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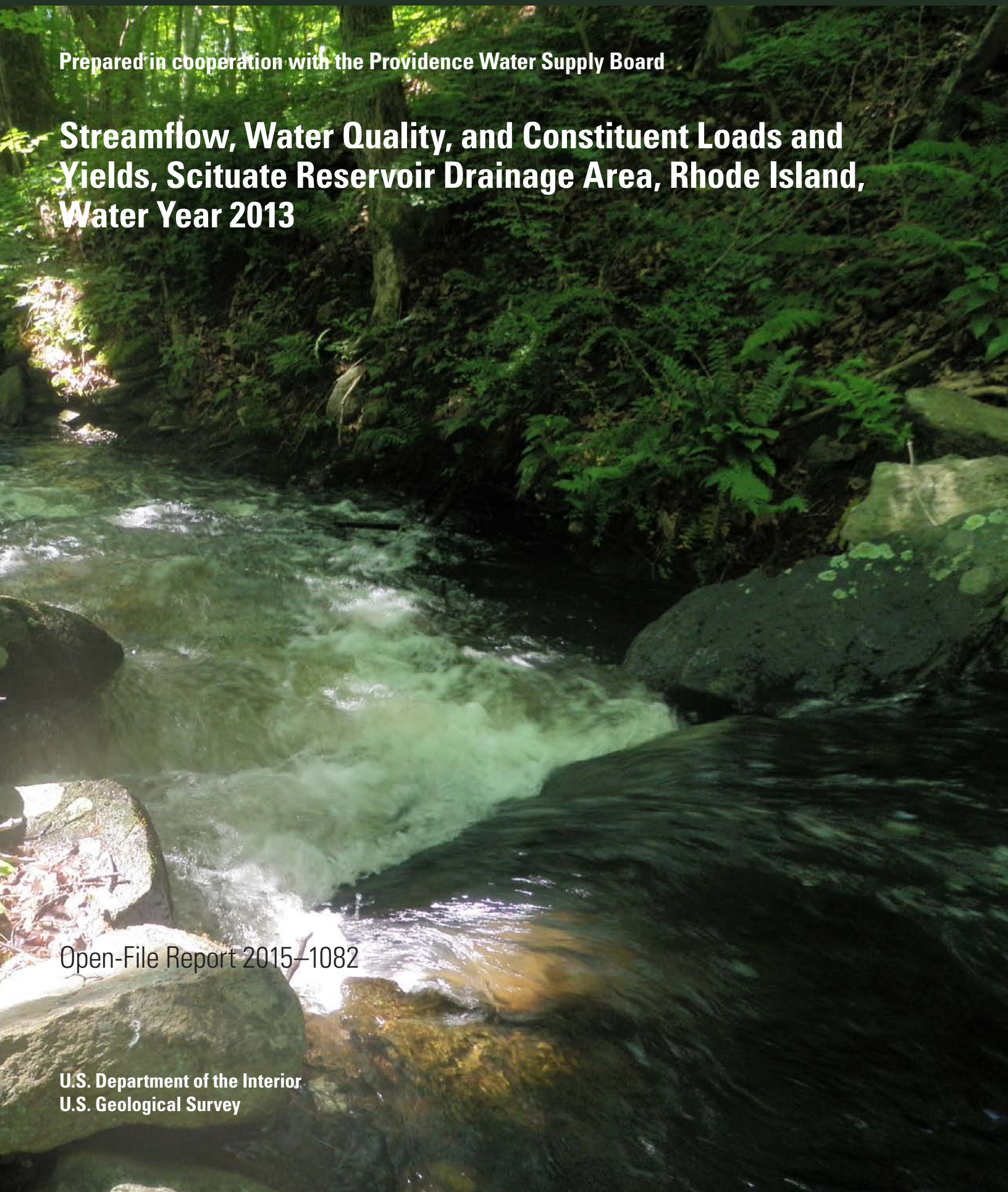

Prepared in cooperation with the Providence Water Supply Board

Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2013

Open-File Report 2015–1082

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

Cover. Moswansicut Stream near North Scituate, Rhode Island. Photograph by Joan Whitley, U.S. Geological Survey.

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By Kirk P. Smith

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U.S. Department of the Interior
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U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
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U.S. Geological Survey, Reston, Virginia: 2015

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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)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83).

Supplemental Information

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

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

Abbreviations

CFU	colony-forming units
E. coli	*Escherichia coli*
MOVE.1	Maintenance of Variance Extension type 1
NWIS	National Water Information System
NTU	nephelometric turbidity units
PCU	platinum cobalt units
PWSB	Providence Water Supply Board
RIDEM	Rhode Island Department of Environmental Management
USGS	U.S. Geological Survey
WY	water year

Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2013

By Kirk P. Smith

Abstract

Streamflow and concentrations of sodium and chloride estimated from records of specific conductance were used to calculate loads of sodium and chloride during water year (WY) 2013 (October 1, 2012, through September 30, 2013) for tributaries to the Scituate Reservoir, Rhode Island. Streamflow and water-quality data used in the study were collected by the U.S. Geological Survey (USGS) or the Providence Water Supply Board (PWSB) in the cooperative study. Streamflow was measured or estimated by the USGS following standard methods at 23 streamgages; 14 of these streamgages are equipped with instrumentation capable of continuously monitoring water level, specific conductance, and water temperature. Water-quality samples were collected at 37 sampling stations by the PWSB and at 14 continuous-record streamgages by the USGS during WY 2013 as part of a long-term sampling program; all stations are in the Scituate Reservoir drainage area. Water-quality data collected by the PWSB 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 2013.

The largest tributary to the reservoir (the Ponaganset River, which was monitored by the USGS) contributed a mean streamflow of 30 cubic feet per second (ft^3/s) to the reservoir during WY 2013. For the same time period, annual mean[1] streamflows measured (or estimated) for the other monitoring stations in this study ranged from about 0.45 to about 19 ft^3/s. Together, tributaries (equipped with instrumentation capable of continuously monitoring specific conductance) transported about 1,300,000 kilograms (kg) of sodium and 2,100,000 kg of chloride to the Scituate Reservoir during WY 2013; sodium and chloride yields for the tributaries ranged from 8,600 to 58,000 kilograms per square mile (kg/mi^2) and from 14,000 to 97,000 kg/mi^2, respectively.

At the stations where water-quality samples were collected by the PWSB, the median of the median chloride concentrations was 18 milligrams per liter (mg/L), median nitrite concentration was 0.002 mg/L as nitrogen (N), median nitrate concentration was less than 0.01 mg/L as N, median orthophosphate concentration was 0.128 mg/L as phosphate, and median concentrations of total coliform bacteria and *Escherichia coli (E. coli)* were 330 and 15 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 100 kilograms per day (kg/d; 50 kilograms per day per square mile [$kg/d/mi^2$]), 10 grams per day (g/d; 5.1 grams per day per square mile [$g/d/mi^2$]), 73 g/d (28 $g/d/mi^2$), 720 g/d (320 $g/d/mi^2$), 21,000 colony-forming units per day ($CFU\times10^6/d$; 8,700 $CFU\times10^6/d/mi^2$), and 1,000 $CFU\times10^6/d$ (510 $CFU\times10^6/d/mi^2$), respectively.

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 square miles (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 tributaries is important for management of the water supply and for the protection of human health. The Providence Water Supply Board (PWSB), 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 60 years.

Since 1993, the U.S. Geological Survey (USGS) has been cooperating with the PWSB and the Rhode Island Department of Environmental Management (RIDEM) to measure streamflow in tributaries to the Scituate Reservoir. Since 2009, streamflow has been continuously measured at 14 streamgages in the drainage area and periodically measured at 9 additional streamgages on tributaries in the drainage area. At the nine partial-record streamgages, daily mean streamflow has been estimated by using methods developed by the USGS (Hirsch, 1982). The USGS also has been continuously

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

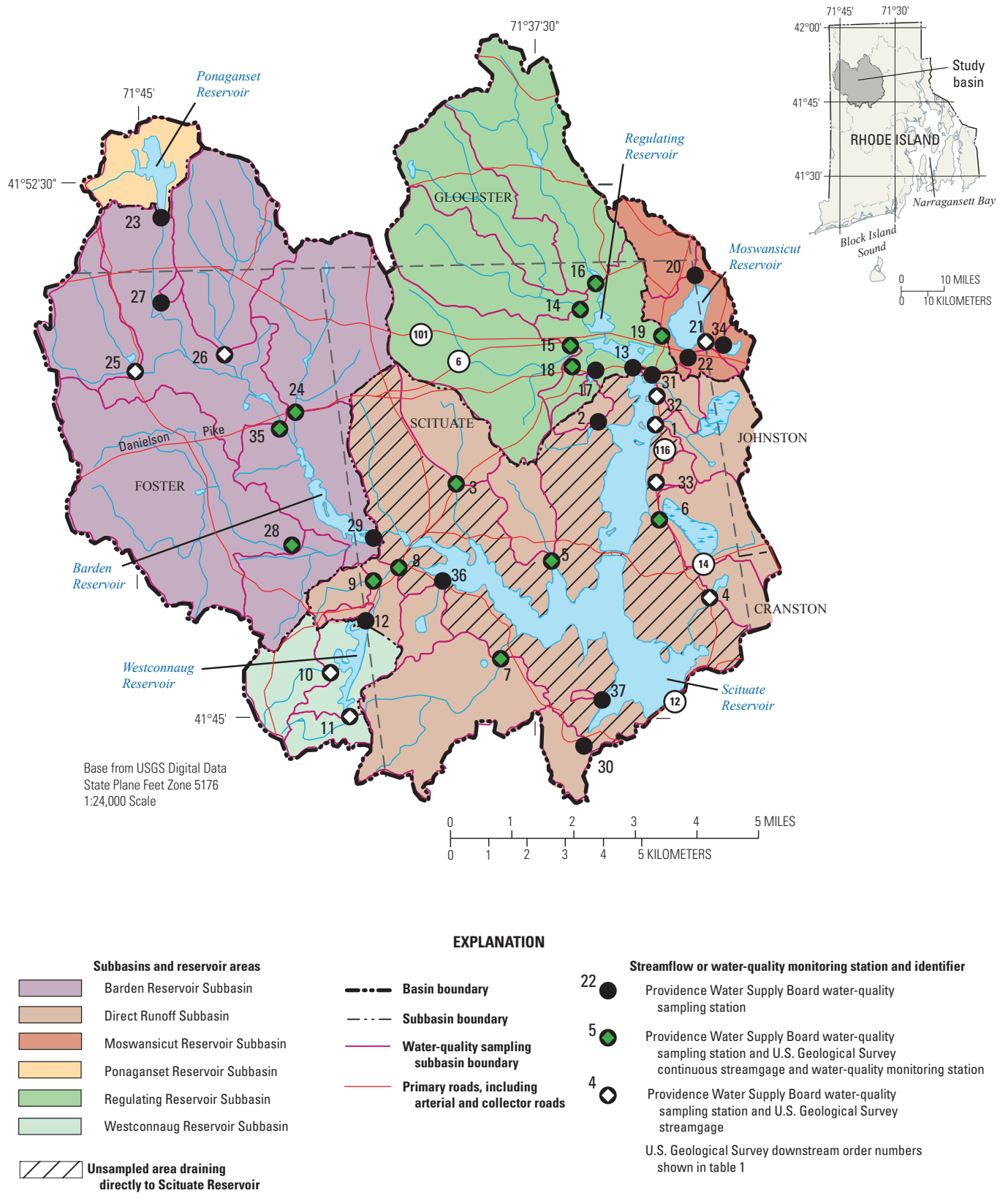

Figure 1. Locations of tributary-reservoir subbasins stations in the Scituate Reservoir drainage area, Rhode Island, 2013.

measuring specific conductance at 14 monitoring stations since 2009. Equations that relate specific conductance to concentrations of sodium and chloride in streamwater were developed as part of a previous USGS/PWSB 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.

Currently (2013), the PWSB regularly collects water-quality samples from 37 tributaries, either monthly or quarterly. Water-quality results are summarized by station number and constituent or parameter in annual reports published by the PWSB. In addition, the USGS has published reports that have compiled and tabulated streamflow (measured or estimated by the USGS) and water-quality data (collected by the PWSB; Breault and others, 2000; Nimiroski and others, 2008; Breault, 2010; Breault and Campbell, 2010a–d; Breault and Smith, 2010; Smith and Breault, 2011; Smith, 2013, 2014).

This report presents data on streamflow, water quality, and loads and yields of selected constituents for water year (WY) 2013[2] in the Scituate Reservoir drainage area. These data were collected as parts of studies done by the USGS in cooperation with the PWSB and the RIDEM. A summary of measured and estimated streamflows is presented for the 14 continuous-record and 9 partial-record streamgages in the drainage area. Estimated monthly and annual loads (and yields) of sodium and chloride are presented for the 14 streamgages at which specific conductance is continuously monitored by the USGS. Summary statistics for water-quality data collected by the PWSB for 37 sampling stations (table 1) during WY 2013 also are presented, and these data were used to calculate loads and yields of selected water-quality constituents.

Streamflow Data Collection and Estimation

Streamflow and water-quality data were collected by the USGS or the PWSB (table 1). Streamflow was measured or estimated by the USGS at 23 streamgages. Measured and estimated streamflows are necessary to estimate water volume and water-quality constituent loads and yields from tributary basins. Stream stage is measured every 10 minutes at most continuous-record streamgages. Streamflow is computed with a stage-discharge relation (known as a rating), which is developed on the basis of periodic manual measurements of streamflow. Daily mean streamflow at a streamgage is calculated by dividing the total volume of water that passes the streamgage each day by 86,400, the number of seconds in a day. Periodic manual streamflow measurements at partial-record streamgages are used concurrently with continuous-record measurements from streamgages in hydrologically similar drainage areas to estimate a continuous record at the partial-record streamgage. Specifically, continuous streamflow records for the nine 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 Information System (NWIS; http://waterdata.usgs.gov/nwis/). The upper and lower 90-percent confidence limits for the estimated mean annual streamflows, as described by Tasker and Driver (1988), are presented in table 2. These data indicate that there is a 90-percent chance that the estimated mean annual streamflow is somewhere between the upper and lower 90-percent confidence limits.

Continuous-record streamgages were operated and maintained by the USGS during WY 2013 in cooperation with RIDEM (USGS streamgage 01115098) and the PWSB (fig. 1; table 1). Streamflow data for these streamgages were collected at 10- or 15-minute intervals (near-real-time streamflow data), were updated at 1-hour intervals on the World Wide Web (WWW), and are available through the NWIS Web Interface (NWIS Web; U.S. Geological Survey, 2007). Error associated with measured streamflows was generally within about 15 percent (U.S. Geological Survey, unpublished data).

Water-Quality Data Collection and Analysis

Water-quality data were collected by the USGS or the PWSB. Concentrations of sodium and chloride were estimated by the USGS from continuous or partial records of specific conductance from 14 of the 23 streamgages. Water-quality samples were collected monthly or quarterly at 37 sampling stations in the Scituate Reservoir drainage area by the PWSB during WY 2013 as part of a long-term sampling program (appendix 1). Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate were calculated for 23 streamgages where streamflow data were collected by the USGS and water-quality samples were collected by the PWSB. 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 data. Specific conductance was measured by the USGS at 10- or 15-minute intervals at the 14 continuous-record streamgages (fig. 1). Measurements were made by using an instream probe and standard USGS methods for continuous streamwater-quality monitoring (Wagner and others, 2006).

[2]Water year 2013 is the period from October 1, 2012, through September 30, 2013.

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous-monitoring streamgages by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; mi², square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by PWSB]

PWSB station number	USGS station number	Station name	Drainage area (mi²)	Frequency of QW sample collection	Number of samples collected by PWSB[1]	Daily estimated Na and Cl loads	Streamflow availability	Specific conductance availability
		Barden Reservoir subbasin						
24	01115190	Dolly Cole Brook	4.90	M	11	Y	Continuous	Continuous
25	01115200	Shippee Brook	2.35	Q	2	N	Estimated	None
26	01115185	Windsor Brook	4.32	Q	3	N	Estimated	None
27	011151845	Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook)	0.10	Q	1	N	None	None
28	01115265	Barden Reservoir (Hemlock Brook)	8.72	M	12	Y	Continuous	Continuous
29	01115271	Ponaganset River (Barden Stream)	33.0	M	12	N	None	None
35	01115187	Ponaganset River	14.0	M	10	Y	Continuous	Continuous
		Direct Runoff subbasin						
1	01115180	Brandy Brook	1.57	M	12	N	Estimated	None
2	01115181	Unnamed Tributary 2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)	0.15	Q	1	N	None	None
3	01115280	Cork Brook	1.79	M	12	Y	Continuous	Continuous
4	01115400	Kent Brook (Betty Pond Stream)	0.85	M	6	N	Estimated	None
5	01115184	Spruce Brook	1.22	Q	4	Y	Continuous	Continuous
6	01115183	Quonapaug Brook	1.96	M	11	Y	Continuous	Continuous
7	01115297	Wilbur Hollow Brook	4.32	M	10	Y	Continuous	Continuous
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	5.18	M	12	Y	Continuous	Continuous
9	01115275	Bear Tree Brook	0.62	Q	3	Y	Continuous	Continuous
30	01115350	Unnamed Tributary 4 to Scituate Reservoir (Coventry Brook, Knight Brook)	0.78	Q	3	N	None	None
31	01115177	Toad Pond	0.04	Q	0	N	None	None
32	01115178	Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)	0.45	Q	3	N	Estimated	None
33	01115182	Unnamed Tributary 3 to Scituate Reservoir (Hall's Estate Brook)	0.28	Q	3	N	Estimated	None
36	--	Outflow from King Pond	0.77	Q	2	N	None	None
37	--	Fire Tower Stream	0.15	Q	2	N	None	None

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous-monitoring streamgages by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; mi², square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by PWSB]

PWSB station number	USGS station number	Station name	Drainage area (mi²)	Frequency of QW sample collection	Number of samples collected by PWSB[1]	Daily estimated Na and Cl loads	Streamflow availability	Specific conductance availability
		Moswansicut Reservoir subbasin						
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	3.25	M	12	Y	Continuous	Continuous
20	01115160	Unnamed Tributary 1 to Moswansicut Reservoir (Blanchard Brook)	1.18	M	9	N	None	None
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	0.29	Q	3	N	Estimated	None
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	0.22	M	11	N	None	None
34	01115164	Kimball Stream	0.27	Q	3	N	None	None
		Ponaganset Reservoir subbasin						
23	011151843	Ponaganset Reservoir	1.92	M	11	N	None	None
		Regulating Reservoir subbasin						
13	01115176	Regulating Reservoir	22.1	M	12	N	None	None
14	01115110	Huntinghouse Brook	6.23	M	8	Y	Continuous	Continuous
15	01115114	Rush Brook	4.70	M	11	Y	Continuous	Continuous
16	01115098	Peeptoad Brook (Harrisdale Brook)	4.96	M	12	Y	Continuous	Continuous
17	01115119	Dexter Pond (Paine Pond)	0.22	Q	2	N	None	None
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	0.28	Q	1	Y	Continuous	Continuous
		Westconnaug Reservoir subbasin						
10	01115274	Westconnaug Brook	1.48	M	12	N	None	None
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook south of Westconnaug Reservoir)	0.72	Q	2	N	None	None
12	011152745	Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug Reservoir)	0.16	Q	1	N	None	None

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

Table 2. Measured or estimated annual mean streamflow for tributaries in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; ft^3/s, cubic feet per second; $ft^3/s/mi^2$, cubic feet per second per square mile; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Annual mean streamflow (ft^3/s)	Upper 90-percent confidence interval (ft^3/s)	Lower 90-percent confidence interval (ft^3/s)	Annual mean streamflow ($ft^3/s/mi^2$)
		Barden Reservoir subbasin				
24	01115190	Dolly Cole Brook	9.5	11	8.2	1.9
25	01115200	Shippee Brook	5.6	20	1.6	2.4
26	01115185	Windsor Brook	8.5	34	2.1	2.0
28	01115265	Barden Reservoir (Hemlock Brook)	19	22	16	2.2
35	01115187	Ponaganset River	30	33	26	2.1
		Direct Runoff subbasin				
1	01115180	Brandy Brook	2.3	4.2	1.3	1.5
3	01115280	Cork Brook	3.4	3.9	2.8	1.9
4	01115400	Kent Brook (Betty Pond Stream)	1.9	9.1	0.40	2.2
5	01115184	Spruce Brook	2.5	2.7	2.2	2.0
6	01115183	Quonapaug Brook	3.7	4.1	3.2	1.9
7	01115297	Wilbur Hollow Brook	7.7	8.7	6.6	1.8
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	9.0	9.7	8.2	1.7
9	01115275	Bear Tree Brook	1.5	1.6	1.4	2.4
32	01115178	Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)	0.58	1.2	0.29	1.3
33	01115182	Unnamed Tributary 3 to Scituate Reservoir (Hall's Estate Brook)	0.46	1.3	0.16	1.6
		Moswansicut Reservoir subbasin				
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	5.7	6.2	5.2	1.8
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Blanchard Brook)	0.62	1.4	0.28	2.1
		Regulating Reservoir subbasin				
14	01115110	Huntinghouse Brook	12	14	10	2.0
15	01115115	Rush Brook	8.3	9.6	6.9	1.8
16	01115098	Peeptoad Brook (Harrisdale Brook)	9.9	12	8.2	2.0
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	0.45	0.54	0.36	1.6
		Westconnaug Reservoir subbasin				
10	01115274	Westconnaug Brook	2.2	3.8	1.2	1.5
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	1.2	2.1	0.71	1.7

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 using the MOVE.1 method (also known as the line of organic correlation; Helsel and Hirsch, 2002) on the basis of concurrent measurements of specific conductance along with sodium and chloride concentrations measured in water-quality samples collected by the USGS from tributaries in the Scituate Reservoir drainage area (U.S. Geological Survey, 2001):

$$C_{Cl} = \left(Spc^{m}\right) \times b \quad \text{and} \tag{1}$$

$$C_{Na} = \left(Spc^{m}\right) \times b, \tag{2}$$

where

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

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

Spc is the specific conductance, in microsiemens per centimeter;

m is the slope from the MOVE.1 analysis (table 3); and

b is the intercept from the MOVE.1 analysis (table 3).

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, values of specific conductance were estimated by proportional distribution between recorded values.

Data Collected by the Providence Water Supply Board

Water-quality samples were collected at fixed stations on 37 tributaries by the PWSB. Sampling was done monthly at 19 stations and quarterly at another 18 stations (table 1) during WY 2013. Water-quality samples were not collected during specific weather conditions; instead, 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 tributaries at the sampling stations were dry or frozen. When possible, water-quality samples were collected by dipping the sample bottle into the tributary at the center of flow (Richard Blodgett, PWSB, written commun., 2005). Samples were transported on ice to the PWSB water-quality laboratory

Table 3. Regression equation coefficients used to estimate concentrations of chloride and sodium from values of specific conductance for each U.S. Geological Survey monitoring station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey]

PWSB station number	USGS station number	Chloride			Sodium		
		Slope	Intercept	Standard error of regressions (percent)	Slope	Intercept	Standard error of regressions (percent)
24	01115190	1.100	0.137	5.23	1.052	0.104	7.14
28	01115265	1.100	0.137	5.23	1.052	0.104	7.14
35	01115187	1.100	0.137	5.23	1.052	0.104	7.14
3	01115280	1.100	0.137	5.23	1.052	0.104	7.14
5	01115184	1.190	0.077	8.47	1.081	0.076	10.6
6	01115183	1.156	0.094	5.07	0.953	0.158	7.02
7	01115297	1.190	0.077	8.47	1.081	0.076	10.6
8	01115276	1.100	0.137	5.23	1.052	0.104	7.14
9	01115275	1.100	0.137	5.23	1.052	0.104	7.14
19	01115170	1.100	0.137	5.23	1.052	0.104	7.14
14	01115110	1.190	0.077	8.47	1.081	0.076	10.6
15	01115114	1.100	0.137	5.23	1.052	0.104	7.14
16	01115098	1.156	0.094	5.07	0.953	0.158	7.02
18	01115120	1.100	0.137	5.23	1.052	0.104	7.14

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 Supply Board Quality Assurance Program Manual (Providence Water Supply Board Water Quality Laboratory, 2012).

Water-quality samples were collected by the PWSB during a wide range of flow conditions. The daily mean flow-duration curve for Rush Brook near Elmdale Road near North Scituate (USGS streamgage 01115114) for WY 2013 is shown in figure 2. The curve represents the percentage of time that each flow was equaled or exceeded at this station. The flows at this station on days when water-quality samples were collected are represented by the plotted points superimposed on the curve. Samples were collected at flow durations ranging from the 3d percentile to the 82d percentile; this range indicates that the water-quality samples collected in WY 2013 represented a wide range of flow conditions during that water year.

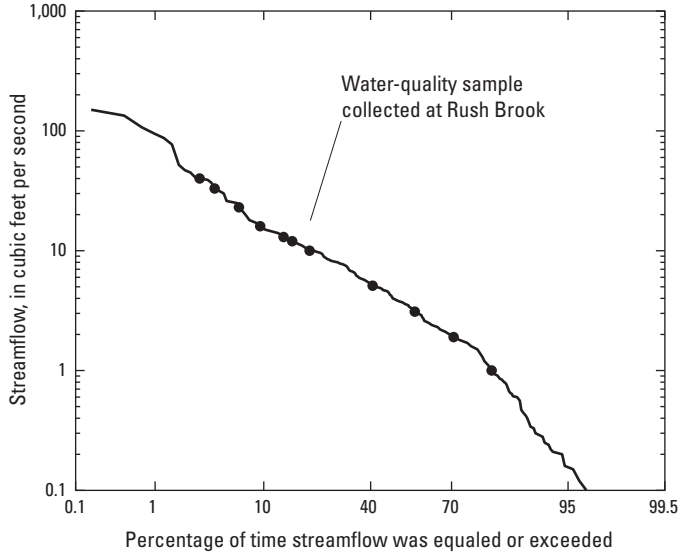

Figure 2. Flow-duration curve and streamflow on the dates (represented by points) when water-quality samples were collected for the U.S. Geological Survey continuous-record streamgage on Rush Brook near Elmdale Road near North Scituate (01115114), Rhode Island, water year 2013.

Estimating Daily, Monthly, and Annual Loads and Yields

Daily, monthly, and annual sodium and chloride loads in kilograms were estimated for all streamgages for which continuous-streamflow and specific-conductance data were available for WY 2013. 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 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). Daily data were summed to estimate monthly or annual loads.

Daily loads of water-quality constituents (in samples collected by the PWSB) were calculated for all sampling dates during WY 2013 (table 4, 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 or colony-forming units (CFU) per liter in single samples by the daily discharge (in liters per day) for the day on which each sample was collected. The flows, which in some cases were estimates, were assumed to be representative of the flow at the time of the sample collection. Loads in grams or kilograms (or millions of CFUs for bacteria) per day and yields in grams or kilograms (or millions of CFUs for bacteria) per day per square mile were calculated for bacteria, chloride, nitrite, nitrate, and orthophosphate from this water-quality data. Censored data (or concentrations reported as less than method detection limits) were replaced with concentrations equal to 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 annual streamflow at the streamgage on the Ponaganset River (PWSB station 35; USGS streamgage 01115187) for the entire period of its operation (mean of the annual mean streamflows for the period of record, WY 1994–2012) prior to WY 2013 was about 29 ft^3/s (http://waterdata.usgs.gov/nwis). During WY 2013, annual mean streamflow was 30 ft^3/s (fig. 3). Mean annual streamflow in Peeptoad Brook (PWSB station 16, streamgage 01115098), the other long-term continuous-record streamgage in the Scituate Reservoir drainage area, for its period of record (WY 1994–2012) prior to WY 2013 was about 11 ft^3/s (http://waterdata.usgs.gov/nwis). Annual mean streamflow in Peeptoad Brook during WY 2013 was 9.9 ft^3/s (table 2).

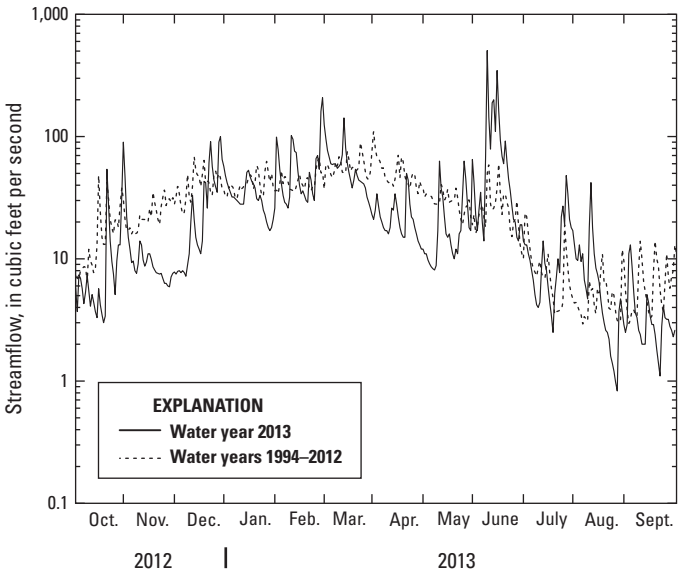

Figure 3. Measured daily mean streamflow for October 1, 2012, through September 30, 2013, and mean daily streamflow for October 1, 1994, through September 30, 2012, for the U.S. Geological Survey continuous-record streamgage on the Ponaganset River at South Foster (01115187) in the Scituate Reservoir drainage area, Rhode Island.

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, 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 tributaries. In the case of loads, tributaries with high flows tend to have high loads because the greater volume of water can carry more of the constituent to the reservoir per unit time. Yields represent the constituent load per unit of drainage area and are calculated by dividing the load estimated for a streamgage by the drainage area to the monitoring station. Yields are useful for comparison among streamgages that have different drainage areas because the effects of basin size and therefore total streamflow volume are attenuated. Yields also 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 dataset 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 in estimates of constituent masses delivered to receiving waters.

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 the most likely values for sodium and chloride coming from tributaries 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. The uncertainties associated with estimating streamflow are commonly assumed to affect load and yield calculations more than the errors 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 tributaries and their drainage basins.

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). Nimiroski and Waldron (2002) previously indicated that tributaries in basins with state-maintained roads had substantially higher concentrations of sodium and chloride than tributaries in basins with low road density, presumably because of deicing activities. In addition, sodium is a constituent of potential concern for human health; some persons on restricted diets might need to limit intake of sodium.

Estimated monthly mean[3] sodium concentrations in tributaries of the Scituate Reservoir drainage area ranged from 3.5 to 42.0 mg/L, and estimated monthly mean chloride concentrations ranged from 5.3 to 72.2 mg/L (table 5). The highest monthly mean concentrations of sodium and chloride were measured in Bear Tree Brook (PWSB station 9) in September 2012 (42.0 and 72.2 mg/L, respectively; table 5). The highest annual mean[4] concentrations of sodium and chloride also were

[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.

Table 5. Monthly mean concentrations of chloride and sodium estimated from continuous measurements of specific conductance in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligrams per liter; monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	October		November		December		January		February		March	
			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	22.1	13.5	22.3	13.7	20.1	12.4	21.1	13.0	21.6	13.2	21.9	13.4
28	01115265	Barden Reservoir (Hemlock Brook)	20.5	12.6	20.0	12.3	16.0	9.94	17.9	11.1	16.1	10.0	17.1	10.6
35	01115187	Ponaganset River	17.2	10.7	18.7	11.5	16.2	10.1	16.6	10.3	17.1	10.6	16.8	10.4
Direct Runoff subbasin														
3	01115280	Cork Brook	29.4	17.8	31.2	18.8	25.8	15.7	27.7	16.8	27.5	16.7	29.4	17.8
5	01115184	Spruce Brook	16.6	9.98	16.1	9.73	14.3	8.73	14.7	8.91	13.6	8.33	13.8	8.42
6	01115183	Quonapaug Brook	35.6	21.0	40.8	23.6	30.5	18.5	31.4	19.0	31.4	18.9	29.0	17.7
7	01115297	Wilbur Hollow Brook	11.3	7.05	11.7	7.25	8.57	5.47	9.11	5.78	7.92	5.09	8.31	5.32
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	20.2	12.4	22.6	13.8	16.2	10.0	16.5	10.2	17.1	10.6	19.5	12.0
9	01115275	Bear Tree Brook	46.2	27.3	54.8	32.2	45	26.7	46.0	27.3	39.1	23.3	38.7	23.1
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	35.7	21.4	35.9	21.5	35.3	21.2	35.1	21.1	35.1	21.1	35.4	21.2
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	13.2	8.09	13.2	8.10	9.28	5.87	9.72	6.14	9.61	6.06	10.9	6.79
15	01115114	Regulating Reservoir (Rush Brook)	28.7	17.3	34.1	20.5	24.4	14.8	30.7	18.5	29.4	17.8	34.1	20.4
16	01115098	Peeptoad Brook (Harrisdale Brook)	31.0	18.8	33.0	19.8	28.6	17.6	27.4	16.9	30.4	18.5	29.2	17.9
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	34.9	21.0	50.8	30.0	35.9	21.5	50.4	29.8	39.1	23.2	34.5	20.7
Scituate Reservoir drainage area														
		Average	25.9	15.6	28.9	17.3	23.3	14.2	25.3	15.3	23.9	14.5	24.2	14.7

Table 5. Monthly mean concentrations of chloride and sodium estimated from continuous measurements of specific conductance in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligrams per liter; monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	April		May		June		July		August		September	
			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	25.6	15.6	24.7	15.1	17.1	10.6	23.8	14.5	20.5	12.6	23.6	14.4
28	01115265	Barden Reservoir (Hemlock Brook)	21.0	12.9	19.1	11.8	11.6	7.31	25.5	15.5	23.2	14.2	30.1	18.2
35	01115187	Ponaganset River	19.6	12.1	19.2	11.8	12.4	7.81	19.8	12.2	18.5	11.4	20.1	12.3
Direct Runoff subbasin														
3	01115280	Cork Brook	31.9	19.2	31.1	18.8	18.3	11.3	28.3	17.2	30.7	18.5	37.8	22.6
5	01115184	Spruce Brook	16.2	9.79	18.0	10.8	11.6	7.16	18.3	10.9	20.2	11.9	23.7	13.8
6	01115183	Quonapaug Brook	35.6	21.0	37.7	22.1	22.8	14.5	38.9	22.6	37.8	22.1	39.1	22.7
7	01115297	Wilbur Hollow Brook	10.6	6.62	10.3	6.47	5.26	3.50	12.9	7.95	19.6	11.6	11.0	6.87
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	20.0	12.3	20.6	12.6	14.6	9.07	22.4	13.7	24.8	15.1	21.9	13.4
9	01115275	Bear Tree Brook	46.5	27.6	50.2	29.7	34.5	20.7	51.4	30.3	62.6	36.6	72.2	42.0
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	37.3	22.3	38.8	23.2	36.2	21.7	40.3	24.0	37.6	22.5	36.8	22.1
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	12.2	7.52	11.7	7.27	7.04	4.57	12.8	7.90	13.4	8.20	14.8	8.97
15	01115114	Regulating Reservoir (Rush Brook)	40.8	24.3	37.6	22.5	19.3	11.8	44.8	26.6	42.2	25.1	51.6	30.5
16	01115098	Peeptoad Brook (Harrisdale Brook)	35.5	21.0	36.4	21.4	24.5	15.5	26.9	16.7	26.5	16.5	33.7	20.1
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	48.2	28.6	55.0	32.4	28.4	17.2	29.2	17.6	22.6	13.8	37.0	22.2
Scituate Reservoir drainage area														
		Average	28.6	17.2	29.3	17.6	18.8	11.6	28.2	17.0	28.6	17.2	32.4	19.3

measured in Bear Tree Brook, 26.8 and 45.1 mg/L, respectively (table 6). These high concentrations are the result of residual sodium and chloride leaching from a formerly uncovered salt storage pile to groundwater (Nimiroski and Waldron, 2002) and relatively small surface-water flows.

During WY 2013, the Scituate Reservoir received about 1,300,000 kg (about 1,400 tons) of sodium and 2,100,000 kg (about 2,300 tons) of chloride from tributaries that are equipped with instrumentation capable of continuously monitoring specific conductance. The highest sodium and chloride loads in the watershed during WY 2013 (260,000 and 430,000 kg, respectively) were measured at the Ponaganset River station (PWSB station 35; table 6). Monthly estimated sodium and chloride loads were highest in the months of February, March, and June (table 7). During these 3 months, the sum of the monthly sodium and chloride loads at each station accounted for 50 percent of the annual load for the monitored area in the Scituate Reservoir drainage area. The highest annual sodium and chloride yields were 58,000 and 97,000 kg/mi^2, respectively, measured at Bear Tree Brook (PWSB station 9; table 6).

Physical and Chemical 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 in each subbasin (table 8). 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 tributaries in the Scituate Reservoir drainage area ranged from 5.4 to 6.9; the median of the medians for all stations was 6.4. Median values of color ranged from 11 to 160 platinum cobalt units (PCU); the median for all stations was 40 PCU. Median values of turbidity ranged from 0.29 to 1.8 nephelometric turbidity units (NTU); the median for all stations was 0.63 NTU. Median alkalinity values in tributaries were low, ranging from 3.1 to 18 mg/L as $CaCO_3$; the median for all stations was 6.9 mg/L as $CaCO_3$ (table 8).

Constituent Concentrations and Daily Loads and Yields

Fecal indicator bacteria, chloride, and nutrients such as nitrogen (N) and phosphorus 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 such as waste disposal, use of septic systems, and road deicing. Sources of nutrients in tributary streamwater include atmospheric deposition, leaching of naturally occurring organic material, discharge of groundwater that is enriched with nutrients from septic-system leachate, and runoff contaminated with fertilizer or animal waste. The ultimate intended use of water in the tributaries is drinking water, which must meet specific water-quality standards. For this reason, the PWSB and the USGS closely monitor concentrations of these constituents in tributaries. Median concentrations, loads, and yields of water-quality constituents are given in tables 8 and 9.

Bacteria

Median concentrations of total coliform bacteria and *E. coli* were above the detection limit (10 CFU/100 mL) at all sites (table 8). Total coliform bacteria concentrations were greater than *E. coli* concentrations (as expected because total coliform is more inclusive); the medians of median concentrations for all sites in the drainage area were 330 CFU/100 mL for total coliform bacteria and 15 CFU/100 mL for *E. coli*. The median concentration of total coliform bacteria was highest at Cork Brook (PWSB station 3; table 8) at more than 2,400 CFU/100 mL. The median concentration of *E. coli* was highest at Unnamed Tributary #2 to Scituate Reservoir (PWSB station 2; table 8) at 160 CFU/100 mL.

Median concentrations of fecal indicator bacteria were lowest at sampling stations Westconnaug Brook (PWSB station 8), Ponaganset Reservoir (PWSB station 23), and Unnamed Tributary to Regulating Reservoir (PWSB station 18). Median concentrations of *E. coli* were lowest at Ponaganset River (PWSB station 29), Moswansicut Reservoir (PWSB station 19), and Regulating Reservoir (PWSB station 13). Median daily loads and yields of total coliform bacteria and *E. coli* varied by more than two orders of magnitude; the highest median daily yield of total coliform bacteria (28,000 CFU×10^6/d/mi^2) was at Unnamed Tributary to Westconnaug Reservoir (PWSB station 11; table 9), and the highest median daily yield of *E. coli* (1,600 CFU×10^6/d/mi^2) was at Barden Reservoir (PWSB station 28; table 9). Although relatively high for sampling stations in the Scituate Reservoir subbasin, median daily bacteria yields at Unnamed Tributary to Westconnaug Reservoir are low to moderate compared to yields of indicator bacteria in sewage-contaminated streamwater or streamwater affected by stormwater runoff in an urban environment (Breault and others, 2002). The median daily loads of total coliform bacteria for all subbasins in the Scituate Reservoir drainage area ranged from 440 to 200,000 CFU×10^6/d, and yields ranged from 1,600 to 28,000 CFU×10^6/d/mi^2; *E. coli* loads ranged from 100 to 14,000 CFU×10^6/d, and yields ranged from 190 to 1,600 CFU×10^6/d/mi^2 (table 9). Median daily loads for total

Table 6. Annual mean chloride and sodium concentrations, loads, and yields by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; mg/L, milligrams per liter; kg/yr, kilograms per year; kg/yr/mi^2, kilograms per year per square mile; Cl, chloride; Na, sodium; annual mean concentrations were calculated by dividing the annual load by the total discharge for the year; annual mean yields were calculated by dividing the sum of individual loads by the sum of the drainage area; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Concentration		Load		Yield	
			Cl (mg/L)	Na (mg/L)	Cl (kg/yr)	Na (kg/yr)	Cl (kg/yr/mi^2)	Na (kg/yr/mi^2)
Barden Reservoir subbasin								
24	01115190	Dolly Cole Brook	20.9	12.8	180,000	110,000	36,000	22,000
28	01115265	Barden Reservoir (Hemlock Brook)	16.4	10.1	280,000	170,000	32,000	20,000
35	01115187	Ponaganset River	16.3	10.1	430,000	260,000	30,000	19,000
Direct Runoff subbasin								
3	01115280	Cork Brook	26.3	16.0	79,000	48,000	44,000	27,000
5	01115184	Spruce Brook	14.7	8.91	32,000	20,000	26,000	16,000
6	01115183	Quonapaug Brook	30.6	18.5	99,000	60,000	51,000	31,000
7	01115297	Wilbur Hollow Brook	8.59	5.46	58,000	37,000	14,000	8,600
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	18.2	11.2	140,000	89,000	28,000	17,000
9	01115275	Bear Tree Brook	45.1	26.8	60,000	36,000	97,000	58,000
Moswansicut Reservoir subbasin								
19	01115170	Moswansicut Reservoir, (Moswansicut Stream North, Moswansicut Pond)	36.2	21.7	180,000	110,000	56,000	34,000
Regulating Reservoir subbasin								
14	01115110	Huntinghouse Brook	9.86	6.20	110,000	68,000	17,000	11,000
15	01115114	Rush Brook	29.1	17.6	210,000	130,000	45,000	27,000
16	01115098	Peeptoad Brook (Harrisdale Brook)	28.7	17.6	250,000	150,000	51,000	31,000
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	36.6	21.9	14,000	8,600	51,000	31,000
Scituate Reservoir drainage area								
			Mean		Total		Mean	
			24.1	14.6	2,100,000	1,300,000	34,000	21,000

coliform bacteria were substantially higher than the values in the previous water year, when the median daily loads of total coliform bacteria ranged from 40 to 65,000 CFU×10^6/d. At many stations, median daily loads of *E. coli* were less than values in the previous water year, when loads of *E. coli* ranged from 50 to 13,000 CFU×10^6/d (Smith, 2013).

Chloride and Sodium

The highest median chloride concentration (65 mg/L) was measured in the Direct Runoff subbasin at Unnamed Tributary #2 to Scituate Reservoir (PWSB station 2; table 8). Median daily chloride loads and yields estimated from samples collected by the PWSB varied among monitoring stations in the drainage area (table 9); the median daily chloride yield for monitored areas within the drainage area was 50 kg/d/mi^2. Ponaganset River (PWSB station 35) had the largest median daily chloride load (780 kg/d). The largest median daily chloride yield (290 kg/d/mi^2) was determined for Bear Tree Brook (PWSB station 9). The mean daily yield of chloride and sodium for the drainage areas above the 14 USGS continuous-record streamgages, which represent nearly 66 percent of the Scituate Reservoir drainage area, was 94 kg/d/mi^2 and 57 kg/d/mi^2, respectively. The mean daily yields of chloride and sodium for WY 2013 were about 14 percent higher than the annual mean yields for WY 2012 (82 and 50 kg/d/mi^2, respectively; Smith, 2013).

Table 7. Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; kg, kilogram; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board; loads estimated from continuous flow and concentration data estimated from specific conductance values collected by the U.S. Geological Survey]

PWSB station number	USGS station number	Station name	October		November		December		January		February		March	
			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	7,800	4,800	6,500	4,000	19,000	12,000	15,000	9,200	34,000	21,000	31,000	19,000
28	01115265	Barden Reservoir (Hemlock Brook)	16,000	10,000	9,600	5,900	23,000	14,000	18,000	11,000	41,000	25,000	43,000	27,000
35	01115187	Ponaganset River	17,000	11,000	13,000	7,800	40,000	25,000	43,000	26,000	68,000	42,000	71,000	44,000
Direct Runoff subbasin														
3	01115280	Cork Brook	4,600	2,800	3,600	2,200	8,200	5,000	5,900	3,500	14,000	8,700	12,000	7,100
5	01115184	Spruce Brook	1,900	1,100	2,000	1,200	2,900	1,800	3,000	1,800	3,500	2,100	4,700	2,900
6	01115183	Quonapaug Brook	4,400	2,600	4,400	2,500	11,000	6,600	9,600	5,800	16,000	9,300	16,000	9,800
7	01115297	Wilbur Hollow Brook	3,400	2,100	3,300	2,100	5,300	3,400	5,500	3,500	7,000	4,500	7,600	4,900
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	7,400	4,500	7,100	4,300	10,000	6,400	12,000	7,600	13,000	8,000	15,000	9,500
9	01115275	Bear Tree Brook	2,800	1,700	4,000	2,300	4,600	2,700	4,800	2,900	5,100	3,000	7,400	4,400
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	7,800	4,700	6,900	4,100	18,000	11,000	15,000	8,800	21,000	13,000	32,000	19,000
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	4,900	3,000	4,900	3,000	11,000	6,700	8,700	5,500	16,000	9,900	21,000	13,000
15	01115114	Regulating Reservoir (Rush Brook)	11,000	6,700	8,800	5,300	22,000	13,000	17,000	11,000	37,000	22,000	36,000	22,000
16	01115098	Peeptoad Brook (Harrisdale Brook)	8,200	5,000	5,600	3,400	27,000	17,000	16,000	9,900	38,000	23,000	42,000	25,000
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	270	160	320	190	1,800	1,100	1,600	930	3,200	1,900	2,700	1,600
Scituate Reservoir drainage area														
		Total	97,000	60,000	80,000	48,000	200,000	130,000	180,000	110,000	320,000	190,000	340,000	210,000

Table 7. Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013. —Continued

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; kg, kilogram; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board; loads estimated from continuous flow and concentration data estimated from specific conductance values collected by the U.S. Geological Survey]

PWSB station number	USGS station number	Station name	April		May		June		July		August		September	
			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	12,000	7,500	10,000	6,100	31,000	19,000	5,000	3,100	2,600	1,600	1,100	670
28	01115265	Barden Reservoir (Hemlock Brook)	22,000	14,000	24,000	15,000	57,000	36,000	13,000	7,800	7,100	4,300	3,200	1,900
35	01115187	Ponaganset River	32,000	19,000	32,000	20,000	77,000	48,000	18,000	11,000	10,000	6,300	5,400	3,300
Direct Runoff subbasin														
3	01115280	Cork Brook	6,500	3,900	6,200	3,700	13,000	8,100	2,300	1,400	1,200	740	700	420
5	01115184	Spruce Brook	3,000	1,800	2,500	1,500	5,100	3,200	2,200	1,300	880	520	630	360
6	01115183	Quonapaug Brook	8,000	4,700	4,300	2,500	16,000	10,000	5,500	3,200	2,600	1,500	1,900	1,100
7	01115297	Wilbur Hollow Brook	5,600	3,500	4,400	2,700	8,800	5,800	3,000	1,900	1,900	1,100	2,500	1,600
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	12,000	7,200	9,300	5,700	31,000	19,000	15,000	9,100	7,000	4,300	5,100	3,100
9	01115275	Bear Tree Brook	6,300	3,700	5,500	3,300	7,400	4,400	6,400	3,800	3,800	2,200	2,400	1,400
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	15,000	8,800	11,000	6,500	35,000	21,000	13,000	7,700	5,900	3,500	2,900	1,800
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	9,600	5,900	7,100	4,400	19,000	12,000	3,800	2,400	1,400	860	730	440
15	01115114	Regulating Reservoir (Rush Brook)	18,000	11,000	16,000	9,600	33,000	20,000	8,500	5,000	3,600	2,100	1,900	1,100
16	01115098	Peeptoad Brook (Harrisdale Brook)	21,000	13,000	14,000	8,200	62,000	39,000	8,400	5,200	3,700	2,300	5,000	3,000
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	1,000	620	420	250	2,900	1,700	180	110	38	23	32	19
Scituate Reservoir drainage area														
		Total	170,000	100,000	150,000	89,000	400,000	250,000	100,000	63,000	52,000	31,000	33,000	20,000

Table 8. Median values for water-quality data collected at Providence Water Supply Board stations by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; 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, nitrogen; PO_4, phosphate; <, less than; >, greater than; --, no data; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Properties			Constituents						
			pH (units)	Color (PCU)	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	Total coliform bacteria (CFU/100mL)	*E. coli* (CFU/100mL)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Ortho-phosphate (mg/L as PO_4)
Barden Reservoir subbasin												
24	01115190	Dolly Cole Brook	6.3	40	0.65	4.1	190	10	22	0.002	0.01	0.060
25	01115200	Shippee Brook	6.4	51	0.40	5.3	260	55	18	0.002	0.01	0.370
26	01115185	Windsor Brook	6.4	28	0.39	3.9	390	10	16	0.001	0.01	0.230
27	011151845	Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook)	5.4	35	0.37	4.0	740	10	0.70	0.001	<0.01	0.140
28	01115265	Barden Reservoir (Hemlock Brook)	6.1	110	0.55	4.2	330	20	20	0.004	<0.01	0.130
29	01115271	Ponaganset River (Barden Stream)	6.4	53	0.62	4.4	90	5.0	17	0.002	<0.01	0.085
35	01115187	Ponaganset River	6.3	53	0.68	5.0	330	10	18	0.002	0.008	0.060
Direct Runoff subbasin												
1	01115180	Brandy Brook	6.9	70	1.8	13	420	15	12	0.003	0.01	0.165
2	01115181	Unnamed Tributary #2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)	6.5	11	0.37	4.8	490	160	65	0.001	0.02	0.130
3	01115280	Cork Brook	6.6	29	0.31	6	>2,400	15	33	0.002	0.02	0.125
4	01115400	Kent Brook (Betty Pond Stream)	6.4	17	0.54	7.7	90	7.5	4.9	0.001	0.008	0.060
5	01115184	Spruce Brook	6.3	73	0.56	5.3	400	20	16	0.002	0.02	0.120
6	01115183	Quonapaug Brook	6.4	120	1.7	12	350	20	34	0.003	0.02	0.140
7	01115297	Wilbur Hollow Brook	6.4	59	0.73	6.7	460	20	9.0	0.004	<0.01	0.100
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	6.3	19	0.46	3.7	75	7.5	9.1	0.001	<0.01	0.075
9	01115275	Bear Tree Brook	6.6	38	0.41	8.7	380	20	56	0.002	0.07	0.130
30	01115350	Unnamed Tributary #4 to Scituate Reservoir (Coventry Brook, Knight Brook)	6.3	48	0.46	4.7	150	20	16	0.002	0.02	0.130
31	1115177	Toad Pond	--	--	--	--	--	--	--	--	--	--
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	6.6	47	0.71	7.5	360	10	13	0.002	0.04	0.180
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	6.5	45	0.44	11	820	60	12	0.001	0.03	0.100
36	--	Outflow from King Pond	6.6	27	0.36	5.6	260	7.5	3.7	0.001	0.008	0.075
37	--	Fire Tower Stream	6.0	23	0.32	4.1	280	15	5.6	0.001	0.03	0.200

Table 8. Median values for water-quality data collected at Providence Water Supply Board stations by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; 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, nitrogen; PO_4, phosphate; <, less than; >, greater than; --, no data; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Properties			Constituents						
			pH (units)	Color (PCU)	Turbidity (NTU)	Alkalinity (mg/L as $CaCO_3$)	Total coliform bacteria (CFU/100mL)	*E. coli* (CFU/100mL)	Chloride (mg/L)	Nitrite (mg/L as N)	Nitrate (mg/L as N)	Ortho-phosphate (mg/L as PO_4)
Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	6.9	19	1.1	9.4	110	5.0	35	0.003	0.015	0.070
20	01115160	Unnamed Tributary #1 to Moswansicut Reservoir (Blanchard Brook)	6.3	120	0.74	7.1	270	20	49	0.003	<0.01	0.240
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	6.8	40	0.84	16	310	10	30	0.003	0.02	0.160
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	6.8	35	1.8	18	550	100	34	0.012	0.14	0.140
34	01115164	Kimball Stream	6.6	38	0.98	11	620	20	38	0.003	0.03	0.250
Ponaganset Reservoir subbasin												
23	011151843	Ponaganset Reservoir	6.3	12	0.41	3.2	40	10	13	0.001	0.01	0.050
Regulating Reservoir subbasin												
13	01115176	Regulating Reservoir	6.8	28	0.87	8.8	130	5.0	29	0.002	0.01	0.070
14	01115110	Huntinghouse Brook	6.6	25	0.62	8.9	340	40	12	0.002	0.01	0.150
15	01115114	Rush Brook	6.8	60	0.9	8.6	260	30	36	0.002	0.01	0.130
16	01115098	Peeptoad Brook (Harrisdale Brook)	6.6	33	0.88	12	320	10	34	0.002	0.01	0.105
17	01115119	Dexter Pond (Paine Pond)	6.3	44	0.72	9.5	110	10	34	0.002	<0.01	0.055
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	6.8	49	0.63	11	60	20	48	0.002	<0.01	0.150
Westconnaug Reservoir subbasin												
10	01115274	Westconnaug Brook	5.8	30	0.29	3.1	440	10	19	0.002	0.01	0.110
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	5.6	130	1.0	5.0	1,300	15	0.65	0.006	0.015	0.080
12	011152745	Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug Reservoir)	6.0	160	1.0	7.7	570	140	22	0.004	0.04	0.090
Scituate Reservoir drainage area												
		Minimum	5.4	11	0.29	3.1	40	5.0	0.65	0.001	<0.01	0.050
		Median	6.4	40	0.63	6.9	330	15	18	0.002	0.01	0.128
		Maximum	6.9	160	1.8	18	>2,400	160	65	0.012	0.14	0.370

Table 9. 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, 2012, through September 30, 2013.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; CFU×10^6/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; N, nitrogen; PO_4, phosphate; 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; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Total coliform bacteria		*E. coli*		Chloride		Nitrite (as N)		Nitrate (as N)		Orthophosphate (as PO_4)	
			(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	49,000	10,000	2,200	450	260	53	22	4.5	160	33	870	180
25	01115200	Shippee Brook	11,000	4,800	3,000	1,300	59	25	5.1	2.1	61	26	2,000	860
26	01115185	Windsor Brook	26,000	6,000	860	200	180	42	8.6	2.0	170	39	2,000	460
28	01115265	Barden Reservoir	91,000	10,000	14,000	1,600	540	61	130	15.0	220	25	3,300	370
35	01115187	Ponaganset River	200,000	14,000	7,400	530	780	55	49	3.5	460	33	2,500	180
Direct Runoff subbasin														
1	01115180	Brandy Brook	18,000	11,000	1,100	680	35	22	7.4	4.7	36	23	460	290
3	01115280	Cork Brook	19,000	10,000	630	350	90	50	5.9	3.3	55	31	490	270
4	01115400	Kent Brook	2,900	3,400	160	190	12	14	3.2	3.8	14	16	150	170
5	01115184	Spruce Brook	30,000	25,000	960	780	90	74	7.1	5.8	71	58	700	570
6	01115183	Quonapaug Brook	15,000	7,700	2,100	1,100	120	61	10	5.1	73	37	720	370
7	01115297	Wilbur Hollow Brook	49,000	11,000	2,300	530	100	23	30	6.9	81	19	1,400	320
8	01115276	Westconnaug Brook	29,000	5,500	1,500	280	180	35	20	3.8	120	23	1,600	310
9	01115275	Bear Tree Brook	8,700	14,000	190	310	180	290	8.3	13.0	290	470	320	520
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	2,200	4,900	100	220	13	29	2.3	5.1	23.0	51	290	640
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Hall's Estate Brook)	2,200	7,900	130	460	3.0	11	0.32	1.1	3.2	11	25	89
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	31,000	9,400	1,700	510	390	120	38	12	190	57	780	240
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	4,800	17,000	180	620	47	160	4.7	16	16	55	250	860

Table 9. 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, 2012, through September 30, 2013.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; CFU×10^6/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; N, nitrogen; PO_4, phosphate; 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; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	Station name	Total coliform bacteria		*E. coli*		Chloride		Nitrite (as N)		Nitrate (as N)		Orthophosphate (as PO_4)	
			(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)
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	54,000	8,700	6,700	1,100	280	44	23	3.7	180	28	2,200	350
15	01115114	Regulating Reservoir (Rush Brook)	36,000	7,700	2,500	530	390	83	25	5.3	120	26	1,000	210
16	01115098	Peeptoad Brook (Harrisdale Brook)	23,000	4,600	1,000	210	390	79	16	3.2	110	23	980	200
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	440	1,600	150	540	35	130	1.5	5.4	3.7	13	110	390
Westconnaug Reservoir subbasin														
10	01115274	Westconnaug Brook	12,000	8,100	680	460	68	46	11	7.1	40	27	490	330
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	21,000	28,000	260	360	1.0	1.4	17	24	22	31	140	190
Scituate Reservoir drainage area														
		Minimum	440	1,600	100	190	1.0	1.4	0.32	1.1	3.2	11	25	89
		Median	21,000	8,700	1,000	510	100	50	10	5.1	73	28	720	320
		Maximum	200,000	28,000	14,000	1,600	780	290	130	24	460	470	3,300	860

Nutrients

Median concentrations of nitrite and nitrate (table 8) were 0.002 and 0.01 mg/L as N, respectively. The highest median concentrations of nitrite (0.012 mg/L) and nitrate (0.14 mg/L) were measured in samples collected at Moswansicut Reservoir (PWSB station 22). The median concentration of orthophosphate for the entire study area (table 8) was 0.128 mg/L as phosphate (PO_4). The maximum median concentration of orthophosphate (0.370 mg/L as PO_4) was measured in Shippee Brook (PWSB station 25). Median daily nutrient loads from the Barden Reservoir (PWSB station 28) into the Scituate Reservoir of nitrite (130 g/d), nitrate (220 g/d), and orthophosphate (3,300 g/d) were among the largest for all the sampled stations. However, median daily nitrate loads for WY 2013 were larger at Ponaganset River (PWSB station 35; 460 g/d) and Bear Tree Brook (PWSB station 9; 290 g/d). The largest median daily yield for nitrite (24 g/d/mi^2) was determined for Unnamed Tributary to Westconnaug Reservoir (PWSB station 11). The largest median daily yield for nitrate (470 g/d/mi^2) was determined for Bear Tree Brook (PWSB station 9), and the largest median daily yields for orthophosphate (860 g/d/mi^2) were determined for Shippee Brook (PWSB station 25) and Unnamed Tributary #2 to Moswansicut Reservoir (PWSB station 21; table 9). The median daily yield for orthophosphate for Unnamed Tributary #1 to Scituate Reservoir (PWSB station 32; 640 g/d/mi^2) was high compared with values for other stations in the monitoring network.

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Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; 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; N, nitrogen; PO_4, phosphate; <, less than; --, data not available; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
			Barden Reservoir subbasin							
24	01115190	Dolly Cole Brook	10/05/12	0.68	22,000	2,000	40	3.3	180	<8.3
			11/02/12	6.7	87,000	1,600	260	33	160	3,800
			12/07/12	2.1	8,200	510	130	10	<26	360
			01/04/13	8.8	41,000	2,200	450	22	<110	1,900
			02/01/13	28	89,000	<3,400	1,500	140	680	2,100
			03/15/13	20	24,000	4,900	1,100	49	490	10,000
			04/05/13	7.1	5,200	<870	460	17	170	870
			05/03/13	2.9	49,000	15,000	200	14	<35	140
			06/18/13	14	790,000	6,800	520	68	<170	680
			07/30/13	3.9	270,000	9,500	180	29	<48	1,300
			08/15/13	1.1	78,000	<130	52	8.1	27	160
25	01115200	Shippee Brook	10/19/12	0.91	4,400	220	52	4.4	<11	130
			04/19/13	2.3	18,000	5,700	66	5.7	110	3,900
26	01115185	Windsor Brook	10/19/12	1.3	26,000	650	34	6.5	<16	2,000
			01/18/13	8.7	13,000	<1,100	330	21	210	2,500
			04/19/13	3.5	33,000	860	180	8.6	170	2,000
28	01115265	Barden Reservoir (Hemlock Brook)	10/30/12	44	9,800,000	2,300,000	250	540	2,200	17,000
			11/13/12	5.9	43,000	20,000	310	43	140	4,900
			12/11/12	19	240,000	98,000	980	140	<230	7,000
			01/08/13	9.1	38,000	<1,100	440	22	220	3,300
			02/26/13	44	32,000	<5,400	1,700	220	<540	9,700
			03/12/13	37	81,000	18,000	1,800	180	<450	17,000
			04/09/13	8.9	33,000	2,200	540	44	220	1,500
			05/14/13	12	100,000	18,000	590	120	<150	3,200
			06/21/13	22	350,000	5,400	900	270	1,600	1,100
			07/23/13	12	51,000,000	9,700,000	530	260	<150	2,600
			08/13/13	6.1	190,000	10,000	320	75	<75	2,200
			09/10/13	1.1	19,000	540	78	57	<13	190

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

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PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
			Barden Reservoir subbasin—Continued							
35	01115187	Ponaganset River	10/05/12	5.7	270,000	15,000	220	28	700	<70
			11/02/12	15	220,000	7,300	870	37	370	4,800
			12/07/12	7.2	55,000	1,800	310	18	<88	1,800
			02/01/13	78	650,000	130,000	3,300	380	1,900	7,600
			03/15/13	61	15,000	<7,500	2,400	150	<750	15,000
			04/05/13	20	24,000	<2,400	900	49	490	2,000
			05/03/13	9.8	170,000	<1,200	470	48	<120	960
			06/18/13	60	970,000	15,000	1,900	290	<730	2,900
			07/30/13	17	120,000	33,000	680	120	420	5,800
			08/15/13	6.4	640,000	3,100	330	47	<78	1,300
			Direct Runoff subbasin							
1	01115180	Brandy Brook	10/02/12	0.85	23,000	4,200	26	6.3	21	290
			11/15/12	1.5	20,000	3,800	150	15	38	750
			12/04/12	1.0	7,400	250	33	7.4	<12	520
			01/29/13	1.7	25,000	840	49	17	<21	380
			02/05/13	2.2	3,700	2,100	3.2	11	53	53
			03/26/13	3.2	10,000	1,600	84	23	230	620
			04/02/13	3.0	16,000	<370	88	7.3	73	1,900
			05/07/13	0.73	1,100	<90	21	5.4	72	400
			06/04/13	1.3	160,000	1,300	36	16	33	1,000
			07/02/13	2.8	410,000	14,000	68	7.0	140	980
			08/06/13	0.64	28,000	<79	17	4.7	16	300
			09/17/13	0.49	7,500	<60	14	2.4	12	110

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; 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; N, nitrogen; PO_4, phosphate; <, less than; --, data not available; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
			Direct Runoff subbasin—Continued							
3	01115280	Cork Brook	10/04/12	0.87	16,000	640	79	2.1	<11	64
			11/01/12	2.9	25,000	1,400	45	21	<35	990
			12/06/12	1.1	1,100	540	88	2.7	54	380
			01/03/13	2.3	21,000	560	160	5.6	56	730
			02/07/13	1.6	<200	<200	110	3.9	78	700
			03/21/13	5.1	2,500	<620	430	12	370	1,500
			04/04/13	2.5	7,900	1,800	200	6.1	150	610
			05/02/13	1.7	33,000	5,800	130	8.3	120	250
			06/06/13	1.1	21,000	2,200	90	8.1	54	240
			07/29/13	1.1	30,000	270	89	11	81	590
			08/16/13	0.27	5,000	<33	5.5	1.3	6.6	99
			09/05/13	0.31	28,000	2,300	26	1.5	30	83
4	01115400	Kent Brook	12/04/12	0.23	440	56	3.7	0.56	<2.8	140
			01/29/13	0.90	2,200	<110	12	2.2	<11	150
			02/05/13	1.4	2,000	1,400	8.5	6.8	<17	34
			03/26/13	2.0	3,500	490	23	15	300	250
			04/02/13	1.7	5,900	<210	22	4.2	42	550
			07/02/13	0.46	39,000	<57	--	1.1	11	45
5	01115184	Spruce Brook	10/31/12	3.2	53,000	6,300	120	--	--	--
			01/15/13	2.9	7,800	710	85	7.1	71	990
			04/16/13	2.4	4,100	1,200	95	12	230	700
			07/16/13	1.1	75,000	540	49	5.4	54	240

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; 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; N, nitrogen; PO_4, phosphate; <, less than; --, data not available; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parentheses for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
Direct Runoff subbasin—Continued										
6	01115183	Quonapaug Brook	10/02/12	0.80	43,000	12,000	78	7.8	20	310
			11/15/12	1.8	15,000	1,800	61	18	44	2,100
			12/04/12	1.0	8,600	490	100	7.3	73	200
			01/29/13	2.1	18,000	2,100	170	10	360	720
			02/05/13	2.9	17,000	2,800	240	14	71	71
			03/26/13	4.9	13,000	2,400	410	24	120	720
			04/02/13	4.5	6,600	2,200	400	11	220	770
			05/07/13	0.65	840	320	68	7.9	<7.9	560
			06/04/13	1.5	17,000	2,600	120	44	73	1,100
			07/02/13	4.2	500,000	<510	320	10	210	1,100
			09/17/13	0.37	4,900	91	26	8.1	18	680
7	01115297	Wilbur Hollow Brook	10/04/12	2.1	68,000	6,200	46	21	51	210
			11/01/12	7.0	94,000	12,000	34	68	170	8,000
			12/06/12	2.6	23,000	2,500	62	13	<32	570
			02/07/13	6.1	6,000	1,500	140	30	150	2,700
			03/21/13	13	13,000	<1,600	260	32	<160	4,500
			04/04/13	6.6	13,000	1,600	140	190	81	1,800
			05/02/13	4.9	110,000	9,600	120	24	240	360
			06/06/13	3.1	49,000	2,300	56	30	<38	1,400
			08/16/13	0.74	78,000	<91	18	5.4	<9.1	91
			09/05/13	6.6	1,300,000	32,000	100	81	<81	1,100

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

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PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
			Direct Runoff subbasin—Continued							
8	01115276	Westconnaug Brook	10/12/12	2.6	50,000	<320	58	6.4	<32	190
			11/20/12	4.2	10,000	2,100	92	10	<51	820
			12/18/12	11	2,700	2,700	230	27	<130	3,200
			01/11/13	9.2	<1,100	<1,100	200	23	<110	7,700
			02/22/13	11	<1,300	<1,300	260	27	270	1,900
			03/22/13	9.6	2,300	<1,200	210	23	470	4,200
			04/29/13	6.0	47,000	2,900	160	15	<73	1,900
			05/10/13	6.4	7,800	1,600	160	16	160	1,300
			06/24/13	24	140,000	<2,900	530	290	<290	2,900
			07/12/13	13	190,000	3,200	270	32	320	950
			08/01/13	4.2	250,000	1,000	96	10	<51	620
			09/13/13	4.5	180,000	<550	96	11	110	440
9	01115275	Bear Tree Brook	10/16/12	0.39	3,600	190	62	1.9	48	120
			04/16/13	1.7	8,700	3,700	200	8.3	290	910
			07/16/13	1.3	200,000	<160	180	10	480	320
32	01115178	Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)	11/19/12	0.23	2,100	57	7.2	1.1	23	57
			01/17/13	0.82	2,200	<100	25	4.0	<10	360
			04/18/13	0.47	4,900	460	13	2.3	46	290
33	01115182	Unnamed Tributary 3 to Scituate Reservoir (Hall's Estate Brook)	10/24/12	0.10	2,000	50	3.0	0.25	<1.2	25
			04/17/13	0.23	2,200	330	5.6	0.56	17	50
			07/17/13	0.04	7,400	130	1.6	0.32	3.2	21

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

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PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
Moswansicut Reservoir subbasin										
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	10/11/12	1.5	40,000	<180	130	3.7	<18	110
			11/08/12	3.1	39,000	4,500	250	76	76	380
			12/13/12	4.1	7,000	5,000	350	50	100	2,500
			01/10/13	4.8	1,200	<590	400	35	230	1,300
			02/21/13	7.1	1,700	<870	610	35	1,000	2,600
			03/14/13	14	6,800	<1,700	1,200	68	1,400	3,100
			04/11/13	6.0	22,000	2,900	540	29	290	440
			05/09/13	4.2	4,100	<510	380	41	310	1,000
			06/20/13	13	64,000	<1,600	1,100	95	320	7,900
			07/31/13	5.6	230,000	<680	480	41	140	550
			08/08/13	0.79	50,000	3,900	70	5.8	<9.7	77
			09/12/13	0.59	65,000	2,900	51	4.3	29	72
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	01/30/13	0.73	2,000	180	47	11	89	270
			04/15/13	0.64	4,800	<78	50	4.7	<7.8	250
			07/15/13	0.32	79,000	2,400	23	2.4	16	170
Regulating Reservoir subbasin										
14	01115110	Huntinghouse Brook	10/01/12	0.93	43,000	4,500	27	4.5	<11	230
			11/05/12	4.8	63,000	7,000	420	23	<59	2,100
			12/03/12	3.4	100,000	10,000	130	17	<42	1,700
			02/04/13	9.2	27,000	4,500	230	23	230	6,100
			03/18/13	15	11,000	3,700	400	37	370	7,700
			04/01/13	13	45,000	6,400	390	64	320	3,800
			05/06/13	4.8	130,000	12,000	130	12	120	1,100
			06/03/13	12	13,000,000	1,200,000	320	88	590	2,300

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PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
			Regulating Reservoir subbasin—Continued							
15	01115114	Rush Brook	10/01/12	1.6	82,000	8,600	140	12	<20	1,000
			11/05/12	3.1	20,000	760	85	7.6	<38	3,100
			12/17/12	10	180,000	17,000	700	49	<120	730
			01/07/13	4.9	11,000	<600	390	24	120	600
			02/04/13	5.5	28,000	15,000	470	27	130	3,400
			03/18/13	6.8	6,700	1,700	680	33	330	4,000
			04/01/13	7.4	43,000	16,000	660	36	720	2,400
			05/06/13	1.8	36,000	1,300	230	8.8	44	130
			06/17/13	9.8	180,000	22,000	710	72	<120	1,400
			07/01/13	2.6	76,000	2,500	300	25	64	830
			08/05/13	0.94	11,000	690	120	11	<11	390
16	01115098	Peeptoad Brook (Harrisdale Brook)	10/01/12	1.2	21,000	590	85	5.9	<15	120
			11/05/12	1.6	14,000	390	150	7.8	<20	510
			12/03/12	1.6	17,000	1,200	140	7.8	<20	120
			01/07/13	6.8	13,000	<830	480	33	330	2,500
			02/04/13	6.4	38,000	<780	490	31	160	3,100
			03/18/13	11	67,000	8,100	930	27	540	9,100
			04/01/13	9.1	18,000	<1,100	810	45	450	2,000
			05/06/13	3.9	25,000	950	460	19	95	570
			06/03/13	5.3	650,000	13,000	500	13	130	1,000
			07/01/13	4.3	450,000	32,000	320	420	210	1,300
			08/05/13	1.8	20,000	3,100	140	13	44	260
			09/16/13	1.5	40,000	<180	120	3.7	37	950
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	04/15/13	0.30	440	150	35	1.5	<3.7	110

Table 4. Daily loads of bacteria, chloride, nitrate, nitrite, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2012, through September 30, 2013.—Continued

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PWSB station number	USGS station number	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)	Orthophosphate (g/d as PO_4)
Westconnaug Reservoir subbasin										
10	01115274	Westconnaug Brook	10/30/12	4.8	470,000	35,000	22	47	<59	710
			11/13/12	0.97	12,000	480	43	2.4	<12	330
			12/11/12	3.3	29,000	800	130	8.0	<40	880
			01/08/13	2.2	7,900	530	92	5.3	53	1,200
			02/26/13	4.6	4,500	2,300	230	11	<57	1,200
			03/12/13	4.1	2,000	1,000	210	10	100	610
			04/09/13	1.6	2,800	<200	93	7.9	40	360
			05/14/13	0.63	9,700	150	38	1.5	15	200
			06/25/13	3.6	86,000	3,500	190	17	<44	1,000
			07/23/13	0.69	4,800,000	290,000	31	17	34	300
			08/13/13	0.45	23,000	550	21	17	11	88
			09/10/13	0.20	12,000	<24	8.4	17	4.8	19
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	10/23/12	0.46	14,000	110	0.79	17	34	68
			04/23/13	0.84	27,000	410	1.2	17	<10	210

Appendix 1. Water-Quality Data Collected by the Providence Water Supply Board at 37 Monitoring Stations in the Scituate Reservoir Drainage Area, Water Year 2013

[Available as a separately downloaded Microsoft Excel® file, at http://pubs.usgs.gov/of/2015/1082/.]

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