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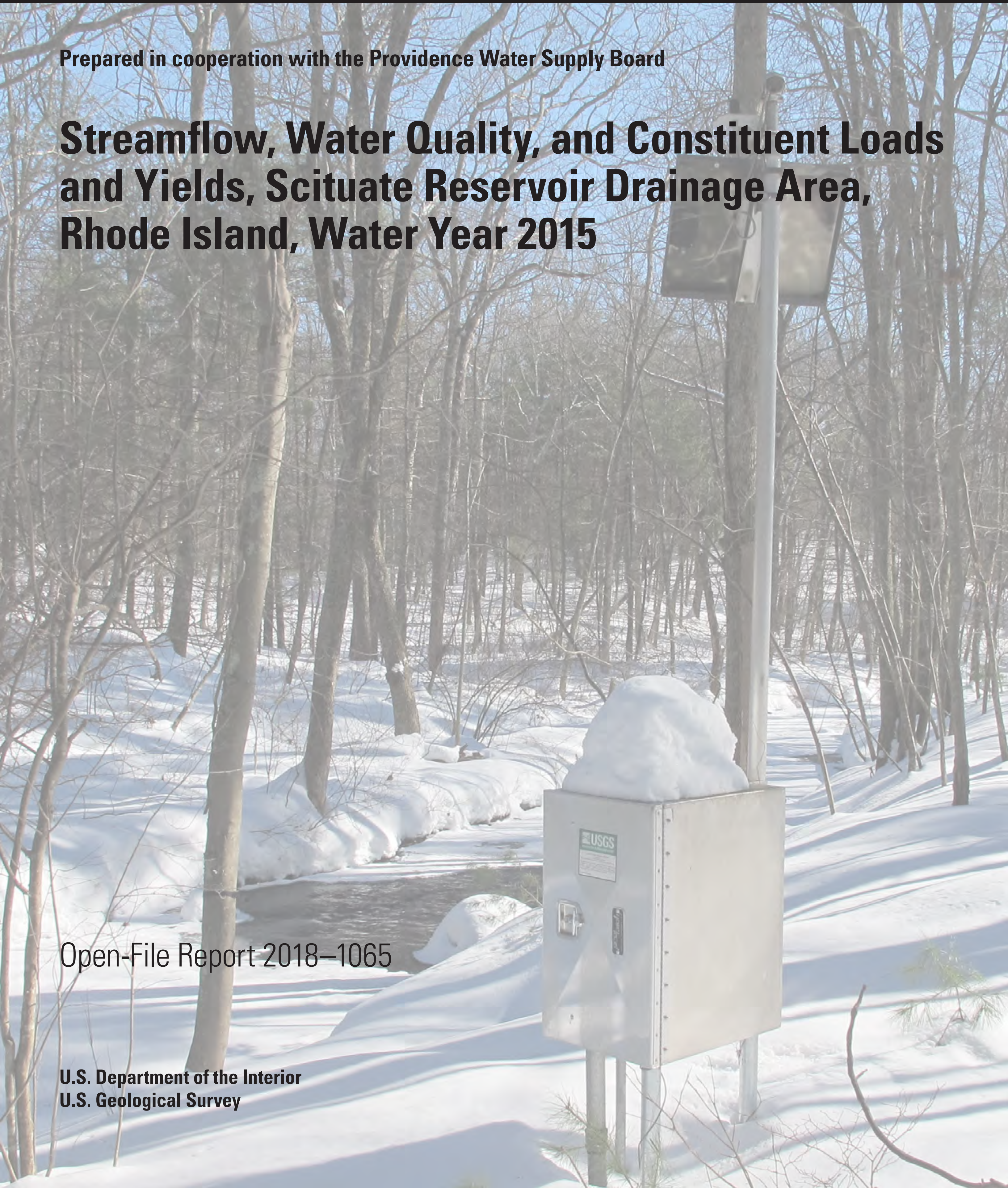

Prepared in cooperation with the Providence Water Supply Board

Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2015

Open-File Report 2018–1065

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

Cover. U.S. Geological Survey streamgage at Huntinghouse Brook, near North Scituate, Rhode Island. Photograph by Kirk P. Smith, U.S. Geological Survey.

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RYAN K. ZINKE, Secretary

U.S. Geological Survey
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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
mile (mi)	1.609	kilometer (km)
	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)

Datum

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/100 mL).

Loads of chemical constituents in water are given either in grams or kilograms (or millions of colony forming units for bacteria) per day or year, and yields are given in grams or kilograms (or millions of colony forming units for bacteria) per day 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
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 2015

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) 2015 (October 1, 2014, through September 30, 2015) 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 and the Providence Water Supply Board. Streamflow was measured or estimated by the U.S. Geological Survey 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 36 sampling stations by the Providence Water Supply Board and at 14 continuous-record streamgages by the U.S. Geological Survey during WY 2015 as part of a long-term sampling program; all stations are in the Scituate Reservoir drainage area. Water-quality data collected by the Providence Water Supply Board 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 2015.

The largest tributary to the reservoir (the Ponaganset River, which was monitored by the U.S. Geological Survey) contributed a mean streamflow of 25 cubic feet per second to the reservoir during WY 2015. For the same time period, annual mean[1] streamflows measured (or estimated) for the other monitoring stations in this study ranged from about 0.38 to about 14 cubic feet per second. Together, tributaries (equipped with instrumentation capable of continuously monitoring specific conductance) transported about 1,500,000 kilograms of sodium and 2,400,000 kilograms of chloride to the Scituate Reservoir during WY 2015; sodium and chloride yields for the tributaries ranged from 8,000 to 54,000 kilograms per square mile and from 12,000 to 91,000 kilograms per square mile, respectively.

At the stations where water-quality samples were collected by the Providence Water Supply Board, the medians of the median concentrations were the following: for chloride, 29.5 milligrams per liter; for nitrite, 0.002 milligrams per liter as nitrogen; for nitrate, 0.05 milligrams per liter as nitrogen; for orthophosphate, 0.08 milligrams per liter as phosphate; and for total coliform bacteria and *Escherichia coli*, 440 and 20 colony forming units per 100 milliliters, respectively. The medians of the median daily loads (and yields) of chloride, nitrite, nitrate, orthophosphate, and total coliform and *Escherichia coli* bacteria were 170 kilograms per day (79 kilograms per day per square mile), 14 grams per day (5.2 grams per day per square mile), 670 grams per day (190 grams per day per square mile), 640 grams per day (210 grams per day per square mile), 18,000 million colony forming units per day (7,600 million colony forming units per day per square mile), and 1,200 million colony forming units per day (810 million colony forming units per day per square mile), 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 in parts of the towns of Cranston, Foster, Glocester, Johnston, and Scituate, Rhode Island (. 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.

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

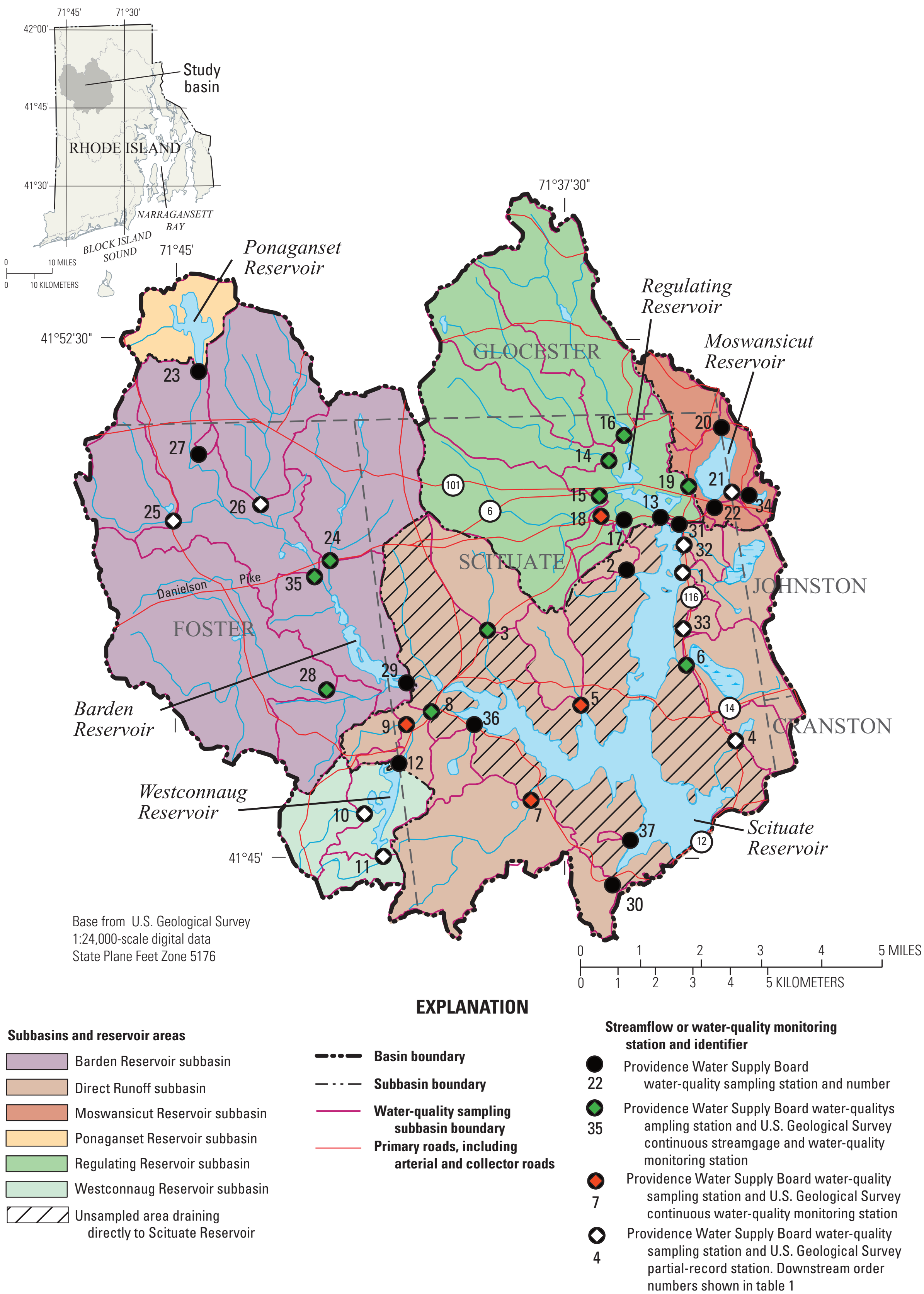

Figure 1. Locations of tributary-reservoir subbasins and stations in the Scituate Reservoir drainage area, Rhode Island, 2015.

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and specific conductance monitoring by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

[Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; mi^2, square mile; QW, water quality; Na, sodium; Cl, chloride; M, monthly; Q, quarterly; Y, yes; N, no; Continuous, recorded at 10- or 15-minute intervals; --, none]

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

Table 1. Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and specific conductance monitoring by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.—Continued

[Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; mi², square mile; QW, water quality; Na, sodium; Cl, chloride; M, monthly; Q, quarterly; Y, yes; N, no; Continuous, recorded at 10- or 15-minute intervals; --, none]

PWSB station number	USGS station number	Station name	Drainage area (mi^2)	Frequency of QW sample collection	Number of samples collected by Providence Water[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	11	Y	Continuous	Continuous
20	01115160	Unnamed Tributary 1 to Moswansicut Reservoir (Blanchard Brook)	1.18	M	8	N	None	None
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	0.29	Q	1	N	Estimated	None
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	0.22	M	8	N	None	None
34	01115164	Kimball Stream	0.27	Q	2	N	None	None
		Ponaganset Reservoir subbasin						
23	011151843	Ponaganset Reservoir	1.92	M	9	N	None	None
		Regulating Reservoir subbasin						
13	01115176	Regulating Reservoir	22.1	M	9	N	None	None
14	01115110	Huntinghouse Brook	6.23	M	8	Y	Continuous	Continuous
15	01115114	Rush Brook	4.70	M	9	Y	Continuous	Continuous
16	01115098	Peeptoad Brook (Harrisdale Brook)	4.96	M	8	Y	Continuous	Continuous
17	01115119	Dexter Pond (Paine Pond)	0.22	Q	1	N	None	None
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	0.28	Q	1	Y	Estimated	Continuous
		Westconnaug Reservoir subbasin						
10	01115274	Westconnaug Brook	1.48	M	8	N	Estimated	None
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook south of Westconnaug Reservoir)	0.72	Q	1	N	Estimated	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.

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 10 streamgages in the drainage area (table 1). Streamflow also was continuously measured at four additional streamgages during 2009–14 and periodically measured at nine additional streamgages on tributaries in the drainage area. At the 13 streamgages without continuous flow data (partial-record streamgages; table 1), daily mean streamflow has been estimated by using methods developed by the USGS (Hirsch, 1982). The USGS also has been continuously measuring specific conductance at 14 monitoring stations since 2009. Equations that relate specific conductance to concentrations of sodium and chloride in stream water were developed as part of previous USGS/PWSB cooperative studies (Smith, 2015b; 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 (2015), the PWSB collects water-quality samples from 37 tributaries within the Scituate Reservoir drainage area, either monthly or quarterly. 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, 2015a, 2015b, 2016).

This report presents data on streamflow, water quality, and loads and yields of selected constituents for water year (WY) 2015[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 10 continuous-record and 13 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 36 of the 37 sampling stations (table 1) during WY 2015 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 and 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 nearby, hydrologically similar drainage areas to estimate a continuous daily record at the partial-record streamgages. Specifically, continuous-streamflow records for the 13 partial-record sites in the Scituate Reservoir drainage area (table 1) were estimated by using the Maintenance of Variance Extension type 1 (MOVE.1) method, as described by Ries and Friesz (2000) and Smith (2015b); data needed to estimate streamflows at partial-record sites were retrieved from the USGS National Water Information System (NWIS; U.S. Geological Survey, 2016). 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 2015 in cooperation with RIDEM (USGS streamgage 01115187) 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 internet, and are available through the NWIS Web interface (U.S. Geological Survey, 2016). Error associated with measured streamflows was generally within about 15 percent as noted in the annual water year summary for each USGS streamgage (U.S. Geological Survey, 2016).

Water-Quality Data Collection and Analysis

Water-quality data were collected by the USGS and the PWSB. Concentrations of sodium and chloride were estimated by the USGS from continuous records of specific conductance from 14 of the 21 streamgages. Water-quality samples were collected monthly or quarterly at 36 sampling stations in the Scituate Reservoir drainage area by the PWSB during WY 2015 as part of a long-term sampling program (table 1).

Data Collected by the U.S. Geological Survey

The USGS collected and analyzed specific conductance data at the 14 continuous-record streamgages (fig. 1, table 1).

[2]October 1, 2014, through September 30, 2015.

Table 2. Measured or estimated annual mean streamflow for tributaries in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

[Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; ft^3/s, cubic foot per second; $ft^3/s/mi^2$, cubic foot per second per square mile]

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 yield ($ft^3/s/mi^2$)
		Barden Reservoir subbasin				
24	01115190	Dolly Cole Brook	7.2	8.2	6.2	1.5
25	01115200	Shippee Brook	3.8	13	1.1	1.6
26	01115185	Windsor Brook	5.8	23	1.4	1.3
28	01115265	Barden Reservoir (Hemlock Brook)	14	16	12	1.6
35	01115187	Ponaganset River	25	28	22	1.8
		Direct Runoff subbasin				
1	01115180	Brandy Brook	1.8	3.3	1.0	1.2
3	01115280	Cork Brook	2.3	2.7	2.0	1.3
4	01115400	Kent Brook (Betty Pond Stream)	1.5	7.4	0.32	1.8
5	01115184	Spruce Brook	1.9	3.7	1.0	1.6
6	01115183	Quonapaug Brook	2.8	3.1	2.5	1.4
7	01115297	Wilbur Hollow Brook	5.9	11.0	3.0	1.4
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	7.1	7.7	6.5	1.4
9	01115275	Bear Tree Brook	1.2	2.0	0.69	1.9
32	01115178	Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)	0.45	0.91	0.23	1.0
33	01115182	Unnamed Tributary 3 to Scituate Reservoir (Halls Estate Brook)	0.38	1.1	0.14	1.4
		Moswansicut Reservoir subbasin				
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	4.3	4.7	3.9	1.3
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Blanchard Brook)	0.48	1.1	0.22	1.7
		Regulating Reservoir subbasin				
14	01115110	Huntinghouse Brook	9.3	11	8.0	1.5
15	01115115	Rush Brook	6.7	7.8	5.7	1.4
16	01115098	Peeptoad Brook (Harrisdale Brook)	8.4	9.7	7.1	1.7
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	0.48	2.0	0.12	1.7
		Westconnaug Reservoir subbasin				
10	01115274	Westconnaug Brook	1.6	2.9	0.9	1.1
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	0.94	1.6	0.55	1.3

Measurements of specific conductance were recorded automatically at 10- or 15-minute intervals at each streamgage. Measurements were made by using an instream probe and standard USGS methods for continuous stream water-quality monitoring (Wagner and others, 2006). The specific conductance measurement data are available through the NWIS Web interface (U.S. Geological Survey, 2016).

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 (eqs. 1 and 2). These regression equations were developed by 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[3] along with sodium[4] and chloride[5] concentrations measured in water-quality samples collected by the USGS from tributaries in the Scituate Reservoir drainage area (U.S. Geological Survey, 2016).

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

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

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 conducted monthly at 19 stations and quarterly at another 18 stations (table 1) during WY 2015. No water samples were collected at Toad Pond (PWSB station 31) during WY 2015. 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 at the P.J. Holton Water Purification Plant in Scituate. Water-quality properties and constituent concentrations were measured by using unfiltered water samples. These water-quality properties included pH, alkalinity, color, turbidity, and concentrations of chloride, nitrite, nitrate, orthophosphate, and bacteria (*Escherichia coli* [*E. coli*] and total coliform) (Smith, 2018; https://doi.org/10.5066/F7FJ2FR5). Analytical methods used for the determination of values or concentrations of pH, color, turbidity, alkalinity, chloride (4500–Cl B), and nitrite (4500–NO_2–B) are those documented by Eaton and others (2017). Concentrations of nitrate were determined by cadmium reduction (Hach Method 8192; Hach Company, 2007). Concentrations of orthophosphate were determined by the Hach PhosVer Method (Hach Method 8048; Hach Company, 2007). Standard Method 9222 was used for the determination of concentrations of bacteria in water samples (Eaton and others, 2017).

Water-quality samples were collected by the PWSB during a wide range of flow conditions. The daily mean flow-duration curve for Moswansicut Stream near North Scituate (USGS streamgage 01115170) for WY 2015 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 0.4 percentile to the 98th percentile; this range indicates that the water-quality samples collected in WY 2015 represented a wide range of flow conditions during that water year.

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 2015. 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. At the four continuous monitoring stations where instantaneous flow was unavailable (table 1), daily mean concentrations of sodium and chloride were calculated from the daily mean value of specific conductance for each day. The latter method may result in less accurate concentrations because instantaneous measurements of specific conductance

[3]Specific conductance parameter code 90095.

[4]Sodium parameter code 00930.

[5]Chloride parameter code 00940.

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, 2014, through September 30, 2015.

[Locations of stations are shown in figure 1. U.S. Geological Survey (USGS) parameter codes: specific conductance, 90095; chloride, 00940; sodium, 00930. PWSB, Providence Water Supply Board]

PWSB station number	USGS station number	Samples used in analyses		Chloride			Sodium		
		Sample data range (month/day/year)	Sample count	Slope	Intercept	Standard error of regressions (percent)	Slope	Intercept	Standard error of regressions (percent)
24	01115190	03/08/2000; 03/29/2005; 01/22/2009 to 07/06/2017	26	1.2571	0.06894	3.8	1.2244	0.04913	7.3
28	01115265	03/28/2001; 03/30/2005; 01/22/2009 to 07/06/2017	26	1.2270	0.07901	5.5	1.1326	0.07443	9.0
35	01115187	03/28/2001; 03/29/2005; 01/22/2009 to 07/06/2017	26	1.2428	0.07282	6.3	1.1751	0.06094	8.4
3	01115280	03/08/2000; 03/30/2005; 01/22/2009 to 07/19/2017	26	1.2217	0.07704	4.9	1.0722	0.09611	7.8
5	01115184	03/05/2009 to 07/20/2017	23	1.2558	0.06221	6.5	1.0813	0.08318	6.1
6	01115183	03/08/2000; 03/30/2005; 01/22/2009 to 07/20/2017	34	1.1920	0.07872	6.7	1.2291	0.03842	9.2
7	01115297	03/28/2001; 03/30/2005; 01/22/2009 to 07/20/2017	25	1.0552	0.13303	6.3	0.89330	0.16852	8.6
8	01115276	01/22/2009 to 07/19/2017	23	1.1016	0.13513	4.9	1.0463	0.10969	5.9
9	01115275	03/08/2000; 03/30/2005; 01/22/2009 to 07/20/2017	25	1.0600	0.17564	4.2	1.0734	0.09639	5.6
19	01115170	03/08/2000; 03/29/2005; 01/22/2009 to 07/20/2017	29	1.2410	0.06537	4.0	1.1927	0.04976	4.7
14	01115110	03/28/2001; 03/29/2005; 01/22/2009 to 07/19/2017	30	1.2030	0.07202	12	1.0670	0.07766	11
15	01115114	01/22/2009 to 07/20/2017	32	1.1757	0.09313	4.0	1.0902	0.08738	7.5
16	01115098	03/28/2001; 03/29/2005; 01/22/2009 to 07/20/2017	27	1.2748	0.05402	6.9	1.0919	0.08072	9.6
18	01115120	01/22/2009 to 07/19/2017	18	1.2098	0.07604	4.5	1.0879	0.08393	5.1

may change (decrease or increase) with surface water runoff; however, the variability of instantaneous measurements of specific conductance at these streamgages was generally small, and daily mean values did not differ substantially from daily flow-weighted values estimated during prior water years when instantaneous flow data were available. Daily sodium and chloride loads were estimated by multiplying daily 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 (from samples collected by the PWSB) were calculated for all sampling dates during WY 2015 (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.

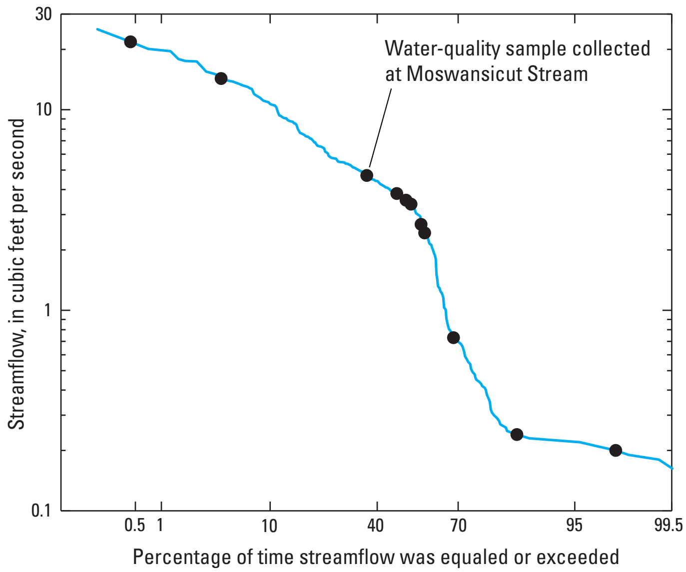

Figure 2. Flow-duration curve and streamflow on the dates (represented by points) when water-quality samples were collected for the U.S. Geological Survey continuous streamgage on Moswansicut Stream near North Scituate (01115170), Rhode Island, water year 2015.

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. 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, WYs 1994–2014) prior to WY 2015 was about 29 cubic feet per second (ft^3/s) (U.S. Geological Survey, 2016). During WY 2015, annual mean streamflow (25 ft^3/s) was lower than mean of the annual mean streamflows for the period of record, and daily mean streamflows for many months were less than the median daily mean streamflows and, in some cases, less than the 10th percentile for the daily mean streamflows for the period of record (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 (WYs 1994–2014) prior to WY 2015 was about 10.6 ft^3/s (U.S. Geological Survey, 2016). Annual mean streamflow in Peeptoad Brook during WY 2015 also was lower (8.4 ft^3/s) than the mean annual streamflow for its period of record.

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

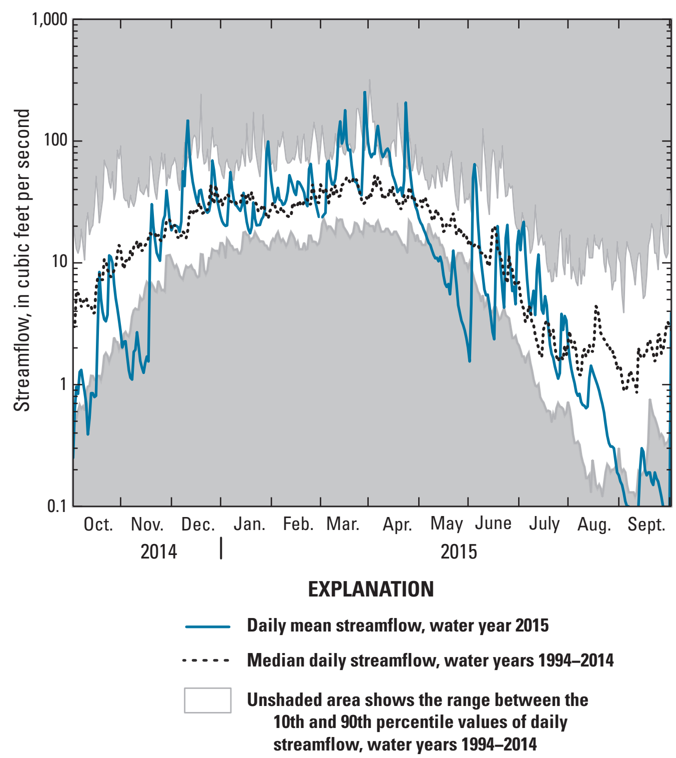

Figure 3. Measured daily mean streamflow for October 1, 2014, through September 30, 2015, and the 10th percentile, median, and 90th percentile values of daily streamflow for October 1, 1994, through September 30, 2014, for the U.S. Geological Survey continuous-record streamgage on the Ponaganset River at South Foster (01115187) in the Scituate Reservoir drainage area, Rhode Island.

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 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, based on the available data and analysis methods. 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 streamflow are commonly assumed to affect load and yield calculations more than the errors associated with measuring specific conductance and (or) chemical analysis, and the uncertainties associated with estimated streamflow are greater than those associated with measured streamflow. 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) 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[6] sodium concentrations in tributaries of the Scituate Reservoir drainage area ranged from 5.7 to 52 milligrams per liter (mg/L), and estimated monthly mean chloride concentrations ranged from 8.5 to 86 mg/L (table 5). The highest monthly mean concentrations of sodium and chloride were estimated for Quonapaug Brook (PWSB station 6) in August 2015 (52 and 86 mg/L, respectively; table 5), Unnamed Tributary to Regulating Reservoir (PWSB station 18) in April 2015 (47 and 86 mg/L, respectively; table 5), and Bear Tree Brook (PWSB station 9) in September 2015 (51 and 86 mg/L, respectively; table 5). The highest annual mean[7] concentrations of sodium and chloride were estimated at Unnamed Tributary to Regulating Reservoir (32 and 57 mg/L, respectively; table 6) which is in the more developed, northeastern part of the Scituate Reservoir drainage area (fig. 1). Annual mean concentrations of sodium and chloride estimated at Bear Tree Brook also were similar at 31 and 53 mg/L, respectively (table 6). These high concentrations at Bear Tree Brook 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 2015, the Scituate Reservoir received about 1,500,000 kilograms (kg) (about 1,600 short tons) of sodium and 2,400,000 kg (about 2,700 short tons) of chloride from tributaries that are equipped with instrumentation capable of continuously monitoring specific conductance. The highest sodium and chloride loads in the drainage area during WY 2015 (320,000 and 530,000 kg, respectively) were estimated at the Ponaganset River station (PWSB station 35; table 6). Monthly estimated sodium and chloride loads were highest in the months of March and April (table 7), except at Unnamed Tributary to Regulating Reservoir, where the monthly estimated loads were higher during February. During March and April, the sum of the monthly sodium and chloride loads at each station accounted for 45 percent of the annual load for the monitored area in the Scituate Reservoir drainage area. The highest annual sodium and chloride yields were 54,000 and 91,000 kilograms per square mile, respectively, measured at Bear Tree Brook (PWSB station 9; table 6). During WY 2015, estimated annual loads of sodium and chloride at the continuous monitoring stations were greater than or equal to the median annual loads for WY 2009–14 at all stations in the Barden Reservoir Subbasin, Spruce Brook (PWSB station 5) and Westconnaug Brook (PWSB station 8) in the Direct Runoff Subbasin, Moswansicut Reservoir (PWSB station 19), and all stations in the Regulating Reservoir Subbasin (fig. 4).

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

[7]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, 2014, through September 30, 2015.

[Monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month. Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; --, no flow]

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	39	23	35	21	27	16	33	20	32	20	33	20
28	01115265	Barden Reservoir (Hemlock Brook)	40	23	33	20	21	13	28	17	28	17	21	13
35	01115187	Ponaganset River	31	18	31	19	22	14	25	15	24	15	24	15
		Direct Runoff subbasin												
3	01115280	Cork Brook	62	34	49	28	29	17	40	23	39	23	45	25
5	01115184	Spruce Brook	50	26	34	19	20	12	23	14	23	14	20	12
6	01115183	Quonapaug Brook	72	43	50	30	33	20	40	24	39	23	43	26
7	01115297	Wilbur Hollow Brook	18	11	13	8.0	9.0	6.0	11	7.0	11	7.2	8.5	5.7
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	31	19	31	19	18	11	21	14	23	14	21	13
9	01115275	Bear Tree Brook	73	44	63	37	47	28	56	33	57	34	44	26
		Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	45	26	45	26	44	26	47	27	47	28	47	28
		Regulating Reservoir subbasin												
14	01115110	Huntinghouse Brook	19	11	21	12	12	7.2	16	9.3	16	9.5	13	7.8
15	01115114	Regulating Reservoir (Rush Brook)	80	46	66	38	29	18	50	30	58	34	48	29
16	01115098	Peeptoad Brook (Harrisdale Brook)	45	26	43	25	44	25	42	24	54	30	52	29
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	52	30	47	27	70	39	67	37	57	32	56	32
		Scituate Reservoir drainage area												
		Average	47	27	40	23	30	18	35	21	36	21	34	20

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, 2014, through September 30, 2015.—Continued

[Monthly mean concentrations were calculated by dividing the monthly load by the total discharge for the month. Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; --, no flow]

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	29	18	37	22	33	20	34	21	36	22	38	23
28	01115265	Barden Reservoir (Hemlock Brook)	20	12	32	19	27	16	30	18	42	24	34	20
35	01115187	Ponaganset River	21	13	27	16	25	15	30	18	29	18	30	18
		Direct Runoff subbasin												
3	01115280	Cork Brook	34	20	39	23	40	23	43	25	50	28	73	40
5	01115184	Spruce Brook	19	11	24	14	24	14	33	18	49	26	56	29
6	01115183	Quonapaug Brook	37	22	43	26	44	26	56	33	86	52	79	48
7	01115297	Wilbur Hollow Brook	9.3	6.1	13	8.3	12	7.5	11	7.3	13	8.3	18	11
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	20	13	26	16	27	17	32	20	31	19	31	19
9	01115275	Bear Tree Brook	46	27	58	35	62	36	71	42	84	50	86	51
		Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	48	28	54	32	54	32	57	33	57	33	55	33
		Regulating Reservoir subbasin												
14	01115110	Huntinghouse Brook	12	7.4	16	9.4	15	8.7	15	8.6	16	9.3	17	10
15	01115114	Regulating Reservoir (Rush Brook)	39	24	63	37	47	28	56	33	76	44	83	48
16	01115098	Peeptoad Brook (Harrisdale Brook)	43	25	49	28	49	28	52	29	58	32	56	31
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	86	47	59	34	72	40	--	--	--	--	--	--
		Scituate Reservoir drainage area												
		Average	33	20	39	23	38	22	40	24	48	28	51	29

Table 6. Annual mean chloride and sodium concentrations, loads, and yields by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

[Annual mean concentrations were calculated by dividing the annual load by the total discharge for the year; annual mean yields for each station were calculated by dividing the individual loads by the drainage areas. Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; mg/L, milligram per liter; kg/yr, kilogram per year; kg/yr/mi^2, kilogram per year per square mile]

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	31	19	200,000	120,000	41,000	25,000
28	01115265	Barden Reservoir (Hemlock Brook)	24	15	300,000	180,000	34,000	21,000
35	01115187	Ponaganset River	24	15	530,000	320,000	38,000	23,000
		Direct Runoff subbasin						
3	01115280	Cork Brook	38	22	80,000	46,000	44,000	26,000
5	01115184	Spruce Brook	23	13	39,000	23,000	32,000	19,000
6	01115183	Quonapaug Brook	41	24	100,000	60,000	51,000	30,000
7	01115297	Wilbur Hollow Brook	10	6.6	53,000	35,000	12,000	8,000
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	23	14	140,000	89,000	27,000	17,000
9	01115275	Bear Tree Brook	53	31	57,000	33,000	91,000	54,000
		Moswansicut Reservoir subbasin						
19	01115170	Moswansicut Reservoir, (Moswansicut Stream North, Moswansicut Pond)	48	28	190,000	110,000	57,000	34,000
		Regulating Reservoir subbasin						
14	01115110	Huntinghouse Brook	14	8.1	110,000	68,000	18,000	11,000
15	01115114	Rush Brook	45	27	270,000	160,000	57,000	34,000
16	01115098	Peeptoad Brook (Harrisdale Brook)	46	26	350,000	200,000	70,000	40,000
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	57	32	24,000	14,000	86,000	49,000
		Scituate Reservoir drainage area						
			Mean		Total		Mean	
			34	20	2,400,000	1,500,000	39,000	23,000

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, and color were routinely collected by the PWSB to characterize water quality in each subbasin (table 8). 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 5.5 to 6.8; the median of the medians for all stations was 6.3. Median values of color ranged from 11 to 150 platinum cobalt units; the median for all stations was 36 platinum cobalt units. Median values of turbidity ranged from 0.17 to 2.1 nephelometric turbidity units; the median for all stations was 0.54 nephelometric turbidity units. Median alkalinity values in tributaries were low, ranging from 2.3 to 16 mg/L as $CaCO_3$; the median for all stations was 5.2 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 cause or contribute to water-quality impairments. Fecal indicator

Table 7. Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

[Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; kg, kilogram]

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	670	410	5,800	3,500	26,000	16,000	30,000	18,000	15,000	9,000	53,000	32,000
28	01115265	Barden Reservoir (Hemlock Brook)	3,500	2,100	21,000	12,000	46,000	28,000	44,000	26,000	19,000	12,000	66,000	40,000
35	01115187	Ponaganset River	7,500	4,500	24,000	14,000	70,000	43,000	63,000	38,000	64,000	39,000	140,000	87,000
		Direct Runoff subbasin												
3	01115280	Cork Brook	530	290	4,200	2,400	10,000	6,000	7,000	4,100	4,100	2,400	24,000	14,000
5	01115184	Spruce Brook	920	490	3,100	1,700	5,200	3,100	4,300	2,600	3,300	1,900	6,400	3,900
6	01115183	Quonapaug Brook	2,600	1,600	9,700	5,800	17,000	10,000	9,000	5,300	7,300	4,300	22,000	13,000
7	01115297	Wilbur Hollow Brook	1,400	840	5,400	3,400	9,100	6,000	5,500	3,500	4,700	3,000	8,400	5,600
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	6,100	3,800	7,400	4,600	16,000	10,000	13,000	8,400	9,300	5,800	25,000	16,000
9	01115275	Bear Tree Brook	2,800	1,700	2,600	1,500	7,100	4,200	5,900	3,500	4,000	2,400	8,700	5,100
		Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	2,300	1,400	5,700	3,400	28,000	17,000	18,000	10,000	15,000	8,600	33,000	19,000
		Regulating Reservoir subbasin												
14	01115110	Huntinghouse Brook	820	470	5,800	3,300	17,000	10,000	12,000	7,200	7,900	4,600	28,000	17,000
15	01115114	Regulating Reservoir (Rush Brook)	1,400	790	15,000	8,800	32,000	20,000	25,000	15,000	20,000	12,000	84,000	50,000
16	01115098	Peeptoad Brook (Harrisdale Brook)	1,500	840	18,000	10,000	62,000	36,000	25,000	15,000	16,000	8,700	86,000	48,000
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	280	160	3,600	2,100	1,600	890	760	430	8,700	4,900	7,200	4,100
		Scituate Reservoir drainage area												
		Total	32,000	19,000	131,000	77,000	350,000	210,000	260,000	160,000	200,000	120,000	590,000	350,000

Table 7. Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015. —Continued

[Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; Cl, chloride; Na, sodium; kg, kilogram]

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	45,000	27,000	9,300	5,600	11,000	6,700	4,400	2,600	940	570	190	120
28	01115265	Barden Reservoir (Hemlock Brook)	57,000	35,000	14,000	8,000	18,000	11,000	6,800	4,000	2,000	1,200	280	160
35	01115187	Ponaganset River	100,000	64,000	18,000	11,000	26,000	16,000	12,000	7,200	1,500	910	610	360
Direct Runoff subbasin														
3	01115280	Cork Brook	17,000	10,000	4,700	2,700	5,300	3,100	1,700	1,000	150	85	230	120.0
5	01115184	Spruce Brook	6,100	3,700	2,900	1,700	3,300	1,900	2,700	1,500	530	280	150	76
6	01115183	Quonapaug Brook	19,000	11,000	5,900	3,500	5,300	3,100	2,200	1,300	230	140	240	140
7	01115297	Wilbur Hollow Brook	9,600	6,400	4,400	2,700	3,300	2,100	1,200	770	120	77	130	76
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	31,000	19,000	13,000	8,400	9,400	5,800	5,000	3,100	3,400	2,100	3,200	2,000
9	01115275	Bear Tree Brook	12,000	6,900	5,100	3,000	3,700	2,200	1,900	1,200	1,600	930	1,500	890
Moswansicut Reservoir subbasin														
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	39,000	23,000	11,000	6,500	23,000	14,000	10,000	5,900	1,000	590	1,100	620
Regulating Reservoir subbasin														
14	01115110	Huntinghouse Brook	25,000	15,000	5,900	3,500	7,500	4,500	3,300	1,900	130	77	99.0	57.00
15	01115114	Regulating Reservoir (Rush Brook)	53,000	32,000	12,000	6,700	20,000	12,000	6,800	4,000	320	180	95.00	54.00
16	01115098	Peeptoad Brook (Harrisdale Brook)	93,000	53,000	19,000	11,000	16,000	9,000	7,400	4,100	1,900	1,000	490	270
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	640	350	1,000	570	330	180	0	0	0	0	0	0
Scituate Reservoir drainage area														
		Total	510,000	310,000	130,000	75,000	150,000	90,000	70,000	39,000	14,000	8,000	8,000	5,000

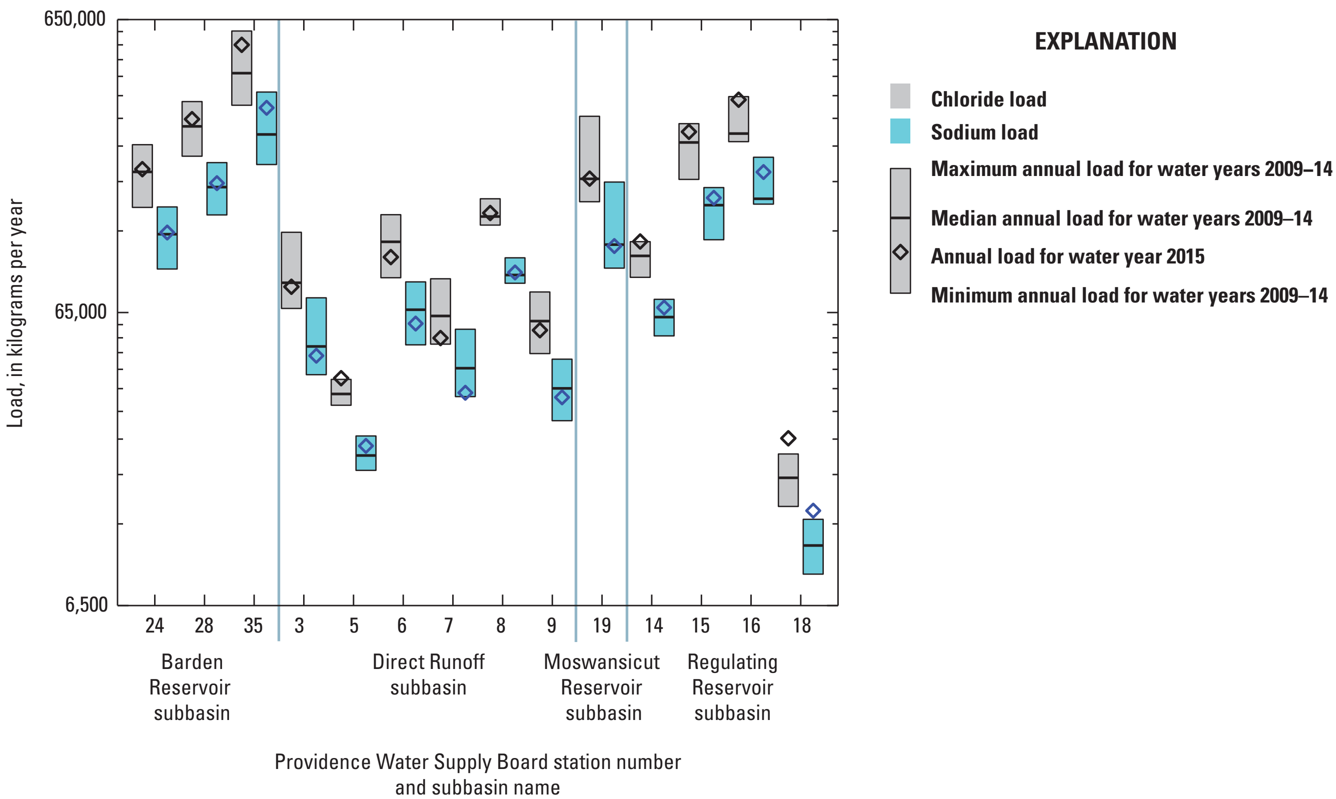

Figure 4. Annual loads of chloride and sodium estimated from streamflow and specific conductance data for water year 2015 and associated minimum, maximum, and median annual loads for water years 2009–14 at 15 Providence Water Supply Board stations in the Scituate Reservoir drainage area, Rhode Island.

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 stream water from precipitation, weathering, or human activities such as waste disposal, use of septic systems, and road deicing. Sources of nutrients in tributary stream water 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 designated use of the Scituate Reservoir, the receiving water for 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 were above the detection limit (10 colony forming units per 100 milliliters [CFU/100 mL]) at all sites (table 8); median concentrations of *E. coli* were equal to or greater than the detection limit (10 CFU/100 mL) at 31 of the 36 sites for which samples were collected. 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 440 CFU/100 mL for total coliform bacteria and 20 CFU/100 mL for *E. coli*. The median concentration of total coliform bacteria was highest at Kimball Stream (PWSB station 34; table 8) at 3,300 CFU/100 mL. The median concentration of *E. coli* was highest at Pine Swamp Brook (PWSB station 32; table 8) at 410 CFU/100 mL.

Median concentrations of fecal indicator bacteria were lowest at Halls Estate Brook (PWSB station 33) and Regulating Reservoir (PWSB station 13). Median concentrations of *E. coli* were below detection limit (10 CFU/100 mL) at Cork Brook (PWSB station 3), Kent Brook (PWSB station 4), Fire Tower Stream (PWSB station 37), Regulating Reservoir (PWSB station 13), and Unnamed Tributary to Westconnaug Brook (PWSB station 12). Median daily loads and yields of total coliform bacteria and *E. coli* varied by two orders of magnitude; the highest median daily yield of total coliform bacteria (41,000 million colony forming units per day per square mile [$CFU\times10^6/d/mi^2$]) was at Unnamed Tributary #2 to Moswansicut Reservoir (PWSB station 21; table 9), and the highest median daily yield of

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, 2014, through September 30, 2015.

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; PCU, platinum cobalt unit; NTU, nephelometric turbidity unit; CFU/100mL, colony forming unit per 100 milliliters; *E. coli*, *Escherichia coli*; mg/L, milligram per liter; $CaCO_3$, calcium carbonate; N, nitrogen; PO_4, phosphate; <, less than; --, no data]

PWSB station number	USGS station number	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 PO_4)
		Barden Reservoir subbasin										
24	01115190	Dolly Cole Brook	6.3	43	0.43	720	25	4.0	29.9	0.001	0.05	0.06
25	01115200	Shippee Brook	6.0	51	0.49	360	23	4.4	12.2	0.002	0.05	0.10
26	01115185	Windsor Brook	6.3	40	0.36	920	70	3.4	23.7	0.002	0.037	0.12
27	011151845	Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook)	5.6	16	0.17	600	88	3.0	15.2	0.001	0.288	0.10
28	01115265	Barden Reservoir (Hemlock Brook)	5.7	100	0.53	270	50	3.3	26.7	0.003	0.05	0.13
29	01115271	Ponaganset River (Barden Stream)	6.2	38	0.54	190	15	3.4	23.5	0.002	0.05	0.06
35	01115187	Ponaganset River	6.3	34	0.48	270	20	4.1	24.5	0.001	0.05	0.09
		Direct Runoff subbasin										
1	01115180	Brandy Brook	6.8	67	1.4	2,400	65	10	11.8	0.003	0.19	0.07
2	01115181	Unnamed Tributary #2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)	5.9	14	0.3	300	10	4.1	90.6	0.001	0.22	0.04
3	01115280	Cork Brook	6.4	30	0.28	2,400	<10	4.2	40.5	0.001	0.08	0.06
4	01115400	Kent Brook (Betty Pond Stream)	6.4	26	0.85	570	<10	6.2	5.3	0.001	0.05	0.04
5	01115184	Spruce Brook	6.4	70	0.54	900	110	6.7	33.5	0.002	0.1	0.11
6	01115183	Quonapaug Brook	6.2	86	1.5	1,600	220	10	43.3	0.004	0.28	0.10
7	01115297	Wilbur Hollow Brook	6.2	60	0.82	410	40	5.9	6.9	0.003	0.05	0.09
8	01115276	Westconnaug Brook (Westconnaug Reservoir)	6.3	15	0.44	270	10	3.7	12.8	0.001	0.05	0.04
9	01115275	Bear Tree Brook	6.6	43	0.59	400	50	7.4	70.1	0.002	0.63	0.05
30	01115350	Unnamed Tributary #4 to Scituate Reservoir Coventry Brook, Knight Brook)	6.0	70	0.66	2,900	200	4.1	34.1	0.003	0.02	0.07
31	01115177	Toad Pond	--	--	--	--	--	--	--	--	--	--
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	6.5	52	0.81	2,700	410	8.6	8.0	0.002	0.39	0.07
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Halls Estate Brook)	6.2	24	0.62	60	20	5.6	8.6	0.002	0.016	0.08
36	--	Outflow from King Pond	6.5	25	0.34	610	13	4.7	1.8	0.001	0.05	0.05
37	--	Fire Tower Stream	5.9	21	0.23	2,000	<10	3.2	3.2	0.001	0.03	0.11

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, 2014, through September 30, 2015.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Alternate station names are given in parentheses for stations where different historical names were used for the same sampling location by the PWSB. Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; PCU, platinum cobalt unit; NTU, nephelometric turbidity unit; CFU/100mL, colony forming unit per 100 milliliters; *E. coli*, *Escherichia coli*; mg/L, milligram per liter; $CaCO_3$, calcium carbonate; N, nitrogen; PO_4, phosphate; <, less than; --, no data]

PWSB station number	USGS station number	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 PO_4)
		Moswansicut Reservoir subbasin										
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	6.7	18	1.1	270	10	10	44.2	0.002	0.05	0.07
20	01115160	Unnamed Tributary #1 to Moswansicut Reservoir (Blanchard Brook)	5.9	150	0.72	560	80	6.9	67.4	0.004	0.095	0.16
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	6.8	33	1.4	1,000	20	16	39.5	0.007	0.65	0.10
22	01115167	Moswansicut Reservoir (Moswansicut Stream South)	6.6	28	2.1	1,600	100	15	71.3	0.007	0.98	0.11
34	01115164	Kimball Stream	6.3	43	0.76	3,300	13	10	43.5	0.003	0.041	0.05
		Ponaganset Reservoir subbasin										
23	011151843	Ponaganset Reservoir	6.1	11	0.69	160	20	3.5	17.5	0.001	0.05	0.08
		Regulating Reservoir subbasin										
13	01115176	Regulating Reservoir	6.6	30	0.86	80	<10	7.6	36.4	0.002	0.05	0.04
14	01115110	Huntinghouse Brook	6.4	33	0.52	470	95	5.7	15.5	0.001	0.05	0.08
15	01115114	Rush Brook	6.7	50	0.76	470	20	7.7	60.5	0.002	0.08	0.09
16	01115098	Peeptoad Brook (Harrisdale Brook)	6.6	30	0.74	310	30	8.0	46.7	0.002	0.082	0.05
17	01115119	Dexter Pond (Paine Pond)	6.0	30	0.42	100	20	4.7	30.2	0.001	0.089	0.13
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	6.3	41	0.48	220	20	6.2	56.3	0.001	0.034	0.14
		Westconnaug Reservoir subbasin										
10	01115274	Westconnaug Brook	5.7	23	0.27	190	15	2.3	29.1	0.001	0.05	0.10
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	5.5	60	0.40	190	10	2.8	5.80	0.002	0.05	0.03
12	011152745	Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug Reservoir)	5.8	48	0.41	490	<10	4.4	64.9	0.001	0.05	0.04
		Scituate Reservoir drainage area										
		Minimum	5.5	11	0.17	60	<10	2.3	1.8	0.001	0.016	0.03
		Median	6.3	36	0.54	440	20	5.2	29.5	0.002	0.05	0.08
		Maximum	6.8	150	2.1	3,300	410	16	90.6	0.007	0.98	0.16

Table 9. Median daily loads and yields of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; CFU×10⁶/d, millions of colony forming units per day; CFU×10⁶/d/mi², millions of colony forming units per day per square mile; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; kg/d/mi², kilogram per day per square mile; N, nitrogen; g/d, gram per day; g/d/mi²; gram per day per square mile; PO_4, phosphate; --, no data]

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/d/mi^2)	(CFU×10^6/d)	(CFU×10^6/d/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	17,000	3,500	940	190	340	69	12	2.3	600	120	790	160
25	01115200	Shippee Brook	16,000	6,600	990	420	200	86	19	8.0	950	410	960	410
26	01115185	Windsor Brook	39,000	9,100	12,000	2,700	650	150	55	13	1,500	350	2,300	540
28	01115265	Barden Reservoir	75,000	8,500	14,000	1,600	940	110	82	9.3	2,300	260	3,700	420
35	01115187	Ponaganset River	96,000	6,900	5,000	350	990	71	40	2.8	1,600	110	2,700	190
		Direct Runoff subbasin												
1	01115180	Brandy Brook	17,000	11,000	1,300	800	42	27	20	12	570	360	220	140
3	01115280	Cork Brook	6,500	3,600	590	330	200	110	5.3	3.0	410	230	300	170
4	01115400	Kent Brook	3,500	4,100	400	470	8.8	10	1.7	2.0	89	100	50	58
5	01115184	Spruce Brook	27,000	22,000	23,000	19,000	49	40	2	2	110	90	160	130
6	01115183	Quonapaug Brook	31,000	16,000	13,000	6,600	340	170	32	16	1,500	740	630	320
7	01115297	Wilbur Hollow Brook	28,000	6,400	6,100	1,400	110	25	46	11	770	180	1,200	280
8	01115276	Westconnaug Brook	30,000	5,800	1,800	350	110	21	15	2.9	740	140	640	120
9	01115275	Bear Tree Brook	19,000	31,000	510	820	66	110	2	3	910	1,500	41	66
32	01115178	Unnamed Tributary #1 to Scituate Reservoir (Pine Swamp Brook)	3,300	7,300	460	1,000	12	27	3.7	8.2	370	820	50	110
33	01115182	Unnamed Tributary #3 to Scituate Reservoir (Halls Estate Brook)	970	3,500	320	1,100	14	50	3.2	11	26	93	130	460
		Moswansicut Reservoir subbasin												
19	01115170	Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)	8,300	2,600	1,100	340	320	98	13	4.0	410	130	660	200
21	01115165	Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	12,000	41,000	250	860	49	170	8.6	30	800	2,800	120	410

Table 9. Median daily loads and yields of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.—Continued

[Water-quality data are from samples collected and analyzed by the Providence Water Supply Board (PWSB). Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; CFU×10⁶/d, millions of colony forming units per day; CFU×10⁶/d/mi², millions of colony forming units per day per square mile; *E. coli*, *Escherichia coli*; kg/d, kilogram per day; kg/d/mi², kilogram per day per square mile; N, nitrogen; g/d, gram per day; g/d/mi²; gram per day per square mile; PO_4, phosphate; --, no data]

PWSB station number	USGS station number	Station name	Total coliform bacteria		*E. coli*		Chloride		Nitrite (as N)		Nitrate (as N)		Orthophosphate (as PO_4)	
			($CFU \times 10^6$/d)	($CFU \times 10^6$/d/mi^2)	($CFU \times 10^6$/d)	($CFU \times 10^6$/d/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	95,000	15,000	12,000	1,800	350	55	27	4.3	1,200	190	3,100	490
15	01115114	Regulating Reservoir (Rush Brook)	37,000	7,900	2,300	490	560	120	23	4.9	1,100	230	930	200
16	01115098	Peeptoad Brook (Harrisdale Brook)	51,000	10,000	6,300	1,300	750	150	27	5.4	380	76	1,100	210
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	--	--	--	--	--	--	--	--	--	--	--	--
		Westconnaug Reservoir subbasin												
10	01115274	Westconnaug Brook	6,400	4,300	760	510	140	91	6.4	4.3	210	140	440	290
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	9,200	13,000	490	680	28	39	9.7	13	32	44	150	210
		Scituate Reservoir drainage area												
		Minimum	970	2,600	250	190	8.8	10	1.7	1.6	26	44	41	58
		Median	18,000	7,600	1,200	810	170	79	14	5.2	670	190	640	210
		Maximum	96,000	41,000	23,000	19,000	990	170	82	30	2,300	2,800	3,700	540

E. coli (19,000 CFU×10^6/d/mi^2) was at Spruce Brook (PWSB station 5; table 9). Although relatively high for sampling stations in the Scituate Reservoir drainage areas, median daily bacteria yields at Moswansicut Reservoir and Quonapaug Brook are low to moderate compared to yields of indicator bacteria in sewage-contaminated stream water or stream water 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 970 to 96,000 million colony forming units per day (CFU×10^6/d), and yields ranged from 2,600 to 41,000 CFU×10^6/d/mi^2; *E. coli* loads ranged from 250 to 23,000 CFU×10^6/d, and yields ranged from 190 to 19,000 CFU×10^6/d/mi^2 (table 9).

Chloride and Sodium

The highest median chloride concentration (90.6 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 79 kilograms per day per square mile (kg/d/mi^2). Ponaganset River (PWSB station 35) had the largest median daily chloride load (990 kilograms per day). The largest median daily chloride yield (170 kg/d/mi^2) was determined for Quonapaug Brook (PWSB station 6) and Unnamed Tributary #2 to Moswansicut Reservoir (PWSB station 21). The estimated annual mean yields 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, were 110 and 63 kg/d/mi^2, respectively. These estimated annual mean yields of chloride and sodium for WY 2015 were higher than the estimated annual mean yields for WY 2014 (90 and 55 kg/d/mi^2, respectively; Smith, 2015a).

Nutrients

Median concentrations of nitrite and nitrate (table 8) were 0.002 and 0.05 mg/L as N, respectively. The highest median concentration of nitrite (0.007 mg/L) was measured in samples collected at Unnamed Tributary #2 to Moswansicut Reservoir (PWSB station 21) and Moswansicut Reservoir (PWSB station 22). The highest median concentration of nitrate (0.98 mg/L) was measured in a sample collected at Moswansicut Reservoir (PWSB station 22). The median concentration of orthophosphate for the entire study area (table 8) was 0.08 mg/L as phosphate (PO_4). The maximum median concentration of orthophosphate (0.16 mg/L as PO_4) was measured in Unnamed Tributary #1 to Moswansicut Reservoir (PWSB station 20). Median daily nitrite, nitrate, and orthophosphate loads were largest at Barden Reservoir (PWSB station 28; 82, 2,300, and 3,700 grams per day [g/d], respectively). The largest median daily yield for nitrite (30 grams per day per square mile [g/d/mi^2]) and nitrate (2,800 g/d/mi^2) was determined for Unnamed Tributary #2 to Moswansicut Reservoir (PWSB station 21). The largest median daily yield for orthophosphate (540 g/d/mi^2) was determined for Windsor Brook (PWSB station 26; table 9). The minimum to maximum ranges for median daily yields of nitrite, nitrate, and orthophosphate for all subbasins in the Scituate Reservoir drainage area were 1.6 to 30, 44 to 2,800, and 58 to 540 g/d/mi^2, respectively.

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Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria ($CFU\times10^6/d$)	*E. coli* ($CFU\times10^6/d$)	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	10/03/14	0.10	2,000	320	6.7	0.24	12	9.8
			11/07/14	0.65	4,000	320	40	3.2	79	330
			12/05/14	4.2	14,000	3,100	310	10	520	1,100
			01/16/15	5.3	5,200	<650	370	13	1,100	910
			03/20/15	16	11,000	3,800	1,100	76	3,500	3,800
			04/17/15	9.4	390,000	23,000	710	23	1,100	1,100
			05/01/15	7.4	270,000	18,000	530	18	900	900
			06/05/15	5.5	340,000	<670	440	13	670	670
			07/16/15	1.3	20,000	660	110	6.6	160	200
			08/07/15	0.50	27,000	1,200	44	1.2	61	24
25	01115200	Shippee Brook	04/03/15	15	30,000	<1,900	400	37	1,900	1,900
			07/20/15	0.08	1,200	76	2.6	0.38	9.5	28
26	01115185	Windsor Brook	04/03/15	23	74,000	23,000	1,300	110.0	3,000	4,600
			07/20/15	0.11	4600	270	6.6	0.54	5.7	40
28	01115265	Barden Reservoir (Hemlock Brook)	11/26/14	21	450,000	140,000	1,300	200	2,500	6,100
			12/16/14	17	91,000	21,000	770	120	2,100	3,700
			01/13/15	22	54,000	<2,700	1,300	110	4,000	3,700
			03/24/15	16	<2,000	<2,000	1,100	39	2,900	6,300
			04/14/15	21	130,000	15,000	1,200	100	2,600	13,000
			05/12/15	6.4	58,000	13,000	430	63	780	3,400
			06/09/15	3.4	23,000	4,200	230	25	420	1,100
			07/14/15	1.9	510,000	46,000	150	4.6	42	420

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.—Continued

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×10^6/d)	Chloride (kg/d)	Nitrite (g/d as N)	Nitrate (g/d as N)	Orthophos-phate (g/d as PO_4)
			Barden Reservoir subbasin—Continued							
35	01115187	Ponaganset River	10/03/14	0.96	99,000	5,900	49	2.3	120	94
			11/07/14	1.9	10,000	3,200	120	4.5	230	680
			12/05/14	18	110,000	4,400	1,000	44	2,200	6,600
			01/16/15	19	23,000	<2,300	1,100	46	5,500	2,800
			03/20/15	50	130,000	12,000	3,100	120	1,500	16,000
			04/17/15	40	280,000	<4,900	2,100	98	4,900	8,800
			05/01/15	20	35,000	5,000	1,200	50	2,500	2,500
			06/05/15	14	110,000	10,000	980	35	1,700	3,100
			07/16/15	4.5	47,000	16,000	300	22	550	1,100
			08/07/15	0.68	93,000	1,700	55	3.3	180	120
			Direct Runoff subbasin							
1	01115180	Brandy Brook	10/07/14	0.25	24,000	680	30	0.62	170	12
			11/17/14	2.9	230,000	29,000	340	22	2,500	430
			12/02/14	2.6	16,000	1,300	57	25	700	570
			01/06/15	3.2	7,000	780	31	23	1,200	700
			04/01/15	4.9	7,200	1,200	89	24	190	600
			05/05/15	2.3	12,000	550	57	17	720	170
			06/02/15	2.7	200,000	39,000	53	26	1,800	260
			07/07/15	0.56	33,000	5,200	18	2.8	430	96
			08/04/15	0.30	17,000	5,900	11	3.7	13	59
3	01115280	Cork Brook	11/06/14	0.24	6,500	590	32	0.59	29	18
			12/04/14	1.8	8,000	890	180	4.5	360	270
			01/15/15	2.0	3,900	<240	160	4.8	1,600	290
			04/02/15	7.5	<920	<920	670	37	3,300	1,700
			05/07/15	2.2	5,800	<260	200	5.3	410	370
			06/04/15	2.4	23,000	1,800	270	18	650	300
			07/02/15	2.1	260,000	<260	220	10	410	310

Table 4. Daily loads of bacteria, chloride, nitrite, nitrate, and orthophosphate by tributary reservoir subbasin in the Scituate Reservoir drainage area, Rhode Island, October 1, 2014, through September 30, 2015.—Continued

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×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										
4	01115400	Kent Brook	10/07/14	0.02	1,100	<1.8	2.2	0.074	1.8	1.8
			11/17/14	0.49	11,000	3,600	5.1	1.2	12	36
			12/02/14	0.86	42,000	840	9.5	2.1	110	63
			01/06/15	2.2	1,600	<270	20	5.5	270	490
			03/17/15	6.0	<730	<730	61	15	1,900	290
			04/01/15	5.5	5,300	1,300	49	27	800.0	530
			05/05/15	0.54	800	<67	8.0	1.3	67	27
			06/02/15	4.2	24,000	<510	69	10	510	200
			07/07/15	0.12	12,000	290	1.80	0.57	14.0	26
			08/04/15	0.01	820	26	0.52	0.077	1.8	1.0
5	01115184	Spruce Brook	10/21/14	0.38	8,400	<47	49	1.9	110	37
			04/21/15	11	100,000	45,000	390	56	2,800	3,100
			07/21/15	0.55	27,000	1,500	45	1.3	42	160
6	01115183	Quonapaug Brook	11/17/14	4.4	540,000	220,000	540	54	5,000	540
			12/02/14	3.7	29,000	11,000	260	27	3,100	720
			01/06/15	4.9	32,000	28,000	360	36	5,500	2,000
			04/01/15	8.9	4,300	2,200	750	43	800	1,500
			05/05/15	3.1	38,000	15,000	310	23	1,300	380
			06/02/15	3.8	3,400,000	160,000	460	47	1,600	1,400
			07/07/15	0.45	29,000	4,400	69	9.9	630	180
7	01115297	Wilbur Hollow Brook	11/06/14	1.8	65,000	13,000	58	8.7	220	130
			12/04/14	8.7	87,000	6,300	150	63	1,100	1,300
			01/15/15	6.3	3,100	<780	62	16	2,800	1,200
			03/19/15	13	<1,600	<1,600	130	65	4,900	3,600
			04/02/15	16	8,100	<2,000	220	120	3,500	11,000

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×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								
			05/07/15	6.3	28,000	6,100	160	46	770	460
			06/04/15	3.8	210,000	28,000	75	19	460	1,200
			07/02/15	6.2	590,000	30,000	110	61	760	1,400
8	01115276	Westconnaug Brook	10/10/14	2.0	30,000	1,500	57	4.9	250	490
			11/14/14	3.6	24,000	1,800	110	--	--	--
			12/12/14	25	74,000	6,200	750	62	1,900	4,300
			01/20/15	8.1	2,000	<990	210	20	1,000	790
			03/27/15	37	36,000	<4,500	1,200	91	14,000	10,000
			04/10/15	24	12,000	<3,000	760	60	3,300	6,000
			05/15/15	8.3	45,000	4,100	300	20	1,000	810
			06/12/15	2.9	22,000	710	100	7.1	360	210
			07/13/15	1.7	21,000	<210	63	4.2	210	170
			08/14/15	4.0	450,000	9,700	95	9.7	480	190
			09/11/15	1.9	39,000	<230	64	4.6	<23	92
9	01115275	Bear Tree Brook	10/21/14	0.34	3,300	<41	66	1.7	910	41
			04/21/15	7.0	65,000	8,600	330	69	3,600	690
			07/21/15	0.30	19,000	510	51	0.7	460	36
32	01115178	Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)	04/16/15	0.75	1,700	180	24	3.7	700	92
			07/29/15	0.04	4,900	740	0.27	--	37	8.4
33	01115182	Unnamed Tributary 3 to Scituate Reservoir (Halls Estate Brook)	04/15/15	0.66	970	320	14	3.2	26	130

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PWSB station number	USGS station number	Station name	Date	Daily mean streamflow (ft^3/s)	Total coliform bacteria (CFU×10^6/d)	*E. coli* (CFU×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)	10/09/14	0.73	7,700	180	79	1.8	89	1,400
			11/25/14	3.4	9,100	4,100	330	17	410	660
			12/11/14	22	140,000	75,000	2,100	110	2,700	2,700
			01/08/15	4.7	5,700	1,100	460	23	570	570
			03/26/15	9.2	<1,100	<1,100	920	23	2,500	1,600
			04/09/15	14	<1,700	<1,700	1,600	70	3,800	7,000
			05/14/15	2.4	8,300	<300	290	5.9	300	240
			06/11/15	2.7	27,000	660	320	13	330	130
			07/09/15	3.5	58,000	1,700	98	8.7	430	1,500
			08/13/15	0.20	2,400	<24	26	0.49	24	54
			09/10/15	0.24	10,000	<29	29	1.2	<2.9	12
21	01115165	Unnamed Tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)	01/26/15	0.51	12,000	250	49	8.6	800	120
				Regulating Reservoir subbasin						
14	01115110	Huntinghouse Brook	11/20/14	2.5	32,000	12,000	82	12	310	120
			12/15/14	12	99,000	11,000	1,600	28	4,000	4,300
			01/05/15	33	330,000	160,000	1,200	160	5,300	4,800
			03/23/15	15	<1,800	<1,800	550	35	1,500	10,000
			04/17/15	12	91,000	8,800	440	29	1,200	2,600
			05/01/15	9.7	280,000	47,000	140	24	1,200	1,700
			06/05/15	6.6	320,000	21,000	250	16	100	810
			07/15/15	3.5	73,000	5,100	130	26	300	3,500
15	01115114	Rush Brook	11/20/14	2.5	37,000	7,300	300	12	4,600	370
			12/15/14	7.2	74,000	3,500	560	35	7,400	2,500
			01/05/15	21	120,000	52,000	1,800	100	1,600	2,600
			03/23/15	11	1,300	1,300	1,800	51	1,100	2,300
			04/17/15	9.4	100,000	2,300	1,400	46	320	2,800

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			Regulating Reservoir subbasin—Continued							
			05/01/15	4.8	55,000	2,300	650	23	38	930
			06/10/15	1.3	20,000	1,300	210	6.3	10	320
			07/15/15	1.6	20,000	7,600	230	11	520	640
			08/07/15	0.06	1,800	<7.3	12	0.15	8,500	13
16	01115098	Peeptoad Brook (Harrisdale Brook)	11/20/14	4.2	48,000	7,200	360	21	9,200	210
			12/15/14	9.5	54,000	16,000	550	47	4,200	2,300
			01/05/15	22	69,000	5,300	2,600	53	1,700	6,400
			03/23/15	14	<1,700	<1,700	1,800	33	180	1,300
			04/17/15	16	140,000	19,000	1,700	76	300	2,700
			05/01/15	8.5	35,000	2,100	950	21	400	830
			06/05/15	4.4	96,000	11,000	510	11	350	530
			07/15/15	2.5	44,000	<300	310	12	320	240
18	01115120	Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)	--	--	--	--	--	--	--	--
			Westconnaug Reservoir subbasin							
10	01115274	Westconnaug Brook	11/26/14	3.3	71,000	6,400	170	16	360	800
			12/16/14	2.9	9,200	710	4.2	7.1	400	780
			01/13/15	2.3	2,200	<280	150	5.6	170	390
			03/24/15	2.9	<360	<360	250	14	39	570
			04/14/15	3.3	4,800	800	250	8.0	21	480
			05/12/15	1.4	8,000	1,000	120	3.3	240	370
			06/09/15	0.32	2,900	160	26	0.78	390	78
			07/14/15	0.18	60,000	17,000	9.0	2.1	91	69
11	01115273	Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir)	04/24/15	2.0	9,200	490	28.0	9.7	32	150

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