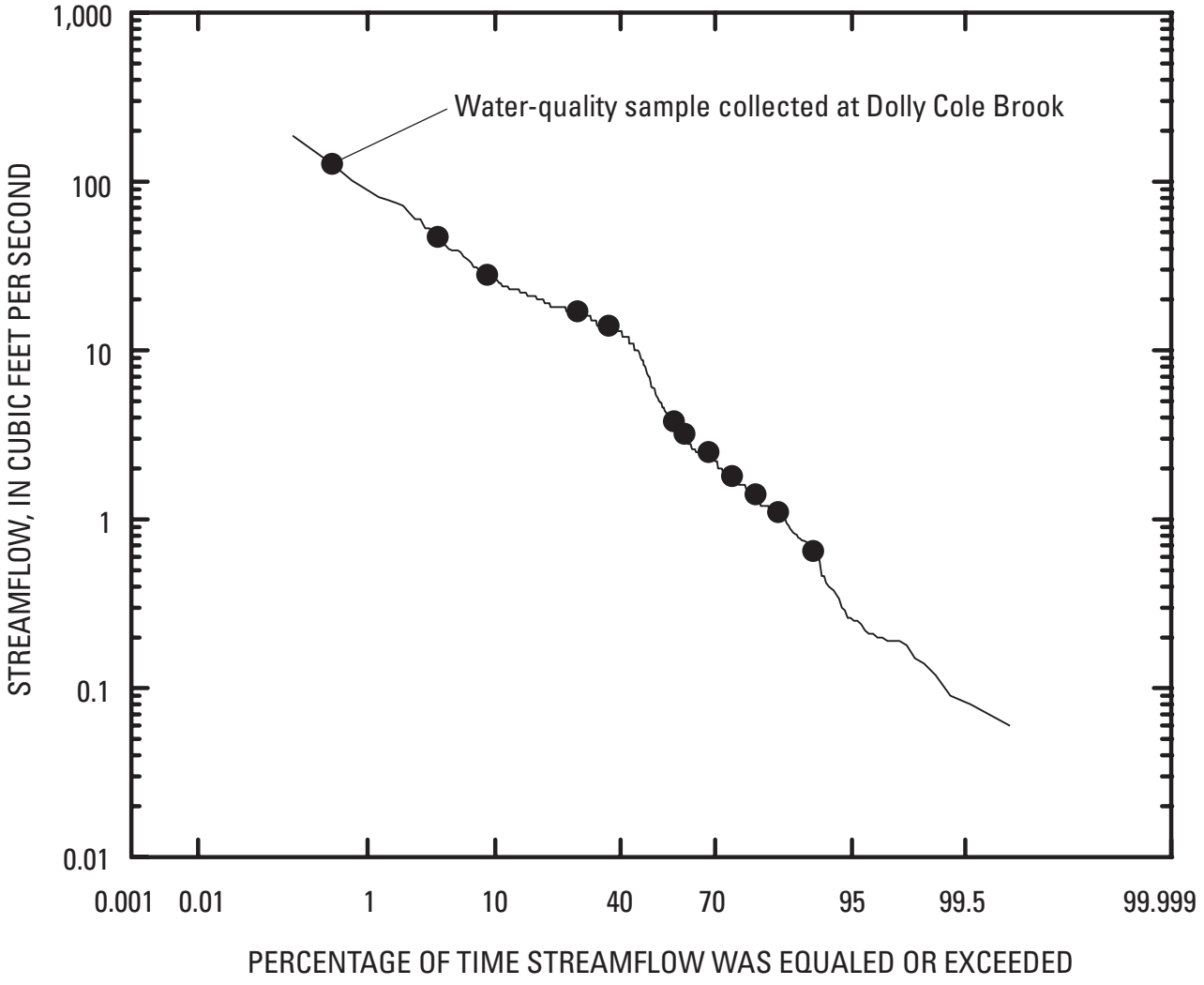

Figure 2. Flow-duration curve for the U.S. Geological Survey continuous streamgage station on Ponaganset River at South Foster (station 01115187) for water year 2002 and streamflow measurements at the Ponaganset River gaging station on the dates when water-quality samples were collected at Dolly Cole Brook (shown as points).

Estimating Daily, Monthly, and Annual Loads and Yields

Daily, monthly, and annual sodium and chloride loads in kilograms were estimated for all sampling sites for which streamflow (periodic or continuous) and continuous specific-conductance data were available during WY 2002. Daily sodium and chloride loads were estimated by multiplying daily (flow-weighted) concentrations of sodium and chloride in milligrams per liter by daily discharge (in liters per day) and added by month or water year. Daily flow-weighted concentrations of sodium and chloride were calculated by multiplying instantaneous flows by concurrent concentrations of sodium and chloride (estimated from measurements of specific conductance) for each day and dividing by the total flow for that day.

Daily loads of water-quality constituents (in samples collected by Providence Water) were calculated for all sampling dates during WY 2002 (table 3, at back of report) for which periodic or continuous streamflow data were available (table 1). These loads were calculated by multiplying constituent concentrations in milligrams per liter or colony forming units (CFU) per 100 milliliters in single samples multiplied by the daily discharge (in liters per day) for the day on which each sample was collected. The flows, which in most cases were estimates, were assumed to be representative of the flow at the time of the sample collection. Loads in kilograms (or millions of CFUs for bacteria) per day and yields in kilograms (or millions of CFUs for bacteria) per day per square mile were calculated for chloride, bacteria, nitrite, nitrate, and orthophosphate from this water-quality data. Censored data (or concentrations reported as less than method detection limits) were replaced with one-half the method detection limit.

Streamflow

Monitoring streamflow is necessary to measure the volume of water and estimate constituent loads to the Scituate Reservoir. The Ponaganset River is the largest monitored tributary to the Scituate Reservoir. Mean streamflow at the gaging station on the Ponaganset River (USGS station number 01115187) for the entire time period of its operation (mean of the daily mean streamflows for the period of record, WY 1994–2006) was 28.3 ft^3/s (wdr.waterdata.usgs.gov/). During WY 2002, annual mean streamflow was 13 ft^3/s (fig. 3; Socolow and others, 2003). Mean streamflow in Peeptoad Brook (01115098), the other continuous streamgage station in the Scituate Reservoir drainage area (USGS station number 01115098), for its period of record (WY 1994–2006) was 10.5 ft^3/s (wdr.water.usgs.gov/). Annual mean streamflow in Peeptoad Brook during WY 2002 was 5.1 ft^3/s (Socolow and others, 2003).

The 13-year periods of record at these two streamgage stations are shorter than time periods typically used to represent long-term average conditions. However, comparison with a nearby station having a period of record from WY 1940–2006 (Quinsigamond River at North Grafton, Mass., USGS station number 01110000) indicates that the distribution of streamflows regionally during the study period with respect to the long-term average flow at that station (41.3 ft^3/s; wdr.water.usgs.gov/) was similar to the distribution at Ponaganset River and Peeptoad Brook; the annual mean flow in WY 2002 was considerably lower than average (17.4 ft^3/s; Socolow and others, 2003). Annual mean streamflows estimated for partial-record monitoring stations are given in table 2. Estimated annual mean streamflows at partial record stations ranged from 0.14 to 8.1 ft^3/s. Annual mean streamflows normalized by drainage area ranged from 0.53 to 2.0 $ft^3/s/mi^2$ (table 2).

Water Quality and Constituent Loads and Yields

Water-quality conditions in the Scituate Reservoir drainage area are described by summary statistics for water-quality properties and constituent concentrations and estimated constituent loads and yields. Loads and yields characterize the rates at which masses of constituents are transferred to the reservoir by tributary streams. In the case of loads, streams with higher flows tend to have higher loads because the greater volume of water carries more of the constituent to the reservoir per unit time. Yields represent the constituent load per unit drainage area and are calculated by dividing the load estimated for a monitoring station by the drainage area to the station. Yields are useful for comparison among sites of different drainage-area sizes because the effects of basin size and, therefore, total streamflow volume are attenuated. Yields are useful for examining potential differences among basin properties that may contribute to reservoir quality.

Summary statistics include means and medians. For some purposes, median values are more appropriate because they are less likely to be affected by high or low concentrations (or outliers). Medians are especially important to use for summarizing a relatively limited number of values. In contrast, continuously monitored streamflow and sodium and chloride loads (estimated from measurements of specific conductance), which include a large number of values, are better summarized in terms of means because a large data set is more resistant to the effects of outliers. Mean values also are particularly appropriate for characterizing loads because outlier values, which typically represent large flows, are important to include when representing the delivery of constituent masses to receiving waters.

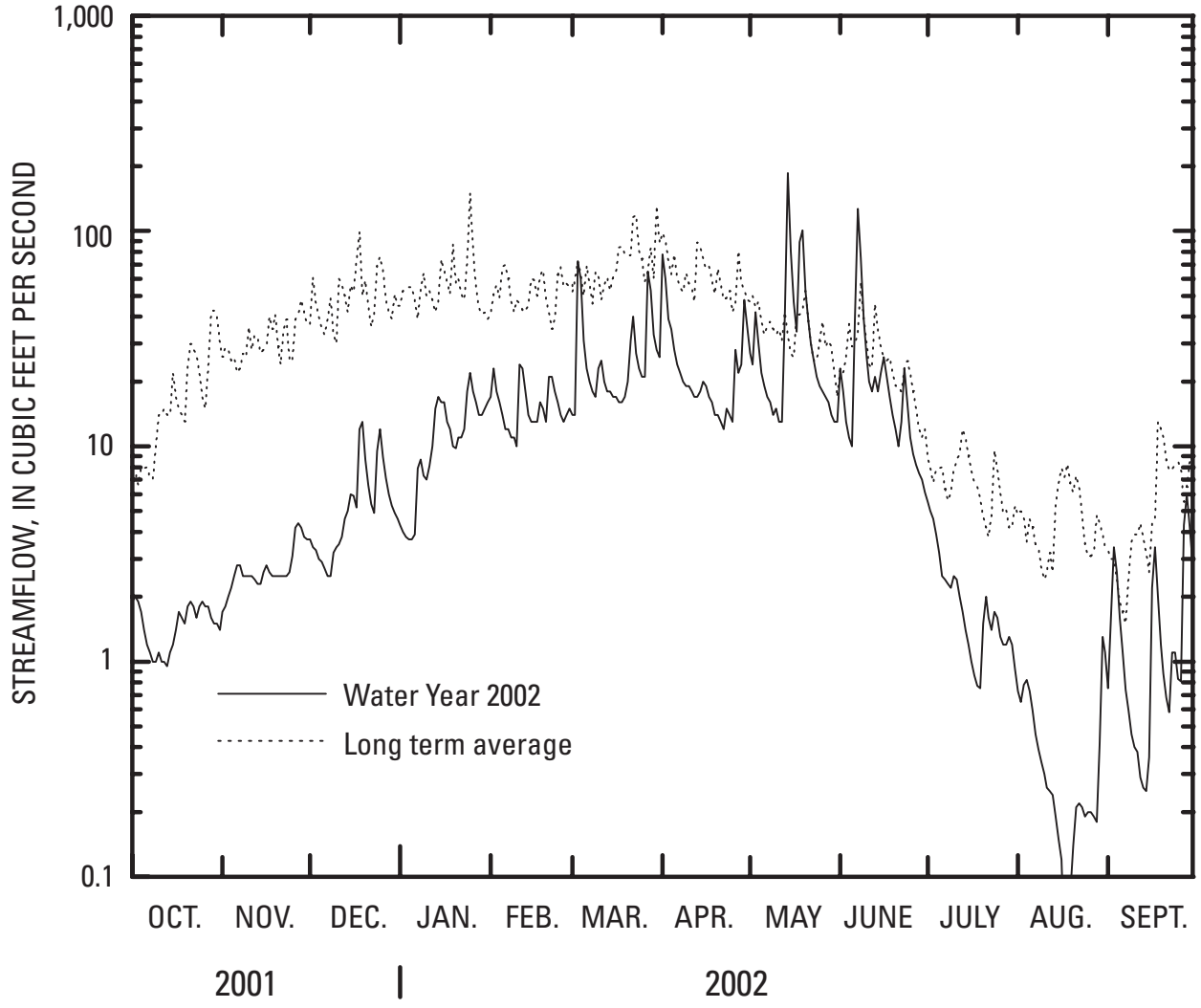

Figure 3. Measured daily mean streamflow for the U.S. Geological Survey continuous-record gaging station on the Ponaganset River at South Foster (station 01115187) in the Scituate Reservoir drainage area, Rhode Island, for October 1, 2001, through September 30, 2002 (solid line), and mean daily streamflow for March 22, 1994, through July 13, 2008 (dotted line).

Sodium and Chloride Loads and Yields Estimated from Specific-Conductance Monitoring Data

Sodium and chloride are constituents of special concern in the Scituate Reservoir drainage area; they are major constituents of road salt used for deicing, and several major roadways cross the drainage basin. State Routes 12 and 14 cut across the main body of the reservoir, and State Route 116 parallels the eastern limb (fig. 1). A recent study by the USGS, in cooperation with Providence Water, indicated that tributary streams in basins with state-maintained roads have substantially higher concentrations of sodium and chloride, presumably because of deicing activities (Nimiroski and Waldron, 2002). In addition, sodium is a constituent of potential concern for human health; some persons on restrictive diets need to limit their intake of sodium.

Estimated monthly mean[3] sodium concentrations in tributary streams of the Scituate Reservoir drainage area ranged from 2.0 to 65.2 mg/L, and estimated monthly mean chloride concentrations ranged from 2.7 to 123 mg/L. The highest monthly mean concentrations of sodium and chloride were measured at station 6 (Quonapaug Brook) in April 2002 (65.2 and 123 mg/L, respectively) (table 4). The highest annual mean[4] concentrations of sodium and chloride were measured at station 9 (Bear Tree Brook) at 30.6 and 51.9 mg/L, respectively (table 5). These high values are not surprising because the waters that pass this station contain sodium and chloride from a formerly uncovered salt storage pile (Nimiroski and Waldron, 2002).

The Scituate Reservoir received about 530,000 kg (about 584 tons) of sodium and 850,000 kg (about 937 tons) of chloride from tributary streams—equipped with instrumentation capable of continuously monitoring specific conductance—during WY 2002. The highest sodium and chloride loads in WY 2002—110,000 kg and 180,000 kg, respectively—were measured at the Peeptoad Brook (Harrisdale Brook) station (Providence Water Station Number 16) (table 5). Monthly sodium and chloride loads were highest at all stations in March and May, with two exceptions (table 6). Monthly sodium and chloride loads were highest in April at the Quonapaug Brook and in June at the Bear Tree Brook station, respectively. The totals of the March and May loads of sodium and chloride accounted for about 44 percent of the annual load for each constituent, on average. The highest annual sodium and chloride yields were 42,000 and 70,000 kg/mi^2, respectively, and were measured at Bear Tree Brook (station 9; table 5).

Uncertainties associated with measuring streamflow and specific conductance and with sodium and chloride sample collection, preservation, and analysis produce uncertainties in load and yield estimates. The load and yield estimates presented in the text and tables are estimated to be the most likely values for loads and yields of sodium and chloride coming from tributary streams or their drainage basins. It may be best to discuss loads and yields in terms of a range within which the true values lie; however, the most probable values of loads and yields are presented for ease of discussion and presentation. The range within which the true values lie depends on the uncertainties in individual measurements of streamflow and concentration, which are difficult to quantify with available information. It is commonly assumed that the uncertainties associated with estimating streamflow affect load and yield calculations more than the error associated with measuring specific conductance and (or) chemical analysis. The most probable values of loads and yields presented in the tables and text are sufficient for planning-level analysis of water quality in tributary streams and their drainage basins.

[3] Monthly mean concentrations were calculated by dividing the total monthly load by the total discharge for the month.

[4] Annual mean concentrations were calculated by dividing the total annual load by the total discharge for the year.

Physical and Chemicals Properties and Daily Loads and Yields Estimated from Data Collected by the Providence Water Supply Board

Physical and Chemical Properties

Physical and chemical properties including pH, turbidity, alkalinity, specific conductance, and color were routinely measured to characterize water quality from each basin (table 7). Specifically, pH is a measure of the acidity of the water; color can be an indirect measure of the amount of organic carbon dissolved in the water column; turbidity is an indirect measure of suspended particles; and alkalinity is a measure of the acid-neutralizing capacity of water.

The median pH in tributary streams in the Scituate Reservoir drainage area ranged from 5.2 to 6.7; the median of the medians among all stations was 6.2. Median values of color ranged from 8.0 to 130 platinum cobalt units (PCU); the median among all stations was 32 PCU. Median values of turbidity ranged from 0.3 to 1.9 nephelometric turbidity units (NTU); the median among all stations was 0.7 NTU. Median alkalinity values in tributary streams were low, ranging from 1.9 to 15 mg/L as $CaCO_3$; the median among all stations was 5.6 mg/L as $CaCO_3$ (table 7).

Table 4. Monthly mean concentrations of chloride and sodium estimated from continuous measurements of specific conductance in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[USGS, U.S. Geological Survey; PW, Providence Water; no., number; mg/L, milligrams per liter; Cl, chloride; Na, sodium; the average root mean square error of the regression estimate for sodium and chloride are 1.2 and 0.06, respectively; monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month]

PW station no.	USGS station no.	Station name	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.	
			Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)
Barden Reservoir subbasin														
24	01115190	Dolly Cole Brook	18.8	12.1	19.1	12.2	19.8	12.7	18.8	12.1	19.3	12.4	20.4	13.1
28	01115265	Barden Reservoir (Hemock Brook)	22.4	14.2	23.4	14.8	19.5	12.5	14.3	9.4	15.3	10.0	14.2	9.3
35	01115187	Ponaganset River	15.4	10.0	15.4	10.1	16.1	10.4	14.7	9.5	14.0	9.2	13.1	8.5
Direct Runoff subbasin														
3	01115280	Cork Brook	28.1	17.5	29.6	18.3	30.5	18.9	25.8	16.2	25.0	15.7	23.9	15.1
6	01115183	Quonapaug Brook	53.3	31.5	40.1	24.2	36.1	22.0	32.2	19.8	31.1	19.2	24.9	15.6
7	01115297	Wilbur Hollow Brook	14.0	9.2	12.5	8.3	11.9	7.9	10.2	6.9	9.8	6.6	8.8	6.0
9	01115275	Bear Tree Brook	72.5	41.8	69.0	39.9	60.6	35.4	53.0	31.3	49.3	29.3	38.6	23.4
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	24.7	15.4	28.6	17.8	29.0	18.0	33.2	20.4	34.4	21.1	39.5	23.6
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	5.5	3.9	2.7	2.0	3.4	2.5	3.2	2.4	3.2	2.4	3.8	2.7
16	01115098	Peeptoad Brook (Harrisdale Brook)	28.1	17.5	27.7	17.3	31.3	19.3	44.9	26.9	44.2	26.5	42.9	25.8
Scituate Reservoir basin														
		Average	28.3	17.3	26.8	16.5	25.8	16.0	25.0	15.5	24.6	15.2	23.0	14.3

PW station no.	USGS station no.	Station name	Apr.		May		June		July		Aug.		Sep.	
			Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)	Cl (mg/L)	Na (mg/L)
Barden Reservoir subbasin														
24	01115190	Dolly Cole Brook	23.0	14.5	20.8	13.3	20.4	13.0	20.9	13.3	21.3	13.5	29.3	18.2
28	01115265	Barden Reservoir (Hemock Brook)	15.5	10.1	12.4	8.2	13.5	8.9	21.0	13.4	21.6	13.7	29.7	18.4
35	01115187	Ponaganset River	12.7	8.2	13.4	9.4	15.7	10.2	15.4	10.3	22.8	12.3	19.3	11.1
Direct Runoff subbasin														
3	01115280	Cork Brook	21.2	13.5	18.7	12.0	16.8	10.9	18.6	12.0	28.4	17.6	35.1	21.4
6	01115183	Quonapaug Brook	123	65.2	26.8	16.6	25.3	15.8	45.7	27.4	51.8	30.6	74.7	42.8
7	01115297	Wilbur Hollow Brook	10.6	7.2	9.4	6.4	12.1	8.1	11.3	7.5	16.0	10.4	24.0	15.1
9	01115275	Bear Tree Brook	38.7	23.5	35.4	21.6	68.0	39.4	80.2	45.8	103	57.7	85.0	48.3
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	28.4	17.7	28.6	17.8	29.0	18.0	31.6	19.5	30.2	18.7	30.3	18.8
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	3.0	2.3	9.1	6.2	10.6	7.1	14.5	9.5	14.9	9.8	17.3	11.2
16	01115098	Peeptoad Brook (Harrisdale Brook)	42.8	25.8	38.8	23.5	36.2	22.1	27.5	17.0	20.3	12.9	18.2	11.7
Scituate Reservoir basin														
		Average	31.9	18.8	21.3	13.5	24.8	15.4	28.7	17.6	33.0	19.7	36.3	21.7

Table 5. Annual mean chloride and sodium concentrations, loads, and yields by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2002, through September 30, 2003.

[USGS, U.S. Geological Survey; PW, Providence Water; no., number; mg/L, milligrams per liter; kg, kilograms; kg/mi^2, kilograms per square mile; Cl, chloride; Na, sodium; annual mean concentrations were calculated by dividing the annual load by the total discharge for the year.]

PW station no.	USGS station no.	Station name	Concentration		Load		Yield	
			Cl (mg/L)	Na (mg/L)	Cl (kg)	Na (kg)	Cl (kg/mi^2)	Na (kg/mi^2)
		Barden Reservoir subbasin						
24	01115190	Dolly Cole Brook	20.8	13.3	76,000	49,000	16,000	9,900
28	01115265	Barden Reservoir (Hemock Brook)	14.4	9.5	100,000	68,000	12,000	7,900
35	01115187	Ponaganset River	14.1	9.3	160,000	100,000	11,000	7,400
		Direct Runoff subbasin						
3	01115280	Cork Brook	21.8	13.8	31,000	20,000	17,000	11,000
6	01115183	Quonapaug Brook	46.1	26.5	91,000	52,000	46,000	27,000
7	01115297	Wilbur Hollow Brook	10.0	6.8	40,000	27,000	9,400	6,300
9	01115275	Bear Tree Brook	51.9	30.6	44,000	26,000	70,000	42,000
		Moswansicut Reservoir subbasin						
19	01115170	Moswansicut Reservoir, (Moswansicut Stream North, Moswansicut Pond)	32.2	19.7	96,000	59,000	29,000	18,000
		Regulating Reservoir subbasin						
14	01115110	Huntinghouse Brook	5.7	4.0	26,000	18,000	4,100	2,900
16	01115098	Peeptoad Brook, (Harrisdale Brook)	40.5	24.5	180,000	110,000	37,000	22,000
		Scituate Reservoir basin						
			Average		Total		Average	
			25.8	15.8	850,000	530,000	25,000	15,000

Table 6. Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[USGS, U.S. Geological Survey; PW, Providence Water; no., number; Cl, chloride; Na, sodium; kg, kilogram]

PW station no.	USGS station no.	Station name	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.	
			Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)
Barden Reservoir subbasin														
24	01115190	Dolly Cole Brook	190	120	280	180	930	600	3,400	2,200	8,000	5,100	19,000	12,000
28	01115265	Barden Reservoir (Hemock Brook)	760	480	1,100	700	2,500	1,600	6,000	3,900	13,000	8,600	25,000	17,000
35	01115187	Ponaganset River	1,700	1,100	3,100	2,000	6,800	4,400	12,000	8,100	15,000	9,800	27,000	18,000
Direct Runoff subbasin														
3	01115280	Cork Brook	150	96	230	140	690	420	2,000	1,300	4,200	2,600	8,600	5,400
6	01115183	Quonapaug Brook	620	370	640	380	1,400	880	3,900	2,400	7,400	4,600	12,000	7,400
7	01115297	Wilbur Hollow Brook	290	190	360	240	900	600	2,400	1,600	4,700	3,200	8,700	5,900
9	01115275	Bear Tree Brook	2,000	1,100	2,100	1,200	2,800	1,600	3,900	2,300	4,800	2,900	5,400	3,300
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	570	350	860	540	2,000	1,300	6,500	4,000	12,000	7,600	27,000	16,000
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	48	34	36	27	160	120	660	490	1,600	1,200	4,500	3,300
16	01115098	Peeptoad Brook (Harrisdale Brook)	990	620	1,300	800	3,400	2,100	13,000	8,000	25,000	15,000	45,000	27,000
Scituate Reservoir basin														
		Total	7,300	4,500	10,000	6,200	22,000	14,000	54,000	34,000	96,000	60,000	180,000	120,000

PW station no.	USGS station no.	Station name	Apr.		May		June		July		Aug.		Sep.	
			Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)	Cl (kg)	Na (kg)
Barden Reservoir subbasin														
24	01115190	Dolly Cole Brook	16,000	10,000	20,000	13,000	7,200	4,600	570	360	160	100	190	120
28	01115265	Barden Reservoir (Hemock Brook)	21,000	14,000	22,000	14,000	9,800	6,400	1,700	1,100	540	340	650	410
35	01115187	Ponaganset River	22,000	15,000	39,000	25,000	26,000	17,000	2,500	1,600	550	350	2,000	1,300
Direct Runoff subbasin														
3	01115280	Cork Brook	5,800	3,700	6,600	4,200	2,400	1,500	250	160	110	71	120	75
6	01115183	Quonapaug Brook	45,000	24,000	12,000	7,700	5,100	3,200	1,200	700	440	260	580	330
7	01115297	Wilbur Hollow Brook	8,100	5,400	9,000	6,100	4,900	3,300	540	360	250	160	330	210
9	01115275	Bear Tree Brook	4,700	2,900	4,700	2,900	6,100	3,500	3,100	1,700	2,300	1,300	1,800	1,000
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	15,000	9,600	19,000	12,000	8,900	5,500	1,500	920	510	320	470	290
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	2,700	2,000	11,000	7,600	4,500	3,000	370	240	95	63	92	59
16	01115098	Peeptoad Brook (Harrisdale Brook)	36,000	22,000	40,000	24,000	17,000	10,000	2,000	1,200	530	340	430	280
Scituate Reservoir basin														
		Total	180,000	110,000	180,000	120,000	92,000	59,000	14,000	8,400	5,500	3,300	6,700	4,100

Constituent Concentrations and Daily Loads and Yields

Fecal indicator bacteria, chloride, and nutrients like phosphorus and nitrogen are commonly detected in natural water; at elevated concentrations, these constituents can render water unfit for the intended use. Fecal indicator bacteria, which are found in the intestines of warm-blooded animals, may indicate impairment from sewage contamination or from livestock or wildlife that defecate in or near the stream margin. Chloride originates in tributary streamwater from precipitation, weathering, or human activities like waste disposal and road deicing. Sources of nutrients in tributary streamwater include atmospheric deposition, leaching of naturally occurring organic material, discharge of groundwater that is enriched in nutrients from septic-system leachate, and runoff contaminated with fertilizer or animal waste. The ultimate intended use of water in the tributary streams is ultimately drinking water, which must meet specific water-quality standards. For this reason, Providence Water and the USGS closely monitor concentrations of these constituents in tributary streams. Median concentrations, loads, and yields of water-quality constituents are given in tables 7 and 8.

Bacteria

Median concentrations of total coliform and *E. coli* bacteria were above the detection limit (3 CFU/100 mL) at nearly all sites (table 7). Total coliform bacteria concentrations were in most cases equal to or greater than *E. coli* concentrations (as expected because total coliform is more inclusive); the median concentrations among all sites in the drainage basin were equal to 22 CFU/100 mL for total coliform bacteria and 14 CFU/100 mL for *E. coli* bacteria. Median concentrations of total coliform and *E. coli* bacteria were greatest (1,200 and 550 CFU/100 mL) at the Unnamed Tributary #2 to Scituate Reservoir (Providence Water Station 2) (table 7). Concentrations of fecal indicator bacteria in some cases were lowest at monitoring stations immediately downstream from subbasin reservoirs, such as station 23 at the outlet of the Ponaganset Reservoir.

Median daily loads and yields of total coliform and *E. coli* bacteria varied over three orders of magnitude; the highest median daily yields for both constituents were at station 6 (Quonapaug Brook) in the Direct Runoff subbasin (table 8). Although relatively high for monitoring stations in the Scituate Reservoir subbasin, median daily bacteria yields at this station are low compared to yields of indicator bacteria in sewage-contaminated streamwater or streamwater influenced by stormwater runoff in an urban environment (Breault and others, 2002). The median of the median daily loads for both types of bacteria for the entire Scituate Reservoir drainage area ranged from 4 to 7,700 CFU×10^6/d; and 16 to 4,000 CFU×10^6/d/mi^2 for yields of total coliform; and 4 to 4,600 CFU×10^6/d for loads of *E. coli*; and about 16 to 2,300 CFU×10^6/d/mi^2 for yields of *E. coli* (table 8).

Chloride

The highest median chloride concentration (60.4 mg/L) was measured in the Direct Runoff subbasin at the Bear Tree Brook station (9) (table 7); this value compares well to the annual mean chloride concentration (51.9 mg/L) estimated from continuously monitored specific conductance at this station (table 5). Median daily chloride loads and yields varied among monitoring stations in the drainage area (table 8), but yields at most stations were within a factor of 2 of the median for the overall drainage area of about 12 kg/d/mi^2, with a few exceptions (Bear Tree Brook (9), Moswansicut Reservoir (19), Unnamed Tributary #2 to Moswansicut Reservoir (21), and Westconnaug Brook (10)). Of these, samples measured at the Moswansicut Reservoir station (19) had the largest median daily chloride load (220 kg/d), whereas the largest median daily chloride yield was determined for Bear Tree Brook station (200 kg/d/mi^2); this yield compares well with the annual mean chloride yield (70,000 kg/yr/mi^2 (table 5) or about 190 kg/d/mi^2) measured at that station by using continuously measured specific-conductance records.

Nutrients

Median concentrations of nitrite and nitrate (table 7) were 0.002 and 0.02 mg/L as N, respectively. Relatively high concentrations of nitrite in Spruce Brook (5) in the Direct Runoff subbasin (0.035 mg/L as N) and nitrate at some monitoring sites, such as Moswansicut Reservoir (22) in the Moswansicut Reservoir subbasin (0.25 mg/L as N) and Unnamed Tributary #2 to Scituate Reservoir (2) in the Direct Runoff subbasin (0.23 mg/L as N), may be affected by nitrogen-enriched runoff or groundwater (Nimiroski and others, 2008). The median concentration of orthophosphate for the entire study area (table 7) was 0.03 mg/L as P. The maximum median concentration of orthophosphate (0.13 mg/L as P) was measured at Unnamed Tributary to Ponaganset River (27). Nutrient loadings from the Ponaganset River (35) into the Scituate Reservoir— nitrite (200 g/d), nitrate (230 g/d), and orthophosphate (330 g/d)—were among the largest of all the sampled stations. Median daily nitrate loads for WY 2002 were larger at only one station, Bear Tree Book (9; 320 g/d). The largest median daily nutrient yield for nitrate (520 g/d/mi^2) was determined for Bear Tree Brook (9); at Spruce Brook (5) for nitrite (33 g/d/mi^2); and at Unnamed Tributary #2 to Moswansicut Reservoir (21) for oththophosphate (150 g/d/mi^2) (table 8).

Table 7. Median values for water-quality data collected at Providence Water stations by tributary reservoir subbasin, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; PCU, platinum cobalt units; NTU, nephelometric turbidity units; CFU/100mL, colony forming units per 100 milliliters; *E. coli.*, *Escherichia coli*; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; N, nitrate; P, phosphorus; --, no data; <, less than]

PW station no.	USGS station no.	Station name	Properties			Constituents						
			pH (units)	Color (PCU)	Turbidity (NTU)	Total coliform bacteria (CFU/100mL)	*E. coli* (CFU/100mL)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Orthophosphate (mg/L as P)
Barden Reservoir subbasin												
24	01115190	Dolly Cole Brook	6.2	44	0.9	5	5	4.2	19.1	0.002	0.02	0.02
25	01115200	Shippee Brook	6.1	27	0.5	8	8	4.4	8.7	0.001	0.03	0.03
26	01115185	Windsor Brook	6.2	33	0.4	12	12	4.2	19.8	0.001	0.02	0.04
27	011151845	Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook)	5.5	21	0.4	5	5	3.0	7.4	0.001	0.15	0.13
28	01115265	Barden Reservoir (Hemlock Brook)	5.8	70	0.7	23	23	4.4	20.4	0.002	0.01	0.03
29	01115271	Ponaganset River (Barden Stream)	--	--	--	--	--	--	--	--	--	--
35	01115187	Ponaganset River	6.3	30	0.6	9	23	5.1	15.9	0.015	0.02	0.03
Direct Runoff subbasin												
1	01115180	Brandy Brook	6.6	55	1.5	23	23	9.4	10.1	0.003	0.05	0.04
2	01115181	Unnamed Tributary #2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)	5.9	9.0	0.6	1,200	550	4.5	--	0.001	0.23	0.08
3	01115280	Cork Brook	6.3	18	0.3	22	12	5.2	25.9	0.001	0.04	0.05
4	01115400	Kent Brook (Betty Pond Stream)	6.6	27	0.8	14	4	6.7	4.0	0.002	0.01	0.01
5	01115184	Spruce Brook	6.1	54	0.5	12	3	5.5	9.5	0.035	0.04	0.06
6	01115183	Quonapaug Brook	6.4	90	1.9	110	57	9.9	31.4	0.003	0.02	0.03
7	01115297	Wilbur Hollow Brook	6.3	130	1.2	14	19	7.1	9.0	0.004	<0.01	0.03
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	6.1	12	0.4	<3	<3	3.1	9.1	0.001	0.02	0.02
9	01115275	Bear Tree Brook	6.5	32	0.4	23	23	7.6	60.4	0.001	0.16	0.04
30	01115350	Unnamed Tributary #4 to Scituate Reservoir (Coventry Brook, Knight Brook)	6.1	27	0.5	23	23	5.7	23.2	0.001	0.01	0.05
31	01115177	Toad Pond	--	--	--	--	--	--	--	--	--	--
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	6.6	68	0.9	75	23	8.6	6.7	0.002	0.05	0.03
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	6.2	18	0.3	23	3	6.3	9.0	0.002	0.04	0.04
36	--	Outflow from King Pond	6.4	22	0.3	12	--	4.5	2.5	0.001	0.03	0.04
37	--	Fire Tower Stream	6.3	20	0.3	23	--	4.8	3.0	0.001	0.03	0.05

Table 7. Median values for water-quality data collected at Providence Water stations by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; PCU, platinum cobalt units; NTU, nephelometric turbidity units; CFU/100mL, colony forming units per 100 milliliters; *E. coli.*, *Escherichia coli*; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; N, nitrate; P, phosphorus; --, no data; <, less than]

PW station no.	USGS station no.	Station name	Properties			Constituents						
			pH (units)	Color (PCU)	Turbidity (NTU)	Total coliform bacteria (CFU/100mL)	*E. coli* (CFU/100mL)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Orthophosphate (mg/L as P)
Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	6.7	15	1.6	7	16	9.1	26.5	0.002	0.02	0.03
20	01115160	Unnamed Tributary #1 to Moswansicut Reservoir (Blanchard Brook)	5.8	120	1.2	23	23	4.7	36.0	0.003	0.01	0.04
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	6.5	85	1.4	23	23	14	31.2	0.003	0.10	0.02
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	6.5	45	1.9	460	460	15	38.4	0.006	0.25	0.03
34	01115164	Kimball Stream	6.2	62	1.1	43	--	15	28.6	0.003	<0.01	0.01
Ponaganset Reservoir subbasin												
23	011151843	Ponaganset Reservoir	5.4	8.0	0.6	<3	<3	1.9	9.9	0.001	0.06	0.02
Regulating Reservoir subbasin												
13	01115176	Regulating Reservoir	6.6	17	0.6	<3	<3	8.8	26.0	0.001	0.01	0.01
14	01115110	Huntinghouse Brook	6.3	35	0.8	39	23	7.3	7.3	0.002	0.02	0.03
15	01115115	Regulating Reservoir (Rush Brook)	6.5	61	0.9	23	23	11	23.6	0.002	0.01	0.04
16	01115098	Peeptoad Brook (Harrisdale Brook)	6.6	28	1.0	23	23	11	25.5	0.002	0.02	0.02
17	01115119	Dexter Pond (Paine Pond)	5.8	78	0.7	<3	<3	5.6	19.7	0.002	0.01	0.03
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	6.2	50	0.5	120	4	7.8	10.0	0.001	0.03	0.04
Westconnaug Reservoir subbasin												
10	01115274	Westconnaug Brook	5.2	23	0.3	4	4	2.0	17.6	0.001	0.02	0.02
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	5.5	90	0.7	<3	<3	3.8	0.7	0.003	0.01	0.03
12	011152745	Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug reservoir)	6.0	18	0.9	4	4	4.1	9.1	0.001	0.01	0.01
Scituate Reservoir basin												
		Median	6.2	32	0.7	22	14	5.6	16.8	0.002	0.02	0.03

Table 8. Median daily loads and yields of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; CFU×10^6/d; millions of colony forming units per day; CFU×10^6/mi^2, millions of colony forming units per square mile; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; kg/d/mi^2, kilograms per day per square mile; g/d, grams per day; g/d/mi^2, grams per day per square mile]

PW station no.	USGS station no.	Station name	Total coliform bacteria		*E. coli*		Chloride		Nitrate (as N)		Nitrite (as N)		Orthophosphate (as P)	
			(CFU×10^6/d)	(CFU×10^6/mi^2)	(CFU×10^6/d)	(CFU×10^6/mi^2)	(kg/d)	(kg/d/mi^2)	(g/d)	(g/d/mi^2)	(g/d)	(g/d/mi^2)	(g/d)	(g/d/mi^2)
Barden Reservoir subbasin														
24	01115190	Dolly Cole Brook	210	42	210	42	21	4.3	1.9	0.39	19	3.8	21	4.2
25	01115200	Shippee Brook	41	18	41	18	19	8.0	1.7	0.71	55	24	38	16
26	01115185	Windsor Brook	110	26	110	26	51	12	2.6	0.61	29	6.7	94	22
28	01115265	Barden Reservoir	1,200	130	770	88	200	22	28	3.2	33	3.8	140	16
35	01115187	Ponaganset River	1,700	120	1,300	92	170	12	200	14	230	16	330	23
Direct Runoff subbasin														
1	01115180	Brandy Brook	1,300	800	990	630	29	19	7.0	4.4	120	75	110	71
3	01115280	Cork Brook	140	80	130	71	11	6.1	0.68	0.38	65	36	21	11
4	01115400	Kent Brook	79	93	28	34	1.8	2.1	0.78	0.92	7.8	9.2	3.4	4.0
5	01115184	Spruce Brook	68	56	68	56	14	11	40	33	40	33	110	92
6	01115183	Quonapaug Brook	7,700	4,000	4,600	2,300	47	24	9.4	4.8	22	11	70	36
7	01115297	Wilbur Hollow Brook	440	100	330	76	16	3.7	7.5	1.7	18	4.1	70	16
8	01115276	Westconnaug Brook	300	57	300	57	130	24	17	3.2	210	41	230	45
9	01115275	Bear Tree Brook	200	330	200	330	120	200	2.1	3.4	320	520	85	140
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	830	1,800	250	560	6.3	14	1.3	2.9	55	120	22	48
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	4.4	16	4.4	16	2.6	9.4	0.59	2.1	30	110	12	42
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	370	120	950	290	220	67	26	8.0	41	13	170	54

Table 8. Median daily loads and yields of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; CFU×10^6/d; millions of colony forming units per day; CFU×10^6/mi^2, millions of colony forming units per square mile; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; kg/d/mi^2, kilograms per day per square mile; g/d, grams per day; g/d/mi^2, grams per day per square mile]

PW station no.	USGS station no.	Station name	Total coliform bacteria		*E. coli*		Chloride		Nitrate (as N)		Nitrite (as N)		Orthophosphate (as P)	
			(CFU×10^6/d)	(CFU×10^6/mi^2)	(CFU×10^6/d)	(CFU×10^6/mi^2)	(kg/d)	(kg/d/mi^2)	(g/d)	(g/d/mi^2)	(g/d)	(g/d/mi^2)	(g/d)	(g/d/mi^2)
Moswansicut Reservoir subbasin—Continued														
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	480	1,700	480	1,700	43	150	4.2	14	140	480	42	150
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	3,200	510	920	150	15	2.4	5.1	0.82	88	14	140	22
15	01115115	Regulating Reservoir (Rush Brook)	1,100	230	810	170	21	4.4	13	2.8	76	16	190	41
16	01115098	Peeptoad Brook (Harrisdale Brook)	1,400	270	490	99	68	14	18	3.6	120	24	110	23
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	1,100	3,800	6.2	22	7.1	25	0.42	1.5	4.4	16	17	59
Westconnaug Reservoir subbasin														
10	01115274	Westconnaug Brook	340	230	340	230	91	62	8.1	5.5	53	36	93	63
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	30	42	30	42	3.0	4.1	4.1	5.6	23	32	61	85
Scituate Reservoir basin														
			370	120	300	88	21	12	5.1	3.2	53	24	85	41

References Cited

Breault, R.F., Sorenson, J.R., and Weiskel, P.K., 2002, Streamflow, water quality, and contaminant loads in the lower Charles River watershed, Massachusetts, 1999–2000: U.S. Geological Survey Water-Resources Investigations Report 02–4137, 131 p.

Breault, R.F., Waldron, M.C., Barlow, L.K., and Dickerman, D.C., 2000, Water-quality conditions in relation to drainage basin characteristics in the Scituate Reservoir basin, Rhode Island, 1982–95: U.S. Geological Survey Water-Resources Investigations Report 00–4086, 46 p.

Granato, G.E., 2008, Computer programs for obtaining and analyzing daily mean streamflow data from the U.S. Geological Survey National Water Information System Web Site: U.S. Geological Survey Open-File Report 2008–1362, CD-ROM.

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

Hirsch, R.M., 1982, A comparison of four streamflow record extension techniques: Water Resources Research, v. 18, no. 4, p. 1081–1088.

Hirsch, R.M., and Gilroy, E.J., 1984, Methods of fitting a straight line to data—Examples in water resources: Water Resources Bulletin, v. 20, no. 5, p. 705–711.

National Institute of Standards and Technology/SEmiconductor MAnufacturing TECHnology, 2003, NIST/SEMATECH e-Handbook of Statistical Methods, accessed April 15, 2008, at http://www.itl.nist.gov/div898/handbook/.

Nimiroski, M.T., DeSimone, L.A., and Waldron, M.C., 2008, Water-quality conditions and constituent loads, 1996–2002, and water-quality trends, 1983–2002, in the Scituate Reservoir drainage area, Rhode Island: U.S. Geological Survey Scientific Investigations Report 2008–5060, 55 p.

Nimiroski, M.T., and Waldron, M.C., 2002, Sources of sodium and chloride in the Scituate Reservoir drainage basin, Rhode Island: U.S. Geological Survey Water-Resources Investigations Report 02–4149, 16 p.

Providence Water Supply Board Water Quality Laboratory, 2003, Quality Assurance Program Manual: Providence Water Supply Board, variously paged.

Ries, K.G., III, and Friesz, P.J., 2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water-Resources Investigations Report 00–4136, 81 p.

Socolow, R.S., Girouard, G.G., and Ramsbey, L.R., 2003, Water resources data for Massachusetts and Rhode Island, 2002: U.S. Geological Survey Water-Data Report MA-RI-02-1, 340 p.

Tasker, G.D., and Driver, N.E., 1988, Nationwide regression models for predicting urban runoff water quality at unmonitored sites: Water Resources Bulletin, v. 24, no. 5, p. 1090–1101.

U.S. Geological Survey, 2006, National Water Information System, accessed November 17, 2008, at http://waterdata.usgs.gov/nwis.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p., 8 attachments, accessed April 10, 2006, at http://pubs.water.usgs.gov/tm1d3.

Table 3. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; ft^3/s, cubic feet per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; --, no data]

PW station no.	USGS station no.	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Ortho-phosphate (g/d as P)
				Barden Reservoir subbasin						
24	01115190	Dolly Cole Brook	10/5/2001	0.13	140	140	6.1	0.6	3.2	6.4
			11/2/2001	0.14	5.1	5.1	7.2	0.7	10	3.4
			12/7/2001	0.27	9.9	9.9	15	0.7	13	13
			1/3/2002	0.37	14	14	20	1.8	9.1	18
			2/1/2002	5.6	210	210	250	20	270	270
			3/1/2002	5.7	210	210	290	20	140	140
			4/5/2002	11	400	400	500	20	270	270
			5/16/2002	13	2,900	2,900	600	--	640	320
			6/7/2002	26	48,000	48,000	1,100	120	640	1,900
			7/5/2002	0.47	260	260	22	3.4	5.7	23
			8/2/2002	0.26	590	590	6.6	1.9	13	3.2
			9/6/2002	0.08	86	18	3.9	0.2	24	4.0
25	01115200	Shippee Brook	10/19/2001	0.03	13	13	0.70	0.1	0.88	11
			1/18/2002	1.3	48	48	37	3.2	95	64
			4/19/2002	3.2	120	120	75	7.8	160	230
			7/19/2002	0.06	35	35	1.0	0.2	15	4.5
26	01115185	Windsor Brook	10/19/2001	0.07	43	43	4.0	0.2	1.9	49
			1/18/2002	1.9	70	70	98	4.6	46	140
			4/19/2002	4.3	160	160	200	10	210	210
			7/19/2002	0.12	700	700	3.6	0.6	12	12
28	01115265	Barden Reservoir	10/9/2001	0.41	90	40	24	3.0	5.0	30
			11/13/2001	0.57	1,300	600	39	2.8	7.0	42
			12/11/2001	1.1	1,200	1,200	67	5.4	27	81
			1/15/2002	8.9	5,000	5,000	340	40	220	650
			2/12/2002	18	10,000	10,000	780	40	440	440
			3/12/2002	18	660	660	740	40	220	1,300
			4/9/2002	16	590	3,500	2,400	18,000	39	200
			5/14/2002	103	110,000	110,000	4,800	1,000	1,300	7,600
			6/11/2002	9.9	--	--	320	70	120	970
			7/9/2002	0.95	2,200	70	46	10	12	70
			8/13/2002	0.21	770	770	11	1.0	26	5.1
			9/10/2002	0.18	100	18	9.8	0.4	8.8	4.4
35	01115187	Ponaganset River	10/5/2001	1.4	310	790	55	30	34	170
			11/2/2001	1.8	400	1,900	73	2.2	0.02	88
			12/7/2001	2.5	92	1,300	110	120	120	120
			1/3/2002	3.8	840	--	210	270	280	190
			2/1/2002	17	1,700	--	620	2,100	2,100	1,200
			3/1/2002	14	510	--	540	10	170	340
			4/5/2002	28	2,700	--	970	1,400	1,400	680
			5/16/2002	47	10,000	--	1,700	1,100	1,100	3,400
			6/7/2002	127	1,400,000	--	3,600	3,100	3,100	9,300
			7/5/2002	3.2	1,800	--	120	310	310	310
			8/2/2002	0.65	18,000	--	29	60	64	7.9
			9/6/2002	1.1	2,500	--	44	20	27	780

Table 3. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water (PW); USGS, U.S. Geological Survey; no., number; ft^3/s, cubic feet per second; $CFU \times 10^6/d$; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; --, no data]

PW station no.	USGS station no.	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Ortho-phosphate (g/d as P)
				Direct Runoff subbasin						
1	01115180	Brandy Brook	10/2/2001	0.42	2,500	240	10	2.1	72	41
			11/6/2001	0.42	41	15	11	0.5	41	31
			12/19/2001	1.2	1,300	1,300	30	5.9	260	210
			1/8/2002	1.1	110	110	29	8.1	220	54
			2/5/2002	2.5	240	240	62	10	550	240
			3/5/2002	4.5	990	990	100	30	110	220
			4/3/2002	4.9	2,800	2,800	87	30	360	720
			5/6/2002	3.3	6,100	6,100	62	20	160	160
			6/4/2002	1.7	--	--	30	10	120	170
			7/30/2002	0.62	3,600	3,600	17	3.0	76	61
			8/6/2002	0.40	230	230	9.1	1.0	20	39
			9/3/2002	0.37	4,200	2,200	9.7	1.8	81	27
3	01115280	Cork Brook	10/4/2001	0.08	43	30	3.9	0.2	22	12
			11/1/2001	0.07	16	7.0	5.0	0.2	3.5	11
			12/6/2001	0.14	--	--	11	0.7	10	21
			2/7/2002	1.5	55	55	110	7.3	700	18
			3/7/2002	3.5	130	130	220	8.6	1,300	86
			4/4/2002	5.1	2,900	2,900	330	10	62	1,000
			5/17/2002	4.3	160	160	230	10	210	320
			6/6/2002	3.1	35,000	35,000	130	10	230	380
			7/29/2002	0.23	130	51	11	0.6	96	73
			8/1/2002	0.14	3,800	3,800	6.8	0.3	65	14
			9/5/2002	0.05	320	130	4.2	0.1	5.4	1.3
4	01115400	Kent Brook	10/2/2001	0.01	88	0.6	0.10	0.04	0.37	0.18
			12/19/2001	0.14	--	--	1.3	0.7	21	3.4
			1/8/2002	0.12	4.4	4.4	1.8	1.2	2.9	2.9
			2/5/2002	0.70	26	26	6.0	3.4	8.6	8.6
			3/5/2002	2.5	240	240	20	6.1	120	31
			4/3/2002	3.1	110	110	30	10	150	530
			5/6/2002	1.3	730	730	13	9.5	16	64
			6/4/2002	0.32	31	31	3.3	0.8	7.8	16
			7/30/2002	0.03	210	210	0.40	0.2	0.88	1.8
			8/6/2002	0.01	7.9	7.9	0.10	0.03	0.17	0.17
			9/3/2002	0.01	70	1.2	0.10	0.03	0.29	0.15
5	01115184	Spruce Brook	10/16/2001	0.08	46	7.9	5.6	10	12	18
			1/31/2002	1.7	62	62	65	540	540	330
			4/16/2002	2.8	100	100	22	60	68	210
			7/16/2002	0.13	73	73	0.90	0.2	1.6	6.4
6	01115183	Quonapaug Brook	10/2/2001	0.22	13,000	5,900	17	1.1	22	27
			11/6/2001	0.22	810	59	17	1.1	2.7	22
			12/19/2001	0.96	--	--	75	9.4	12	70
			3/5/2002	6.7	12,000	12,000	340	40	980	660
			4/3/2002	7.7	4,300	1,700	350	50	380	570
			5/6/2002	5.8	3,300	3,300	57	40	280	430
			6/4/2002	1.7	3,100	1,600	9.6	10	21	330
			7/30/2002	0.39	23,000	23,000	47	4.8	9.5	29
			9/3/2002	0.19	11,000	11,000	18	1.4	60	14

Table 3. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2001, through September 30, 2002.—Continued

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PW station no.	USGS station no.	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Ortho-phosphate (g/d as P)
Direct Runoff subbasin—Continued										
7	01115297	Wilbur Hollow Brook	10/4/2001	0.32	590	590	6.7	3.1	3.9	86
			11/1/2001	0.27	9.9	9.9	7.4	2.6	3.3	33
			12/6/2001	0.52	290	290	13	5.1	25	38
			1/2/2002	0.73	27	27	17	7.1	8.9	54
			2/7/2002	4.4	160	160	83	30	54	54
			3/7/2002	9.8	360	360	230	40	120	720
			4/4/2002	14	510	15,000	2,500	27,000	68	170
			5/17/2002	12	1,200	1,200	160	80	150	590
			6/6/2002	8.8	9,300	9,300	77	80	110	650
			7/29/2002	0.81	4,800	300	15	7.9	9.9	340
			8/1/2002	0.50	780	780	9.4	0.6	6.1	12
			9/5/2002	0.21	120	120	6.1	1.5	5.1	26
8	01115276	Westconnaug Brook	11/9/2001	3.1	110	110	64	7.6	150	76
			12/20/2001	4.6	--	--	95	10	340	340
			2/8/2002	6.8	250	250	140	10	170	83
			3/8/2002	8.5	310	310	200	20	420	210
			4/12/2002	8.2	300	300	320	12,000	20	400
			5/10/2002	8.0	290	290	190	10	390	2,000
			6/14/2002	6.8	--	--	110	10	170	170
			7/12/2002	3.5	340	340	86	4.3	260	260
9	01115275	Bear Tree Brook	10/16/2001	0.36	200	200	60	0.9	180	110
			1/31/2002	1.3	--	--	170	3.2	730	64
			4/16/2002	1.6	59	59	190	3.9	470	120
			7/16/2002	0.44	1,000	1,000	80	1.1	22	43
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	10/18/2001	0.06	--	--	0.01	0.3	3.3	10
			1/30/2002	0.45	830	250	12	2.2	200	33
			4/18/2002	0.55	54	54	16	2.7	110	40
			7/18/2002	0.08	910	910	0.50	0.4	2.0	2.0
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	10/24/2001	<0.01	3.2	0.70	0.10	0.01	0.07	0.37
			1/23/2002	0.12	4.4	4.4	2.6	0.6	44	12
			4/24/2002	0.31	170	23	6.7	0.8	30	15
Moswansicut Reservoir subbasin										
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	10/11/2001	0.28	160	160	18	0.7	14	34
			11/8/2001	0.42	11,000	4,700	28	4.1	41	170
			2/14/2002	5.0	180	5,300	180	9,300	37	370
			3/14/2002	7.2	1,600	260	470	30	1,200	530
			4/11/2002	6.3	230	1,400	290	15,000	31	920
			5/9/2002	5.3	520	520	360	20	780	130
			6/13/2002	3.5	--	--	220	8.6	170	43

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PW station no.	USGS station no.	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU \times 10^6/d$)	*E. coli* ($CFU \times 10^6/d$)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Ortho-phosphate (g/d as P)
Moswansicut Reservoir subbasin—Continued										
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	1/25/2002	0.57	21	21	43	4.2	140	84
			4/26/2002	0.86	480	480	68	4.2	210	42
			7/26/2002	0.11	3,300	1,500	6.0	0.7	2.7	2.7
Regulating Reservoir subbasin										
14	01115110	Huntinghouse Brook	10/1/2001	0.20	1,200	1,200	3.4	0.5	9.8	20
			11/5/2001	0.16	90	5.9	0.02	0.8	2.0	23
			12/3/2001	0.28	290	290	4.8	0.3	14	140
			1/7/2002	1.2	680	680	26	8.8	260	59
			2/4/2002	6.6	650	650	150	10	650	480
			3/4/2002	37	8,200	21,000	820	180	1,800	1,800
			4/1/2002	43	41,000	1,600	960	210	2,100	7,400
			5/6/2002	9.4	3,500	9,000	160	40	690	230
			6/3/2002	3.3	3,500	1,200	61	8.1	160	480
			7/1/2002	0.87	3,200	320	0.40	2.1	11	64
			8/5/2002	0.21	12,000	120	2.8	1.5	10	10
			9/16/2002	0.12	--	7,000	2.5	0.9	15	--
15	01115115	Regulating Reservoir (Rush Brook)	10/1/2001	0.18	1,100	1,100	16	0.4	2.2	18
			11/5/2001	0.14	5.1	5.1	16	0.3	3.4	27
			12/3/2001	0.24	8.8	8.8	22	0.3	5.9	12
			1/7/2002	1.0	560	560	7.6	7.3	150	49
			2/4/2002	5.1	1,100	1,100	400	20	620	370
			3/4/2002	27	15,000	15,000	1,500	130	2,600	660
			4/1/2002	31	33,000	33,000	1,600	220	1,500	12,100
			5/6/2002	7.2	4,100	530	430	30	88	700
			6/3/2002	2.6	2,500	2,500	20	10	64	--
			7/1/2002	0.72	410	410	15	5.3	18	320
16	01115098	Peeptoad Brook (Harrisdale Brook)	10/1/2001	0.69	390	25	41	3.4	17	70
			11/5/2001	0.59	330	330	34	1.4	29	170
			12/3/2001	0.87	490	490	52	1.1	43	14
			1/7/2002	2.4	1,400	1,400	220	10	350	43
			2/4/2002	7.8	290	290	730	30	1,900	59
			3/4/2002	26	48,000	15,000	2,200	120	3,800	380
			4/1/2002	29	170,000	16,000	2,500	70	2,800	3,200
			5/6/2002	10	5,600	980	740	40	120	350
			6/3/2002	4.8	1,100	1,100	68	20	120	490
			7/1/2002	1.9	11,000	330	35	10	46	23
			8/5/2002	0.71	4,200	400	44	1.7	17	8.7
18.0	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	1/25/2002	0.17	6.2	6.2	18	0.4	17	17
			4/26/2002	0.36	2,100	2,100	7.1	2.6	4.4	44
			7/26/2002	0.01	--	0.80	0.20	<0.01	0.59	0.59

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Westconnaug Reservoir subbasin										
10	01115274	Westconnaug Brook	12/11/2001	0.17	96	96	5.9	0.4	4.2	8.3
			1/15/2002	1.7	170	170	71	4.2	250	42
			2/12/2002	3.5	340	340	170	8.6	170	86
			3/12/2002	3.5	3,700	3,700	130	8.6	170	170
			4/9/2002	3.1	300	300	89	7.6	38	760
			5/14/2002	24	880	2,400	1,400	17,000	59	180,000
			6/11/2002	1.9	21,000	11,000	93	9.3	46	93
			7/9/2002	0.15	--	--	6.7	0.2	7.3	--
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	10/23/2001	0.03	1.2	1.2	0.04	0.3	0.78	4.7
			1/22/2002	0.83	30	30	3.0	4.1	61	61
			4/23/2002	1.9	2,000	70	3.1	10	23	93

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