

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 2011**

Open-File Report 2013-1127

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

**Cover.** Photograph shows Hemlock Brook.

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By Kirk P. Smith

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

**U.S. Department of the Interior**

SALLY JEWELL, Secretary

**U.S. Geological Survey**

Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2013

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Suggested citation:

Smith, K.P., 2013, Streamflow, water quality, and constituent loads and yields, Scituate Reservoir drainage area, Rhode Island, water year 2011: U.S. Geological Survey Open-File Report 2013–1127, 32 p., <http://pubs.usgs.gov/of/2013/1127/>.

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Conversion Factors and Datum

| Multiply                      | By      | To obtain                     |
|-------------------------------|---------|-------------------------------|
| Area                          |         |                               |
| square mile (mi²)             | 2.590   | square kilometer (km²)        |
| Flow rate                     |         |                               |
| cubic foot per second (ft³/s) | 0.02832 | cubic meter per second (m³/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).

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                                |
| <i>E. coli</i> | <i>Escherichia coli</i>                             |
| MOVE.1         | Maintenance of Variance Extension type 1            |
| NWIS           | National Water Inventory 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                                          |

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# Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, Water Year 2011

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) 2011 (October 1, 2010, to September 30, 2011), 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). Streamflow was measured or estimated by the USGS following standard methods at 23 streamgages; 14 of these streamgages were also equipped with instrumentation capable of continuously monitoring water level, specific conductance, and water temperature. Water-quality samples also were collected at 37 sampling stations by the PWSB and at 14 continuous-record streamgages by the USGS during WY 2011 as part of a long-term sampling program; all stations were in the Scituate Reservoir drainage area. Water-quality data collected by 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 2011.

The largest tributary to the reservoir (the Ponaganset River, which was monitored by the USGS) contributed a mean streamflow of about 37 cubic feet per second ( $\text{ft}^3/\text{s}$ ) to the reservoir during WY 2011. For the same time period, annual mean<sup>1</sup> streamflows measured (or estimated) for the other monitoring stations in this study ranged from about 0.5 to about 21  $\text{ft}^3/\text{s}$ . Together, tributaries (equipped with instrumentation capable of continuously monitoring specific conductance) transported about 1,600,000 kg (kilograms) of sodium and 2,600,000 kg of chloride to the Scituate Reservoir during WY 2011; sodium and chloride yields for the tributaries ranged from 9,800 to 53,000 kilograms per square mile ( $\text{kg}/\text{mi}^2$ ) and from 15,000 to 90,000  $\text{kg}/\text{mi}^2$ , respectively.

At the stations where water-quality samples were collected by the PWSB, the median of the median chloride concentrations was 20.0 milligrams per liter ( $\text{mg}/\text{L}$ ), median nitrite concentration was 0.002  $\text{mg}/\text{L}$  as nitrogen (N), median nitrate concentration was 0.01  $\text{mg}/\text{L}$  as N, median orthophosphate concentration was 0.07  $\text{mg}/\text{L}$  as phosphorus, and median concentrations of total coliform and *Escherichia coli* (*E. coli*) bacteria were 33 and 23 colony forming units per 100 milliliters ( $\text{CFU}/100\text{mL}$ ), respectively. The medians of the median daily loads (and yields) of chloride, nitrite, nitrate, orthophosphate, and total coliform and *E. coli* bacteria were 230 kilograms per day ( $\text{kg}/\text{d}$ ) (80 kilograms per day per square mile ( $\text{kg}/\text{d}/\text{mi}^2$ )); 10 grams per day ( $\text{g}/\text{d}$ ) (6.3 grams per day per square mile ( $\text{g}/\text{d}/\text{mi}^2$ )); 110  $\text{g}/\text{d}$  (29  $\text{g}/\text{d}/\text{mi}^2$ ); 610  $\text{g}/\text{d}$  (270  $\text{g}/\text{d}/\text{mi}^2$ ); 4,600 million colony forming units per day ( $\text{CFU}\times10^6/\text{d}$ ) (2,500  $\text{CFU}\times10^6/\text{d}/\text{mi}^2$ ); and 1,800  $\text{CFU}\times10^6/\text{d}$  (810  $\text{CFU}\times10^6/\text{d}/\text{mi}^2$ ), respectively.

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<sup>1</sup> The arithmetic mean of the individual daily mean discharges for the year noted or for the designated period.

## Introduction

The Scituate Reservoir is the primary source of drinking water for more than 60 percent of the population of Rhode Island (R.I.). It covers about 94 square miles (mi<sup>2</sup>) 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 these 9 partial-record streamgages, 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 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 (2011), 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,b,c,d; Breault and Smith, 2010; Smith and Breault, 2011).

This report presents data on streamflow, water quality, and loads and yields of selected constituents for water year (WY) 2011<sup>2</sup> 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

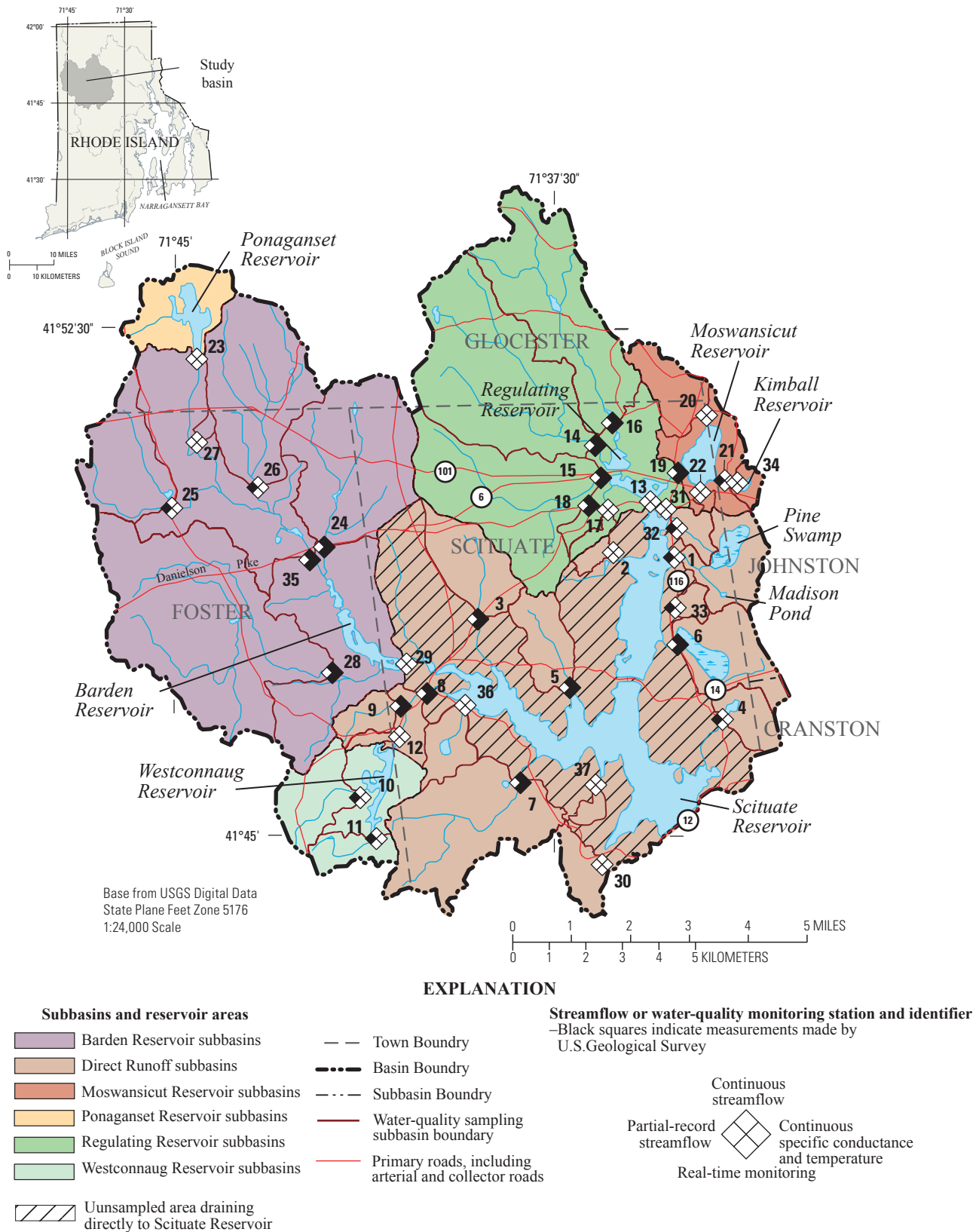
data collected by the PWSB for 37 sampling stations during WY 2011 also are presented, and these data were used to calculate loads and yields of selected water-quality constituents (table 1).

## 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 (or 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 with concurrent 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 Inventory System (NWIS; <http://waterdata.usgs.gov/nwis/>). The upper and lower 90-percent confidence limits about the estimated mean annual streamflows, as described by Tasker and Driver (1988), also 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 2011 in cooperation with RIDEM (USGS streamgage01115098) 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); upper and lower 90-percent confidence limits calculated by methods described by the National Institute of Standards and Technology/Semiconductor MANufacturing TECHnology (2003) are shown in table 2.

<sup>2</sup> October 1, 2010, to September 30, 2011.



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

#### 4 Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, WY 2011

**Table 1.** Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous monitoring stations by tributary reservoir subbasin, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2010, to September 30, 2011.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; mi<sup>2</sup>, square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB station no.               | USGS station no. | Station name                                                                                 | Drainage area (mi <sup>2</sup> ) | Frequency of QW sample collection | Number of samples collected by Providence Water <sup>1</sup> | Daily estimated Na and Cl loads | Estimated stream-flow calculated |
|--------------------------------|------------------|----------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------|--------------------------------------------------------------|---------------------------------|----------------------------------|
| Barden Reservoir Subbasin      |                  |                                                                                              |                                  |                                   |                                                              |                                 |                                  |
| 24                             | 01115190         | Dolly Cole Brook                                                                             | 4.90                             | M                                 | 10                                                           | Y                               | N                                |
| 25                             | 01115200         | Shippee Brook                                                                                | 2.35                             | Q                                 | 3                                                            | N                               | Y                                |
| 26                             | 01115185         | Windsor Brook                                                                                | 4.32                             | Q                                 | 4                                                            | N                               | Y                                |
| 27                             | 011151845        | Unnamed Tributary to Ponaganset River (Unnamed Brook B, Unnamed Brook West of Windsor Brook) | 0.10                             | Q                                 | 2                                                            | N                               | N                                |
| 28                             | 01115265         | Barden Reservoir (Hemlock Brook)                                                             | 8.72                             | M                                 | 12                                                           | Y                               | N                                |
| 29                             | 01115271         | Ponaganset River (Barden Stream)                                                             | 33.0                             | M                                 | 12                                                           | N                               | N                                |
| 35                             | 01115187         | Ponaganset River                                                                             | 14.0                             | M                                 | 11                                                           | Y                               | N                                |
| Direct Runoff Subbasin         |                  |                                                                                              |                                  |                                   |                                                              |                                 |                                  |
| 1                              | 01115180         | Brandy Brook                                                                                 | 1.57                             | M                                 | 11                                                           | N                               | Y                                |
| 2                              | 01115181         | Unnamed Tributary 2 to Scituate Reservoir (Unnamed Brook North of Bullhead Brook)            | 0.15                             | Q                                 | 1                                                            | N                               | N                                |
| 3                              | 01115280         | Cork Brook                                                                                   | 1.79                             | M                                 | 11                                                           | Y                               | N                                |
| 4                              | 01115400         | Kent Brook (Betty Pond Stream)                                                               | 0.85                             | M                                 | 11                                                           | N                               | Y                                |
| 5                              | 01115184         | Spruce Brook                                                                                 | 1.22                             | Q                                 | 3                                                            | Y                               | N                                |
| 6                              | 01115183         | Quonapaug Brook                                                                              | 1.96                             | M                                 | 11                                                           | Y                               | N                                |
| 7                              | 01115297         | Wilbur Hollow Brook                                                                          | 4.32                             | M                                 | 10                                                           | Y                               | N                                |
| 8                              | 01115276         | Westconnaug Brook (Westconnaug Reservoir)                                                    | 5.18                             | M                                 | 9                                                            | Y                               | N                                |
| 9                              | 01115275         | Bear Tree Brook                                                                              | 0.62                             | Q                                 | 2                                                            | Y                               | N                                |
| 30                             | 01115350         | Unnamed Tributary 4 to Scituate Reservoir (Coventry Brook, Knight Brook)                     | 0.78                             | Q                                 | 2                                                            | N                               | N                                |
| 31                             | 01115177         | Toad Pond                                                                                    | 0.04                             | Q                                 | 1                                                            | N                               | N                                |
| 32                             | 01115178         | Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook)                                 | 0.45                             | Q                                 | 3                                                            | N                               | Y                                |
| 33                             | 01115182         | Unnamed Tributary 3 to Scituate Reservoir (Hall's Estate Brook)                              | 0.28                             | Q                                 | 4                                                            | N                               | Y                                |
| 36                             | --               | Outflow from King Pond                                                                       | 0.77                             | Q                                 | 3                                                            | N                               | N                                |
| 37                             | --               | Fire Tower Stream                                                                            | 0.15                             | Q                                 | 2                                                            | N                               | N                                |
| Moswansicut Reservoir Subbasin |                  |                                                                                              |                                  |                                   |                                                              |                                 |                                  |
| 19                             | 01115170         | Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)                           | 3.25                             | M                                 | 11                                                           | Y                               | N                                |
| 20                             | 01115160         | Unnamed Tributary 1 to Moswansicut Reservoir (Blanchard Brook)                               | 1.18                             | M                                 | 10                                                           | N                               | N                                |
| 21                             | 01115165         | Unnamed Tributary 2 to Moswansicut Reservoir (Brook from Kimball Reservoir)                  | 0.29                             | Q                                 | 2                                                            | N                               | Y                                |
| 22                             | 01115167         | Moswansicut Reservoir (Moswansicut Stream South)                                             | 0.22                             | M                                 | 9                                                            | N                               | N                                |
| 34                             | 01115164         | Kimball Stream                                                                               | 0.27                             | Q                                 | 1                                                            | N                               | N                                |

**Table 1.** Providence Water Supply Board water-quality sampling stations, water-quality samples, and available streamflow and continuous monitoring stations by tributary reservoir subbasin, in the Scituate Reservoir drainage area, Rhode Island, October 1, 2010, to September 30, 2011.—Continued

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; mi<sup>2</sup>, square miles; QW, water quality; M, monthly; Q, quarterly; Y, yes; N, no; Na, sodium; Cl, chloride; --, none; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB station no.               | USGS station no. | Station name                                                                              | Drainage area (mi <sup>2</sup> ) | Frequency of QW sample collection | Number of samples collected by Providence Water <sup>1</sup> | Daily estimated Na and Cl loads | Estimated stream-flow calculated |
|--------------------------------|------------------|-------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------|--------------------------------------------------------------|---------------------------------|----------------------------------|
| Ponaganset Reservoir Subbasin  |                  |                                                                                           |                                  |                                   |                                                              |                                 |                                  |
| 23                             | 011151843        | Ponaganset Reservoir                                                                      | 1.92                             | M                                 | 12                                                           | N                               | N                                |
| Regulating Reservoir Subbasin  |                  |                                                                                           |                                  |                                   |                                                              |                                 |                                  |
| 13                             | 01115176         | Regulating Reservoir                                                                      | 22.1                             | M                                 | 11                                                           | N                               | N                                |
| 14                             | 01115110         | Huntinghouse Brook                                                                        | 6.23                             | M                                 | 10                                                           | Y                               | N                                |
| 15                             | 01115114         | Rush Brook                                                                                | 4.70                             | M                                 | 11                                                           | Y                               | N                                |
| 16                             | 01115098         | Peeptoad Brook (Harrisdale Brook)                                                         | 4.96                             | M                                 | 11                                                           | Y                               | N                                |
| 17                             | 01115119         | Dexter Pond (Paine Pond)                                                                  | 0.22                             | Q                                 | 2                                                            | N                               | N                                |
| 18                             | 01115120         | Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)                               | 0.28                             | Q                                 | 1                                                            | Y                               | N                                |
| Westconnaug Reservoir Subbasin |                  |                                                                                           |                                  |                                   |                                                              |                                 |                                  |
| 10                             | 01115274         | Westconnaug Brook                                                                         | 1.48                             | M                                 | 10                                                           | N                               | Y                                |
| 11                             | 01115273         | Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook south of Westconnaug Reservoir) | 0.72                             | Q                                 | 2                                                            | N                               | Y                                |
| 12                             | 011152745        | Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug Reservoir)     | 0.16                             | Q                                 | 1                                                            | N                               | N                                |

<sup>1</sup>Not all samples were analyzed for all water-quality properties or constituents.

## 6 Streamflow, Water Quality, and Constituent Loads and Yields, Scituate Reservoir Drainage Area, Rhode Island, WY 2011

**Table 2.** Measured or estimated annual mean streamflow for tributary streams in the Scituate Reservoir drainage area, Rhode Island, October 1, 2010, through September 30, 2011.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; ft<sup>3</sup>/s, cubic feet per second; ft<sup>3</sup>/s/mi<sup>2</sup>, cubic feet per second per square mile; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by the Providence Water Supply Board]

| PWSB<br>station no.            | USGS<br>station no. | Station name                                                                                 | Annual<br>mean<br>streamflow<br>(ft <sup>3</sup> /s) | Upper<br>90-percent<br>confidence<br>interval<br>(ft <sup>3</sup> /s) | Lower<br>90-percent<br>confidence<br>interval<br>(ft <sup>3</sup> /s) | Annual<br>mean<br>streamflow<br>(ft <sup>3</sup> /s/mi <sup>2</sup> ) |
|--------------------------------|---------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| Barden Reservoir Subbasin      |                     |                                                                                              |                                                      |                                                                       |                                                                       |                                                                       |
| 24                             | 01115190            | Dolly Cole Brook                                                                             | 11                                                   | 13                                                                    | 10                                                                    | 2.3                                                                   |
| 25                             | 01115200            | Shippee Brook                                                                                | 5.8                                                  | 20                                                                    | 1.6                                                                   | 2.5                                                                   |
| 26                             | 01115185            | Windsor Brook                                                                                | 8.8                                                  | 36                                                                    | 2.2                                                                   | 2.0                                                                   |
| 28                             | 01115265            | Barden Reservoir (Hemlock Brook)                                                             | 21                                                   | 24                                                                    | 19                                                                    | 2.4                                                                   |
| 35                             | 01115187            | Ponaganset River                                                                             | 37                                                   | 41                                                                    | 34                                                                    | 2.7                                                                   |
| Direct Runoff Subbasin         |                     |                                                                                              |                                                      |                                                                       |                                                                       |                                                                       |
| 1                              | 01115180            | Brandy Brook                                                                                 | 2.5                                                  | 4.6                                                                   | 1.4                                                                   | 1.6                                                                   |
| 3                              | 01115280            | Cork Brook                                                                                   | 3.4                                                  | 3.9                                                                   | 2.9                                                                   | 1.9                                                                   |
| 4                              | 01115400            | Kent Brook (Betty Pond Stream)                                                               | 2.5                                                  | 12                                                                    | 0.52                                                                  | 2.9                                                                   |
| 5                              | 01115184            | Spruce Brook                                                                                 | 2.3                                                  | 2.4                                                                   | 2.1                                                                   | 1.9                                                                   |
| 6                              | 01115183            | Quonapaug Brook                                                                              | 4.0                                                  | 4.4                                                                   | 3.7                                                                   | 2.1                                                                   |
| 7                              | 01115297            | Wilbur Hollow Brook                                                                          | 8.2                                                  | 8.9                                                                   | 7.5                                                                   | 1.9                                                                   |
| 8                              | 01115276            | Westconnaug Brook (Westconnaug Reservoir)                                                    | 7.5                                                  | 7.8                                                                   | 7.1                                                                   | 1.4                                                                   |
| 9                              | 01115275            | Bear Tree Brook                                                                              | 1.4                                                  | 1.5                                                                   | 1.3                                                                   | 2.2                                                                   |
| 32                             | 01115178            | Unnamed Tributary 1 to Scituate Reservoir<br>(Pine Swamp Brook)                              | 0.64                                                 | 1.3                                                                   | 0.32                                                                  | 1.4                                                                   |
| 33                             | 01115182            | Unnamed Tributary 3 to Scituate Reservoir<br>(Hall's Estate Brook)                           | 0.59                                                 | 1.6                                                                   | 0.21                                                                  | 2.1                                                                   |
| Moswansicut Reservoir Subbasin |                     |                                                                                              |                                                      |                                                                       |                                                                       |                                                                       |
| 19                             | 01115170            | Moswansicut Reservoir<br>(Moswansicut Stream North, Moswansicut Pond)                        | 6.3                                                  | 6.7                                                                   | 5.8                                                                   | 1.9                                                                   |
| 21                             | 01115165            | Unnamed Tributary 2 to Moswansicut Reservoir<br>(Blanchard Brook)                            | 0.69                                                 | 1.5                                                                   | 0.31                                                                  | 2.4                                                                   |
| Regulating Reservoir Subbasin  |                     |                                                                                              |                                                      |                                                                       |                                                                       |                                                                       |
| 14                             | 01115110            | Huntinghouse Brook                                                                           | 13                                                   | 15                                                                    | 11                                                                    | 2.2                                                                   |
| 15                             | 01115115            | Rush Brook                                                                                   | 9.7                                                  | 11                                                                    | 8.3                                                                   | 2.1                                                                   |
| 16                             | 01115098            | Peeptoad Brook (Harrisdale Brook)                                                            | 11                                                   | 13                                                                    | 9.7                                                                   | 2.3                                                                   |
| 18                             | 01115120            | Unnamed Tributary to Regulating Reservoir<br>(Unnamed Brook A)                               | 0.51                                                 | 0.59                                                                  | 0.43                                                                  | 1.8                                                                   |
| Westconnaug Reservoir Subbasin |                     |                                                                                              |                                                      |                                                                       |                                                                       |                                                                       |
| 10                             | 01115274            | Westconnaug Brook                                                                            | 2.4                                                  | 4.2                                                                   | 1.3                                                                   | 1.6                                                                   |
| 11                             | 01115273            | Unnamed Tributary to Westconnaug Reservoir<br>(Unnamed Brook South of Westconnaug Reservoir) | 1.3                                                  | 2.3                                                                   | 0.79                                                                  | 1.9                                                                   |

## Water-Quality Data Collection and Analysis

Water-quality data were collected by the USGS or 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 2011 as part of a long-term sampling program. 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).

Concentrations of sodium and chloride were estimated from continuous or periodic measurements of specific conductance by using equations that were developed by the USGS to relate specific conductance to concentrations of sodium and chloride (equations 1 and 2). These regression equations were developed by the MOVE.1 method (also known as the line of organic correlation; Helsel and Hirsch, 1992) on the basis of concurrent measurements of specific conductance along with sodium and chloride concentrations measured in water-quality samples collected by the USGS from tributaries in the Scituate Reservoir drainage area (U.S. Geological Survey, 2001):

$$C_{Cl} = (SpC^m) \times b, \quad (1)$$

$$C_{Na} = (SpC^m) \times b, \quad (2)$$

where

- $C_{Cl}$  is the chloride concentration, in milligrams per liter (mg/L);
- $C_{Na}$  is the sodium concentration, in mg/L; and
- $SpC$  is the specific conductance, in microsiemens per centimeter at 25° Celsius;
- $m$  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 2011. Water-quality samples were not collected during specific weather conditions; rather, a strictly periodic water-quality sampling schedule was followed so that water-quality samples would be representative of various weather conditions. However, sometimes samples could not be collected because 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, 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, 2003).

The PWSB collected samples during a wide range of flow conditions. The daily mean flow-duration curve for the Quonapaug Brook at North Scituate (USGS streamgage 01115183) for WY 2011 is shown in figure 2. The curve

**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, 2010, through September 30, 2011.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; RMSE, root mean square error]

| PWSB<br>station no. | USGS<br>station no. | Chloride |           |       | Sodium |           |       |
|---------------------|---------------------|----------|-----------|-------|--------|-----------|-------|
|                     |                     | Slope    | Intercept | RMSE  | Slope  | Intercept | RMSE  |
| 24                  | 01115190            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 28                  | 01115265            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 35                  | 01115187            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 3                   | 01115280            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 5                   | 01115184            | 0.0772   | 1.1901    | 0.037 | 0.0760 | 1.0808    | 0.037 |
| 6                   | 01115183            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 7                   | 01115297            | 0.0772   | 1.1901    | 0.037 | 0.0760 | 1.0808    | 0.037 |
| 8                   | 01115276            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 9                   | 01115275            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 19                  | 01115170            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 14                  | 01115110            | 0.0772   | 1.1901    | 0.037 | 0.0760 | 1.0808    | 0.037 |
| 15                  | 01115114            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 16                  | 01115098            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |
| 18                  | 01115120            | 0.1334   | 1.1013    | 0.030 | 0.1074 | 1.0431    | 0.035 |

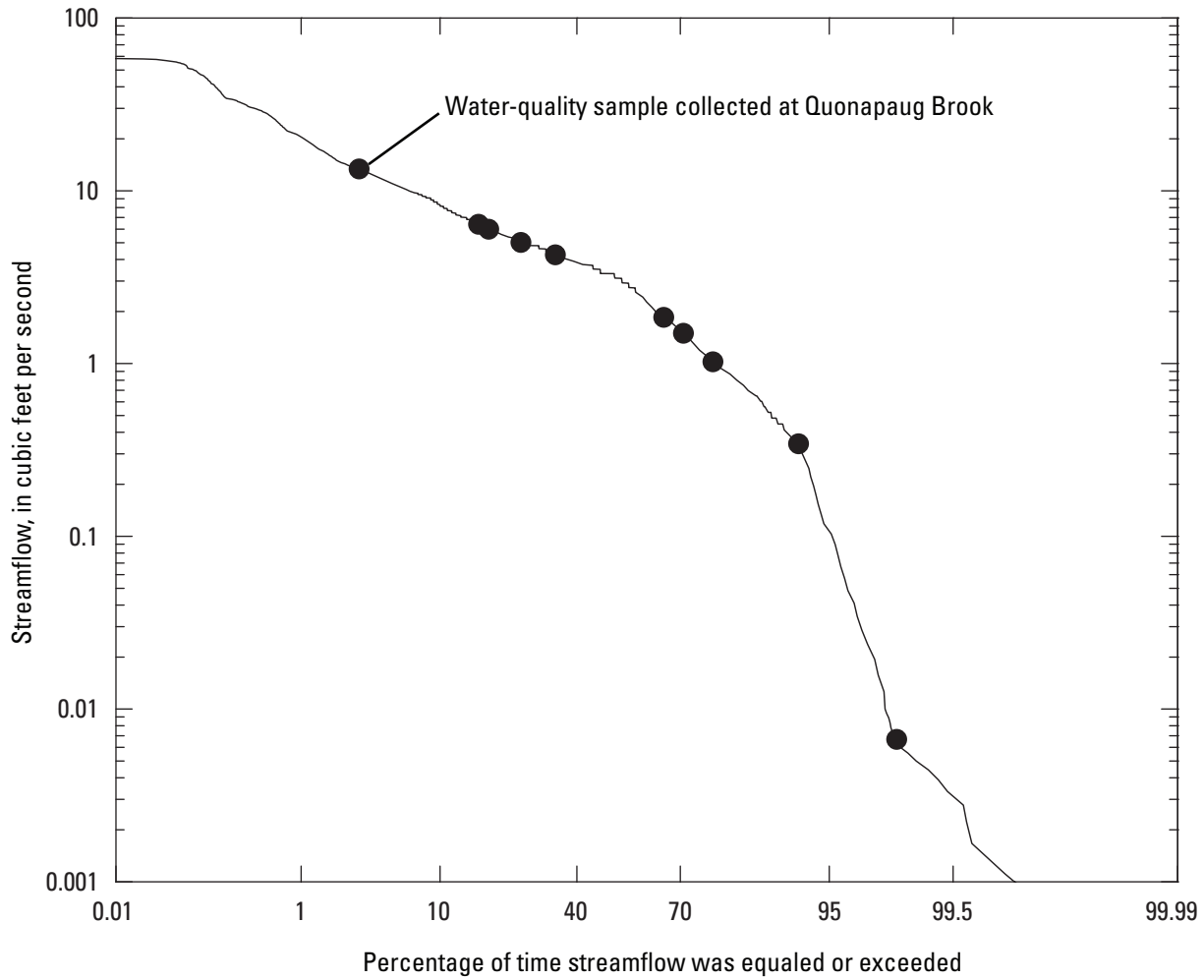
represents the percentage of time that each flow was exceeded at this station. The flows at this station on days when water-quality samples were collected are represented by the plotted points superimposed on the curve. Samples were collected at flow durations ranging from the 3rd percentile to the 98th percentile; this range indicates that the water-quality samples collected in WY 2011 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 2011. 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 was 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 2011 (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.



**Figure 2.** Flow-duration curve for the U.S. Geological Survey continuous streamgage on Quonapaug Brook at North Scituate (01115183) for water year 2011 and streamflow measurements at this streamgage on the dates (represented by points) when water-quality samples were collected.

## 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 daily streamflow at the streamgage on the Ponaganset River (USGS streamgage 01115187) for the entire time period of its operation (mean of the daily mean streamflows for the period of record, WY 1994–2010) prior to WY 2011 was 29 ft<sup>3</sup>/s (<http://waterdata.usgs.gov/nwis>). During WY 2011, annual mean streamflow was 37 ft<sup>3</sup>/s (fig. 3). Mean daily streamflow in Peepetoad Brook (streamgage 01115098), the other long-term continuous-record streamgage in the Scituate Reservoir drainage area, for its period of record (WY 1994–2010) prior to WY 2011 was 11 ft<sup>3</sup>/s (<http://waterdata.usgs.gov/nwis>). Annual mean streamflow in Peepetoad Brook during WY 2011 also was 11 ft<sup>3</sup>/s (table 2).

## Water Quality and Constituent Loads and Yields

Water-quality conditions in the Scituate Reservoir drainage area are described by summary statistics for water-quality properties, 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 higher flows tend to have higher 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 are useful for examining potential differences among basin properties that may contribute to reservoir quality.

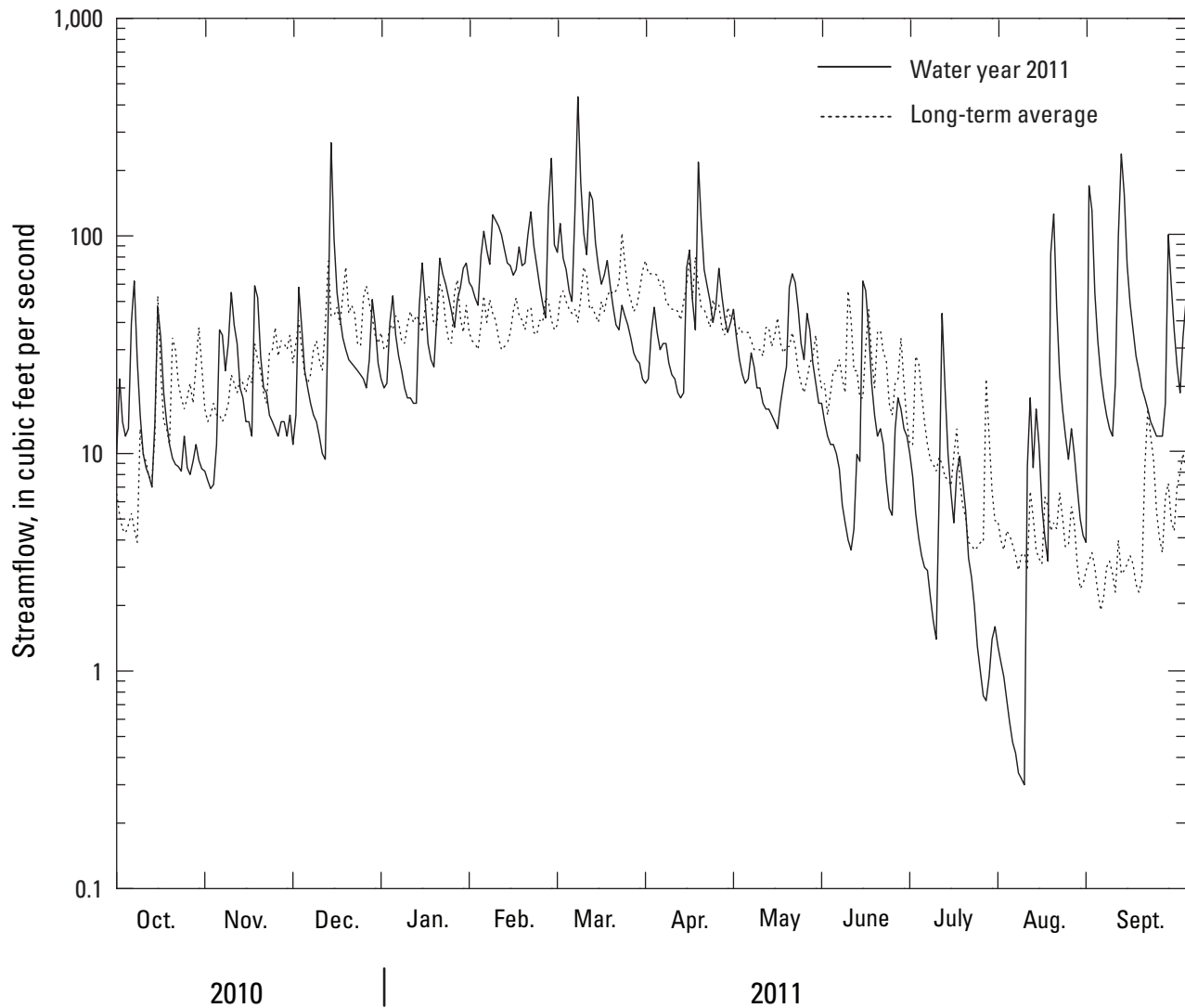
Summary statistics include means and medians. For some purposes, median values are more appropriate because they are less likely to be affected by high or low concentrations (or outliers). Medians are especially important to use for summarizing a relatively limited number of values. In contrast, continuously 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.

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

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

Estimated monthly mean<sup>3</sup> sodium concentrations in tributaries of the Scituate Reservoir drainage area ranged from 4.8 to 37.3 mg/L, and estimated monthly mean chloride concentrations ranged from 7.4 to 64.4 mg/L (table 5). The highest monthly mean concentrations of sodium and chloride were measured in Bear Tree Brook (PWSB station number 9) in October 2010 (37.3 and 64.4 mg/L, respectively; table 5).

<sup>3</sup> Monthly mean concentrations were calculated by dividing the total monthly load by the total discharge for the month.



**Figure 3.** Measured daily mean streamflow 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, for October 1, 2010, through September 30, 2011, and mean daily streamflow for October 1, 1994, through September 30, 2010.

**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, 2010, through September 30, 2011.

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

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                    | October |        | November |        | December |        | January |        | February |        | March  |        |
|--------------------------------|---------------------------|--------------------------------------------------------------------|---------|--------|----------|--------|----------|--------|---------|--------|----------|--------|--------|--------|
|                                |                           |                                                                    | Cl      | Na     | Cl       | Na     | Cl       | Na     | Cl      | Na     | Cl       | Na     | Cl     | Na     |
|                                |                           |                                                                    | (mg/L)  | (mg/L) | (mg/L)   | (mg/L) | (mg/L)   | (mg/L) | (mg/L)  | (mg/L) | (mg/L)   | (mg/L) | (mg/L) | (mg/L) |
| Barden Reservoir Subbasin      |                           |                                                                    |         |        |          |        |          |        |         |        |          |        |        |        |
| 24                             | 01115190                  | Dolly Cole Brook                                                   | 22.5    | 13.8   | 21.5     | 13.2   | 17.9     | 11.1   | 20.8    | 12.8   | 25.4     | 15.5   | 23.1   | 14.2   |
| 28                             | 01115265                  | Barden Reservoir (Hemlock Brook)                                   | 28.2    | 17.1   | 20.4     | 12.6   | 15.0     | 9.37   | 19.5    | 12.1   | 18.5     | 11.5   | 16.2   | 10.1   |
| 35                             | 01115187                  | Ponaganset River                                                   | 18.8    | 11.7   | 18.2     | 11.3   | 14.4     | 9.06   | 18.1    | 11.2   | 21.3     | 13.1   | 16.5   | 10.3   |
| Direct Runoff Subbasin         |                           |                                                                    |         |        |          |        |          |        |         |        |          |        |        |        |
| 3                              | 01115280                  | Cork Brook                                                         | 35.7    | 21.4   | 31.6     | 19.0   | 21.2     | 13.0   | 29.1    | 17.6   | 34.6     | 20.8   | 27.4   | 16.6   |
| 5                              | 01115184                  | Spruce Brook                                                       | 21.8    | 12.8   | 18.3     | 10.9   | 12.4     | 7.66   | 16.4    | 9.84   | 17.0     | 10.2   | 14.3   | 8.71   |
| 6                              | 01115183                  | Quonapaug Brook                                                    | 47.5    | 28.0   | 46.6     | 27.5   | 32.9     | 19.8   | 41.5    | 24.7   | 45.0     | 26.6   | 38.0   | 22.7   |
| 7                              | 01115297                  | Wilbur Hollow Brook                                                | 15.2    | 9.20   | 12.5     | 7.7    | 8.59     | 5.48   | 9.61    | 6.07   | 8.10     | 5.19   | 7.98   | 5.12   |
| 8                              | 01115276                  | Westconnaug Brook (West-connaug Reservoir)                         | 32.6    | 19.6   | 32.8     | 19.7   | 18.5     | 11.5   | 19.0    | 11.8   | 19.4     | 12.0   | 17.3   | 10.8   |
| 9                              | 01115275                  | Bear Tree Brook                                                    | 64.4    | 37.3   | 56.6     | 33.1   | 43.7     | 25.8   | 51.2    | 30.1   | 42.6     | 25.2   | 37.6   | 22.5   |
| Moswansicut Reservoir Subbasin |                           |                                                                    |         |        |          |        |          |        |         |        |          |        |        |        |
| 19                             | 01115170                  | Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond) | 33.1    | 19.9   | 33.2     | 19.9   | 32.9     | 19.8   | 34.2    | 20.5   | 34.4     | 20.7   | 33.2   | 20.0   |
| Regulating Reservoir           |                           |                                                                    |         |        |          |        |          |        |         |        |          |        |        |        |
| 14                             | 01115110                  | Huntinghouse Brook                                                 | 14.8    | 8.99   | 10.9     | 6.80   | 7.48     | 4.82   | 11.9    | 7.39   | 10.3     | 6.44   | 7.83   | 5.03   |
| 15                             | 01115115                  | Rush Brook                                                         | 41.5    | 24.7   | 31.1     | 18.7   | 21.3     | 13.0   | 42.2    | 25.0   | 43.2     | 25.6   | 31.7   | 19.1   |
| 16                             | 01115098                  | Peeptoad Brook (Harrisdale Brook)                                  | 34.9    | 20.9   | 36.7     | 22.0   | 29.4     | 17.8   | 30.7    | 18.6   | 35.9     | 21.5   | 30.2   | 18.2   |
| 18                             | 01115120                  | Unnamed Tributary to Regulating Reservoir (Un-named Brook A)       | 32.1    | 19.3   | 33.7     | 20.2   | 28.1     | 17.0   | 46.7    | 27.6   | 52.1     | 30.5   | 40.4   | 24.0   |
| Scituate Reservoir Basin       |                           |                                                                    |         |        |          |        |          |        |         |        |          |        |        |        |
|                                |                           | Average                                                            | 31.7    | 18.9   | 28.9     | 17.3   | 21.7     | 13.2   | 27.9    | 16.8   | 29.1     | 17.5   | 24.4   | 14.8   |

**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, 2010, through September 30, 2011.—Continued

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

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                    | April  |        | May    |        | June   |        | July   |        | August |        | September |        |
|--------------------------------|---------------------------|--------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
|                                |                           |                                                                    | Cl     | Na     | Cl     | Na     | Cl     | Na     | Cl     | Na     | Cl     | Na     | Cl        | Na     |
|                                |                           |                                                                    | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L)    | (mg/L) |
| Barden Reservoir Subbasin      |                           |                                                                    |        |        |        |        |        |        |        |        |        |        |           |        |
| 24                             | 01115190                  | Dolly Cole Brook                                                   | 22.8   | 14.0   | 23.5   | 14.4   | 24.0   | 14.7   | 23.6   | 14.5   | 20.3   | 12.5   | 18.7      | 11.6   |
| 28                             | 01115265                  | Barden Reservoir (Hemlock Brook)                                   | 17.3   | 10.8   | 19.0   | 11.8   | 19.9   | 12.3   | 20.2   | 12.5   | 17.0   | 10.6   | 14.6      | 9.17   |
| 35                             | 01115187                  | Ponaganset River                                                   | 17.2   | 10.7   | 18.3   | 11.3   | 18.4   | 11.4   | 18.3   | 11.3   | 15.5   | 9.70   | 14.0      | 8.82   |
| Direct Runoff Subbasin         |                           |                                                                    |        |        |        |        |        |        |        |        |        |        |           |        |
| 3                              | 01115280                  | Cork Brook                                                         | 26.1   | 15.9   | 29.3   | 17.8   | 29.5   | 17.9   | 26.6   | 16.2   | 26.1   | 15.9   | 20.1      | 12.4   |
| 5                              | 01115184                  | Spruce Brook                                                       | 14.8   | 8.98   | 16.1   | 9.68   | 17.4   | 10.4   | 18.3   | 10.9   | 19.0   | 11.3   | 16.7      | 10.0   |
| 6                              | 01115183                  | Quonapaug Brook                                                    | 36.9   | 22.1   | 37.2   | 22.2   | 36.0   | 21.5   | 38.2   | 22.8   | 40.0   | 23.8   | 35.8      | 21.4   |
| 7                              | 01115297                  | Wilbur Hollow Brook                                                | 9.16   | 5.81   | 9.43   | 5.97   | 7.44   | 4.80   | 8.83   | 5.62   | 10.2   | 6.41   | 8.38      | 5.36   |
| 8                              | 01115276                  | Westconnaug Brook (West-connaug Reservoir)                         | 18.0   | 11.2   | 19.7   | 12.2   | 21.1   | 13.0   | 24.4   | 14.9   | 19.4   | 12.0   | 17.4      | 10.8   |
| 9                              | 01115275                  | Bear Tree Brook                                                    | 40.3   | 24.0   | 46.5   | 27.5   | 51.9   | 30.5   | 59.0   | 34.4   | 45.7   | 26.9   | 43.7      | 25.9   |
| Moswansicut Reservoir Subbasin |                           |                                                                    |        |        |        |        |        |        |        |        |        |        |           |        |
| 19                             | 01115170                  | Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond) | 35.6   | 21.3   | 36.6   | 21.9   | 36.5   | 21.8   | 36.6   | 21.9   | 36.7   | 21.9   | 35.1      | 21.1   |
| Regulating Reservoir Subbasin  |                           |                                                                    |        |        |        |        |        |        |        |        |        |        |           |        |
| 14                             | 01115110                  | Huntinghouse Brook                                                 | 9.59   | 6.05   | 10.4   | 6.51   | 11.4   | 7.09   | 12.0   | 7.41   | 10.5   | 6.60   | 8.80      | 5.59   |
| 15                             | 01115115                  | Regulating Reservoir (Rush Brook)                                  | 29.3   | 17.7   | 36.0   | 21.6   | 41.1   | 24.4   | 34.6   | 20.7   | 27.6   | 16.7   | 24.8      | 15.1   |
| 16                             | 01115098                  | Peepthead Brook (Harrisdale Brook)                                 | 34.1   | 20.5   | 34.4   | 20.7   | 36.9   | 22.1   | 38.1   | 22.8   | 38.3   | 22.8   | 39.3      | 23.4   |
| 18                             | 01115120                  | Unnamed Tributary to Regulating Reservoir (Un-named Brook A)       | 41.3   | 24.5   | 47.8   | 28.2   | 38.9   | 23.2   | 26.6   | 16.2   | 29.4   | 17.8   | 31.8      | 19.1   |
| Scituate Reservoir Basin       |                           |                                                                    |        |        |        |        |        |        |        |        |        |        |           |        |
|                                | Average                   |                                                                    | 25.2   | 15.3   | 27.4   | 16.6   | 27.9   | 16.8   | 27.5   | 16.6   | 25.4   | 15.4   | 23.5      | 14.3   |

The highest annual mean<sup>4</sup> concentrations of sodium and chloride also were measured in Bear Tree Brook, 27.0 and 45.8 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.

The Scituate Reservoir received about 1,600,000 kg (about 1,800 tons) of sodium and 2,600,000 kg (about 2,900 tons) of chloride from tributaries—equipped with instrumentation capable of continuously monitoring specific conductance—during WY 2011. The highest sodium and chloride loads in the watershed during WY 2011—360,000 kg and 580,000 kg, respectively—were measured at the Ponaganset River station (PWSB station number 35; table 6). Monthly estimated sodium and chloride loads were highest in March at 13 stations and in February at 1 station (Ponaganset River; table 7). For these months, the estimated load of sodium and chloride at each station accounted for 12–23 percent of the annual load for each constituent at the respective stations. The highest annual sodium and chloride yields were 53,000 and 90,000 kg/mi<sup>2</sup>, respectively, and were measured at Bear Tree Brook (PWSB station number 9; table 6).

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.

<sup>4</sup> Annual mean concentrations were calculated by dividing the total annual load by the total discharge for the year.

## **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 from each basin (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 5.6 to 6.8; the median of the medians for all stations was 6.2. Median values of color ranged from 12 to 210 platinum cobalt units (PCU); the median for all stations was 55 PCU. Median values of turbidity ranged from 0.21 to 1.9 nephelometric turbidity units (NTU); the median for all stations was 0.68 NTU. Median alkalinity values in tributaries were low, ranging from 2.5 to 15 mg/L as CaCO<sub>3</sub>; the median for all stations was 4.9 mg/L as CaCO<sub>3</sub> (table 8).

### **Constituent Concentrations and Daily Loads and Yields**

Fecal indicator bacteria, chloride, and nutrients such as phosphorus and nitrogen are commonly detected in natural water; at elevated concentrations, these constituents can render water unfit for the intended use. Fecal indicator bacteria, which are found in the intestines of warm-blooded animals, may indicate impairment from sewage contamination or from livestock or wildlife that defecate in or near the stream margin. Chloride originates in tributary streamwater from precipitation, weathering, or human activities 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 in 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.

**Table 6.** Annual mean chloride and sodium concentrations, loads, and yields by sampling station in the Scituate Reservoir drainage area, Rhode Island, October 1, 2010, through September 30, 2011.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; mg/L, milligrams per liter; kg, kilograms; kg/mi<sup>2</sup>, kilograms per square mile; Cl, chloride; Na, sodium; annual mean concentrations were calculated by dividing the annual load by the total discharge for the year; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

| PWSB<br>station<br>no.         | USGS<br>station<br>no. | Station name                                                        | Concentration |              | Load       |            | Yield          |                |
|--------------------------------|------------------------|---------------------------------------------------------------------|---------------|--------------|------------|------------|----------------|----------------|
|                                |                        |                                                                     | Cl<br>(mg/L)  | Na<br>(mg/L) | Cl<br>(kg) | Na<br>(kg) | Cl<br>(kg/mi²) | Na<br>(kg/mi²) |
| Barden Reservoir Subbasin      |                        |                                                                     |               |              |            |            |                |                |
| 24                             | 01115190               | Dolly Cole Brook                                                    | 22.1          | 13.6         | 220,000    | 140,000    | 45,000         | 28,000         |
| 28                             | 01115265               | Barden Reservoir (Hemlock Brook)                                    | 17.6          | 10.9         | 330,000    | 200,000    | 38,000         | 23,000         |
| 35                             | 01115187               | Ponaganset River                                                    | 17.5          | 10.9         | 580,000    | 360,000    | 41,000         | 26,000         |
| Direct Runoff Subbasin         |                        |                                                                     |               |              |            |            |                |                |
| 3                              | 01115280               | Cork Brook                                                          | 27.1          | 16.4         | 82,000     | 50,000     | 46,000         | 28,000         |
| 5                              | 01115184               | Spruce Brook                                                        | 15.7          | 9.47         | 32,000     | 19,000     | 26,000         | 16,000         |
| 6                              | 01115183               | Quonapaug Brook                                                     | 38.9          | 23.2         | 140,000    | 83,000     | 71,000         | 42,000         |
| 7                              | 01115297               | Wilbur Hollow Brook                                                 | 9.16          | 5.80         | 67,000     | 42,000     | 15,000         | 9,800          |
| 8                              | 01115276               | Westconnaug Brook (Westconnaug Reservoir)                           | 19.7          | 12.2         | 130,000    | 81,000     | 25,000         | 16,000         |
| 9                              | 01115275               | Bear Tree Brook                                                     | 45.8          | 27.0         | 56,000     | 33,000     | 90,000         | 53,000         |
| Moswansicut Reservoir Subbasin |                        |                                                                     |               |              |            |            |                |                |
| 19                             | 01115170               | Moswansicut Reservoir, (Moswansicut Stream North, Moswansicut Pond) | 34.7          | 20.8         | 190,000    | 120,000    | 60,000         | 36,000         |
| Regulating Reservoir Subbasin  |                        |                                                                     |               |              |            |            |                |                |
| 14                             | 01115110               | Huntinghouse Brook                                                  | 9.50          | 5.99         | 110,000    | 71,000     | 18,000         | 11,000         |
| 15                             | 01115115               | Rush Brook                                                          | 32.2          | 19.3         | 280,000    | 170,000    | 59,000         | 35,000         |
| 16                             | 01115098               | Peeptoad Brook (Harrisdale Brook)                                   | 33.7          | 20.3         | 330,000    | 200,000    | 67,000         | 40,000         |
| 18                             | 01115120               | Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)         | 40.0          | 23.8         | 18,000     | 11,000     | 64,000         | 38,000         |
| Scituate Reservoir Basin       |                        |                                                                     |               |              |            |            |                |                |
|                                |                        |                                                                     | Average       |              | Total      |            | Average        |                |
|                                |                        |                                                                     | 26.0          | 15.7         | 2,600,000  | 1,600,000  | 48,000         | 29,000         |

**Table 7.** Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area Rhode Island, October 1, 2010, through September 30, 2011.

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; Cl, chloride; Na, sodium; kg, kilogram; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                             | October |        | November |        | December |         | January |         | February |         | March   |         |
|--------------------------------|---------------------------|-----------------------------------------------------------------------------|---------|--------|----------|--------|----------|---------|---------|---------|----------|---------|---------|---------|
|                                |                           |                                                                             | Cl      | Na     | Cl       | Na     | Cl       | Na      | Cl      | Na      | Cl       | Na      | Cl      | Na      |
|                                |                           |                                                                             | (Kg)    | (Kg)   | (Kg)     | (Kg)   | (Kg)     | (Kg)    | (Kg)    | (Kg)    | (Kg)     | (Kg)    | (Kg)    | (Kg)    |
| Barden Reservoir Subbasin      |                           |                                                                             |         |        |          |        |          |         |         |         |          |         |         |         |
| 24                             | 01115190                  | Dolly Cole Brook                                                            | 7,200   | 4,400  | 13,000   | 8,200  | 19,000   | 12,000  | 18,000  | 11,000  | 41,000   | 25,000  | 44,000  | 27,000  |
| 28                             | 01115265                  | Barden Reservoir<br>(Hemlock Brook)                                         | 14,000  | 8,700  | 17,000   | 10,000 | 25,000   | 16,000  | 30,000  | 19,000  | 41,000   | 25,000  | 56,000  | 35,000  |
| 35                             | 01115187                  | Ponaganset River                                                            | 23,000  | 14,000 | 29,000   | 18,000 | 40,000   | 25,000  | 59,000  | 37,000  | 130,000  | 81,000  | 98,000  | 61,000  |
| Direct Runoff Subbasin         |                           |                                                                             |         |        |          |        |          |         |         |         |          |         |         |         |
| 3                              | 01115280                  | Cork Brook                                                                  | 2,300   | 1,400  | 4,400    | 2,700  | 7,200    | 4,400   | 6,500   | 4,000   | 10,000   | 6,200   | 16,000  | 9,500   |
| 5                              | 01115184                  | Spruce Brook                                                                | 810     | 480    | 1,300    | 780    | 2,700    | 1,600   | 2,400   | 1,400   | 3,300    | 2,000   | 6,100   | 3,700   |
| 6                              | 01115183                  | Quonapaug Brook                                                             | 5,900   | 3,500  | 9,600    | 5,700  | 13,000   | 7,700   | 12,000  | 7,400   | 18,000   | 11,000  | 25,000  | 15,000  |
| 7                              | 01115297                  | Wilbur Hollow Brook                                                         | 4,400   | 2,700  | 5,000    | 3,100  | 6,300    | 4,000   | 5,000   | 3,200   | 6,300    | 4,000   | 9,700   | 6,200   |
| 8                              | 01115276                  | Westconnaug Brook (West-<br>connaug Reservoir)                              | 5,900   | 3,600  | 6,700    | 4,000  | 9,400    | 5,800   | 11,000  | 6,700   | 12,000   | 7,500   | 16,000  | 10,000  |
| 9                              | 01115275                  | Bear Tree Brook                                                             | 2,900   | 1,700  | 3,100    | 1,800  | 4,400    | 2,600   | 4,200   | 2,400   | 4,300    | 2,500   | 7,200   | 4,300   |
| Moswansicut Reservoir Subbasin |                           |                                                                             |         |        |          |        |          |         |         |         |          |         |         |         |
| 19                             | 01115170                  | Moswansicut Reservoir<br>(Moswansicut Stream<br>North, Moswansicut<br>Pond) | 5,800   | 3,500  | 9,700    | 5,800  | 18,000   | 11,000  | 15,000  | 9,000   | 17,000   | 10,000  | 34,000  | 21,000  |
| Regulating Reservoir           |                           |                                                                             |         |        |          |        |          |         |         |         |          |         |         |         |
| 14                             | 01115110                  | Huntinghouse Brook                                                          | 3,500   | 2,100  | 5,900    | 3,700  | 9,500    | 6,100   | 8,600   | 5,300   | 16,000   | 10,000  | 21,000  | 13,000  |
| 15                             | 01115115                  | Rush Brook                                                                  | 9,000   | 5,300  | 14,000   | 8,500  | 20,000   | 12,000  | 23,000  | 14,000  | 45,000   | 27,000  | 51,000  | 31,000  |
| 16                             | 01115098                  | Peeptoad Brook<br>(Harrisdale Brook)                                        | 14,000  | 8,400  | 28,000   | 17,000 | 38,000   | 23,000  | 19,000  | 11,000  | 39,000   | 24,000  | 69,000  | 42,000  |
| 18                             | 01115120                  | Unnamed Tributary to<br>Regulating Reservoir<br>(Unnamed Brook A)           | 240     | 150    | 330      | 200    | 1,300    | 760     | 1,700   | 1,000   | 3,100    | 1,800   | 4,200   | 2,500   |
| Scituate Reservoir Basin       |                           |                                                                             |         |        |          |        |          |         |         |         |          |         |         |         |
|                                |                           | Total                                                                       | 99,000  | 60,000 | 150,000  | 89,000 | 210,000  | 130,000 | 220,000 | 130,000 | 390,000  | 240,000 | 460,000 | 280,000 |

**Table 7.** Monthly estimated chloride and sodium loads by sampling station in the Scituate Reservoir drainage area Rhode Island, October 1, 2010, through September 30, 2011.—Continued

[PWSB, Providence Water Supply Board; USGS, U.S. Geological Survey; no., number; Cl, chloride; Na, sodium; kg, kilogram; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                                 | April   |         | May     |         | June    |        | July   |        | August  |        | September |         |
|--------------------------------|---------------------------|---------------------------------------------------------------------------------|---------|---------|---------|---------|---------|--------|--------|--------|---------|--------|-----------|---------|
|                                |                           |                                                                                 | Cl      | Na      | Cl      | Na      | Cl      | Na     | Cl     | Na     | Cl      | Na     | Cl        | Na      |
|                                |                           |                                                                                 | (Kg)    | (Kg)    | (Kg)    | (Kg)    | (Kg)    | (Kg)   | (Kg)   | (Kg)   | (Kg)    | (Kg)   | (Kg)      | (Kg)    |
| Barden Reservoir Subbasin      |                           |                                                                                 |         |         |         |         |         |        |        |        |         |        |           |         |
| 24                             | 01115190                  | Dolly Cole Brook                                                                | 28,000  | 17,000  | 13,000  | 8,000   | 6,000   | 3,700  | 3,000  | 1,800  | 13,000  | 8,100  | 15,000    | 9,600   |
| 28                             | 01115265                  | Barden Reservoir<br>(Hemlock Brook)                                             | 39,000  | 24,000  | 25,000  | 15,000  | 15,000  | 9,400  | 6,700  | 4,100  | 26,000  | 16,000 | 32,000    | 20,000  |
| 35                             | 01115187                  | Ponaganset River                                                                | 63,000  | 39,000  | 36,000  | 23,000  | 19,000  | 12,000 | 7,200  | 4,500  | 31,000  | 19,000 | 43,000    | 27,000  |
| Direct Runoff Subbasin         |                           |                                                                                 |         |         |         |         |         |        |        |        |         |        |           |         |
| 3                              | 01115280                  | Cork Brook                                                                      | 11,000  | 6,700   | 6,600   | 4,000   | 3,100   | 1,900  | 1,900  | 1,200  | 6,600   | 4,000  | 6,200     | 3,800   |
| 5                              | 01115184                  | Spruce Brook                                                                    | 4,700   | 2,900   | 3,200   | 1,900   | 1,700   | 1,000  | 1,100  | 630    | 1,600   | 940    | 2,800     | 1,700   |
| 6                              | 01115183                  | Quonapaug Brook                                                                 | 18,000  | 11,000  | 12,000  | 7,000   | 5,100   | 3,000  | 1,700  | 1,000  | 6,900   | 4,100  | 12,000    | 7,300   |
| 7                              | 01115297                  | Wilbur Hollow Brook                                                             | 9,100   | 5,800   | 6,400   | 4,100   | 2,600   | 1,600  | 820    | 520    | 4,400   | 2,700  | 7,000     | 4,500   |
| 8                              | 01115276                  | Westconnaug Brook (West-<br>connaug Reservoir)                                  | 15,000  | 9,400   | 15,000  | 9,500   | 11,000  | 6,500  | 6,400  | 3,900  | 8,400   | 5,200  | 14,000    | 8,500   |
| 9                              | 01115275                  | Bear Tree Brook                                                                 | 6,300   | 3,800   | 5,600   | 3,300   | 4,300   | 2,500  | 3,300  | 1,900  | 4,200   | 2,500  | 5,700     | 3,400   |
| Moswansicut Reservoir Subbasin |                           |                                                                                 |         |         |         |         |         |        |        |        |         |        |           |         |
| 19                             | 01115170                  | Moswansicut Reser-<br>voir (Moswansicut<br>Stream North, Moswan-<br>sicut Pond) | 28,000  | 17,000  | 19,000  | 11,000  | 11,000  | 6,500  | 6,000  | 3,600  | 11,000  | 6,600  | 19,000    | 11,000  |
| Regulating Reservoir Subbasin  |                           |                                                                                 |         |         |         |         |         |        |        |        |         |        |           |         |
| 14                             | 01115110                  | Huntinghouse Brook                                                              | 17,000  | 11,000  | 9,600   | 6,000   | 4,600   | 2,900  | 1,600  | 1,000  | 6,500   | 4,100  | 9,300     | 5,900   |
| 15                             | 01115115                  | Regulating Reservoir<br>(Rush Brook)                                            | 37,000  | 22,000  | 24,000  | 14,000  | 11,000  | 6,400  | 4,800  | 2,900  | 17,000  | 10,000 | 22,000    | 13,000  |
| 16                             | 01115098                  | Peeptoad Brook<br>(Harrisdale Brook)                                            | 34,000  | 21,000  | 13,000  | 7,600   | 15,000  | 8,900  | 4,300  | 2,600  | 26,000  | 15,000 | 34,000    | 20,000  |
| 18                             | 01115120                  | Unnamed Tributary to<br>Regulating Reservoir<br>(Unnamed Brook A)               | 3,000   | 1,800   | 1,500   | 910     | 530     | 320    | 230    | 140    | 690     | 420    | 1,300     | 760     |
| Scituate Reservoir Basin       |                           |                                                                                 |         |         |         |         |         |        |        |        |         |        |           |         |
|                                | Total                     |                                                                                 | 310,000 | 190,000 | 190,000 | 120,000 | 110,000 | 67,000 | 49,000 | 30,000 | 160,000 | 99,000 | 220,000   | 140,000 |

**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, 2010, through September 30, 2011.

[Water-quality data are from samples collected and analyzed by Providence Water (PWSB); no., number; 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<sub>3</sub>, calcium carbonate; N, nitrogen; P, phosphorus; <, less than; >, greater than; --, no data; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB<br>station<br>no.    | USGS<br>station no. | Station name                                                                                       | Properties    |                |                         | Constituents                                |                               |                                               |                         |                           |                           |                                    |
|---------------------------|---------------------|----------------------------------------------------------------------------------------------------|---------------|----------------|-------------------------|---------------------------------------------|-------------------------------|-----------------------------------------------|-------------------------|---------------------------|---------------------------|------------------------------------|
|                           |                     |                                                                                                    | pH<br>(units) | Color<br>(PCU) | Turbid-<br>ity<br>(NTU) | Total coli-<br>form bacteria<br>(CFU/100mL) | <i>E. coli</i><br>(CFU/100mL) | Alkalinity<br>(mg/L as<br>CaCO <sub>3</sub> ) | Chlo-<br>ride<br>(mg/L) | Nitrite<br>(mg/L<br>as N) | Nitrate<br>(mg/L<br>as N) | Orthophos-<br>phate<br>(mg/L as P) |
| Barden Reservoir Subbasin |                     |                                                                                                    |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 24                        | 01115190            | Dolly Cole Brook                                                                                   | 6.1           | 68             | 0.78                    | 23                                          | 14                            | 4.5                                           | 26                      | 0.002                     | 0.01                      | 0.07                               |
| 25                        | 01115200            | Shippee Brook                                                                                      | 6.0           | 45             | 0.75                    | 23                                          | 23                            | 3.1                                           | 15                      | 0.002                     | <0.01                     | 0.05                               |
| 26                        | 01115185            | Windsor Brook                                                                                      | 6.2           | 44             | 0.43                    | 240                                         | 23                            | 2.8                                           | 16                      | 0.001                     | 0.01                      | 0.15                               |
| 27                        | 011151845           | Unnamed Tributary to Ponaganset River<br>(Unnamed Brook B, Unnamed Brook West<br>of Windsor Brook) | 5.8           | 21             | 0.25                    | 12                                          | 2.8                           | 4.6                                           | 14                      | 0.001                     | <0.01                     | 0.02                               |
| 28                        | 01115265            | Barden Reservoir (Hemlock Brook)                                                                   | 5.8           | 80             | 0.63                    | 1,100                                       | 310                           | 2.8                                           | 20                      | 0.003                     | <0.01                     | 0.08                               |
| 29                        | 01115271            | Ponaganset River (Barden Stream)                                                                   | 6.1           | 55             | 0.78                    | 23                                          | 23                            | 4.1                                           | 20                      | 0.002                     | <0.01                     | 0.08                               |
| 35                        | 01115187            | Ponaganset River                                                                                   | 6.2           | 72             | 0.64                    | 23                                          | 23                            | 4.1                                           | 19                      | 0.002                     | <0.01                     | 0.08                               |
| Direct Runoff Subbasin    |                     |                                                                                                    |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 1                         | 01115180            | Brandy Brook                                                                                       | 6.7           | 70             | 1.2                     | 150                                         | 21                            | 9.4                                           | 12                      | 0.002                     | 0.01                      | 0.1                                |
| 2                         | 01115181            | Unnamed Tributary #2 to Scituate Reservoir<br>(Unnamed Brook North of Bullhead Brook)              | 6.3           | 18             | 0.26                    | 23                                          | 23                            | 3.4                                           | 14                      | 0.001                     | 0.03                      | 0.07                               |
| 3                         | 01115280            | Cork Brook                                                                                         | 6.3           | 45             | 0.4                     | >2,400                                      | 240                           | 4.9                                           | 30                      | 0.002                     | 0.01                      | 0.05                               |
| 4                         | 01115400            | Kent Brook (Betty Pond Stream)                                                                     | 6.3           | 32             | 0.68                    | 23                                          | 1.5                           | 7.6                                           | 5.7                     | 0.001                     | <0.01                     | 0.05                               |
| 5                         | 01115184            | Spruce Brook                                                                                       | 6.0           | 70             | 0.43                    | 23                                          | 23                            | 4.2                                           | 19                      | 0.002                     | 0.01                      | 0.06                               |
| 6                         | 01115183            | Quonapaug Brook                                                                                    | 6.4           | 84             | 1                       | 43                                          | 43                            | 8.8                                           | 38                      | 0.002                     | <0.01                     | 0.1                                |
| 7                         | 01115297            | Wilbur Hollow Brook                                                                                | 6.1           | 85             | 0.84                    | 1,100                                       | 33                            | 5.9                                           | 16                      | 0.003                     | <0.01                     | 0.08                               |
| 8                         | 01115276            | Westconnaug Brook (Westconnaug Reservoir)                                                          | 6.1           | 18             | 0.59                    | 23                                          | 23                            | 3.5                                           | 19                      | 0.001                     | 0.01                      | 0.08                               |
| 9                         | 01115275            | Bear Tree Brook                                                                                    | 6.4           | 48             | 0.35                    | 58                                          | 6.5                           | 5.4                                           | 34                      | 0.002                     | 0.04                      | 0.07                               |
| 30                        | 01115350            | Unnamed Tributary #4 to Scituate Reservoir<br>(Coventry Brook, Knight Brook)                       | 6.0           | 57             | 0.37                    | 33                                          | 23                            | 4                                             | 24                      | 0.002                     | 0.02                      | 0.07                               |
| 31                        | 1115177             | Toad Pond                                                                                          | 6.5           | 45             | 0.78                    | 93                                          | 23                            | 4.9                                           | 87                      | 0.002                     | 0.13                      | 0.08                               |
| 32                        | 01115178            | Unnamed Tributary #1 to Scituate Reservoir<br>(Pine Swamp Brook)                                   | 6.3           | 65             | 0.74                    | 23                                          | 23                            | 4.9                                           | 15                      | 0.001                     | 0.01                      | 0.09                               |
| 33                        | 01115182            | Unnamed Tributary #3 to Scituate Reservoir<br>(Hall's Estate Brook)                                | 6.2           | 55             | 0.48                    | 240                                         | 20                            | 2.9                                           | 19                      | 0.002                     | 0.03                      | 0.04                               |
| 36                        | --                  | Outflow from King Pond                                                                             | 6.2           | 20             | 0.26                    | 23                                          | 4                             | 3.4                                           | 5.1                     | 0.001                     | 0.01                      | 0.04                               |
| 37                        | --                  | Fire Tower Stream                                                                                  | 5.8           | 44             | 0.28                    | 4                                           | 4                             | 3.8                                           | 4.6                     | 0.001                     | 0.03                      | 0.03                               |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water (PWSB); no., number; 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<sub>3</sub>, calcium carbonate; N, nitrogen; P, phosphorus; <, less than; >, greater than; --, no data; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB<br>station<br>no.         | USGS<br>station no. | Station name                                                                              | Properties    |                |                         | Constituents                                |                               |                                               |                         |                           |                           |                                    |
|--------------------------------|---------------------|-------------------------------------------------------------------------------------------|---------------|----------------|-------------------------|---------------------------------------------|-------------------------------|-----------------------------------------------|-------------------------|---------------------------|---------------------------|------------------------------------|
|                                |                     |                                                                                           | pH<br>(units) | Color<br>(PCU) | Turbid-<br>ity<br>(NTU) | Total coli-<br>form bacteria<br>(CFU/100mL) | <i>E. coli</i><br>(CFU/100mL) | Alkalinity<br>(mg/L as<br>CaCO <sub>3</sub> ) | Chlo-<br>ride<br>(mg/L) | Nitrite<br>(mg/L<br>as N) | Nitrate<br>(mg/L<br>as N) | Orthophos-<br>phate<br>(mg/L as P) |
| Moswansicut Reservoir Subbasin |                     |                                                                                           |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 19                             | 01115170            | Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)                        | 6.8           | 28             | 1.2                     | 23                                          | 4                             | 7                                             | 32                      | 0.001                     | 0.01                      | 0.06                               |
| 20                             | 01115160            | Unnamed Tributary #1 to Moswansicut Reservoir (Blanchard Brook)                           | 6.1           | 210            | 0.93                    | 350                                         | 240                           | 7.9                                           | 43                      | 0.003                     | 0.01                      | 0.13                               |
| 21                             | 01115165            | Unnamed Tributary #2 to Moswansicut Reservoir (Brook from Kimball Reservoir)              | 6.6           | 85             | 1.4                     | 630                                         | 29                            | 6                                             | 19                      | 0.003                     | 0.03                      | 0.06                               |
| 22                             | 01115167            | Moswansicut Reservoir (Moswansicut Stream South)                                          | 6.6           | 60             | 1.9                     | 1,100                                       | 1,100                         | 15                                            | 40                      | 0.005                     | 0.06                      | 0.15                               |
| 34                             | 01115164            | Kimball Stream                                                                            | 6.5           | 65             | 0.57                    | 23                                          | 9                             | 8.8                                           | 31                      | 0.002                     | <0.01                     | 0.06                               |
| Ponaganset Reservoir Subbasin  |                     |                                                                                           |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 23                             | 011151843           | Ponaganset Reservoir                                                                      | 6.0           | 12             | 0.46                    | 12                                          | 1.5                           | 2.6                                           | 12                      | 0.001                     | 0.01                      | 0.03                               |
| Regulating Reservoir Subbasin  |                     |                                                                                           |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 13                             | 01115176            | Regulating Reservoir                                                                      | 6.7           | 29             | 0.76                    | 9                                           | 4                             | 3.7                                           | 30                      | 0.001                     | <0.01                     | 0.06                               |
| 14                             | 01115110            | Huntinghouse Brook                                                                        | 6.5           | 47             | 0.74                    | 200                                         | 84                            | 9.6                                           | 8.9                     | 0.002                     | <0.01                     | 0.08                               |
| 15                             | 01115115            | Rush Brook                                                                                | 6.6           | 74             | 0.8                     | 150                                         | 39                            | 13                                            | 35                      | 0.002                     | 0.01                      | 0.07                               |
| 16                             | 01115098            | Peeptoad Brook (Harrisdale Brook)                                                         | 6.5           | 42             | 0.98                    | 75                                          | 39                            | 10                                            | 34                      | 0.001                     | 0.01                      | 0.06                               |
| 17                             | 01115119            | Dexter Pond (Paine Pond)                                                                  | 5.9           | 60             | 0.6                     | 120                                         | 5.3                           | 5                                             | 33                      | 0.002                     | <0.01                     | 0.11                               |
| 18                             | 01115120            | Unnamed Tributary to Regulating Reservoir (Unnamed Brook A)                               | 6.5           | 70             | 0.76                    | >2,400                                      | 43                            | 8.9                                           | 43                      | 0.002                     | 0.01                      | 0.07                               |
| Westconnaug Reservoir Subbasin |                     |                                                                                           |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
| 10                             | 01115274            | Westconnaug Brook                                                                         | 5.6           | 33             | 0.21                    | 110                                         | 19                            | 2.5                                           | 23                      | 0.001                     | <0.01                     | 0.065                              |
| 11                             | 01115273            | Unnamed Tributary to Westconnaug Reservoir (Unnamed Brook South of Westconnaug Reservoir) | 5.7           | 100            | 0.64                    | 23                                          | 23                            | 4.1                                           | 32                      | 0.005                     | 0.03                      | 0.035                              |
| 12                             | 011152745           | Unnamed Tributary to Westconnaug Brook (Unnamed Brook north of Westconnaug Reservoir)     | 6.2           | 62             | 0.69                    | 23                                          | 23                            | 4.9                                           | 6.1                     | 0.003                     | 0.05                      | 0.03                               |
| Scituate Reservoir Basin       |                     |                                                                                           |               |                |                         |                                             |                               |                                               |                         |                           |                           |                                    |
|                                |                     | Minimum                                                                                   | 5.6           | 12             | 0.21                    | 4                                           | 1.5                           | 2.5                                           | 4.6                     | 0.001                     | <0.01                     | 0.02                               |
|                                |                     | Median                                                                                    | 6.2           | 55             | 0.68                    | 33                                          | 23                            | 4.9                                           | 20                      | 0.002                     | 0.01                      | 0.07                               |
|                                |                     | Maximum                                                                                   | 6.8           | 210            | 1.9                     | >2,400                                      | 1,100                         | 15                                            | 87                      | 0.005                     | 0.13                      | 0.15                               |

**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, 2010, through September 30, 2011.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; N, nitrogen; P, phosphorus; kg/d, kilograms per day; kg/d/mi<sup>2</sup>, kilograms per day per square mile; g/d, grams per day; g/d/mi<sup>2</sup>, grams per day per square mile; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                                 | Total coliform bacteria  |                                         | E. Coli                  |                                         | Chloride |                         | Nitrite<br>(as N) |                        | Nitrate<br>(as N) |                        | Orthophos-<br>phate (as P) |                        |
|--------------------------------|---------------------------|---------------------------------------------------------------------------------|--------------------------|-----------------------------------------|--------------------------|-----------------------------------------|----------|-------------------------|-------------------|------------------------|-------------------|------------------------|----------------------------|------------------------|
|                                |                           |                                                                                 | (CFU×10 <sup>6</sup> /d) | (CFU×10 <sup>6</sup> /mi <sup>2</sup> ) | (CFU×10 <sup>6</sup> /d) | (CFU×10 <sup>6</sup> /mi <sup>2</sup> ) | (kg/d)   | (kg/d/mi <sup>2</sup> ) | (g/d)             | (g/d/mi <sup>2</sup> ) | (g/d)             | (g/d/mi <sup>2</sup> ) | (g/d)                      | (g/d/mi <sup>2</sup> ) |
| Barden Reservoir Subbasin      |                           |                                                                                 |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
| 24                             | 01115190                  | Dolly Cole Brook                                                                | 3,100                    | 630                                     | 2,200                    | 440                                     | 360      | 73                      | 25                | 5.1                    | 110               | 23                     | 1,100                      | 220                    |
| 25                             | 01115200                  | Shippee Brook                                                                   | 3,200                    | 1,400                                   | 1,900                    | 810                                     | 230      | 98                      | 31                | 13                     | 110               | 47                     | 630                        | 270                    |
| 26                             | 01115185                  | Windsor Brook                                                                   | 75,000                   | 17,000                                  | 4,000                    | 920                                     | 300      | 69                      | 28                | 6.5                    | 200               | 46                     | 4,600                      | 1,100                  |
| 28                             | 01115265                  | Barden Reservoir<br>(Hemlock Brook)                                             | 290,000                  | 33,000                                  | 160,000                  | 18,000                                  | 770      | 88                      | 92                | 10                     | 220               | 25                     | 2,900                      | 330                    |
| 35                             | 01115187                  | Ponaganset River                                                                | 11,000                   | 790                                     | 11,000                   | 790                                     | 1,400    | 100                     | 88                | 6.3                    | 490               | 35                     | 3,600                      | 260                    |
| Direct Runoff Subbasin         |                           |                                                                                 |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
| 1                              | 01115180                  | Brandy Brook                                                                    | 6,700                    | 4,300                                   | 1,400                    | 890                                     | 73       | 46                      | 9                 | 6                      | 28                | 18                     | 610                        | 390                    |
| 3                              | 01115280                  | Cork Brook                                                                      | >65,000                  | >36,000                                 | 65,000                   | 36,000                                  | 76       | 42                      | 5.4               | 3                      | 54                | 30                     | 200                        | 110                    |
| 4                              | 01115400                  | Kent Brook                                                                      | 850                      | 1,000                                   | 320                      | 380                                     | 15       | 18                      | 2.2               | 2.6                    | 22                | 26                     | 170                        | 200                    |
| 5                              | 01115184                  | Spruce Brook                                                                    | 2,800                    | 2,300                                   | 490                      | 400                                     | 36       | 30                      | 2.3               | 1.9                    | 13                | 11                     | 92                         | 75                     |
| 6                              | 01115183                  | Quonapaug Brook                                                                 | 4,600                    | 2,300                                   | 4,400                    | 2,200                                   | 310      | 160                     | 14                | 7.1                    | 81                | 41                     | 730                        | 370                    |
| 7                              | 01115297                  | Wilbur Hollow Brook                                                             | 210,000                  | 48,000                                  | 4,700                    | 1,100                                   | 290      | 67                      | 41                | 9.4                    | 130               | 29                     | 1,200                      | 280                    |
| 8                              | 01115276                  | Westconnaug Brook                                                               | 1,800                    | 350                                     | 1,600                    | 310                                     | 390      | 75                      | 24                | 4.6                    | 120               | 23                     | 820                        | 160                    |
| 9                              | 01115275                  | Bear Tree Brook                                                                 | 1,200                    | 1,900                                   | 170                      | 270                                     | 140      | 230                     | 6.7               | 11                     | 200               | 320                    | 230                        | 370                    |
| 32                             | 01115178                  | Unnamed Tributary #1<br>to Scituate Reservoir<br>(Pine Swamp Brook)             | 570                      | 1,300                                   | 100                      | 220                                     | 38       | 84                      | 2.5               | 5.6                    | 25                | 56                     | 220                        | 490                    |
| 33                             | 01115182                  | Unnamed Tributary #3<br>to Scituate Reservoir<br>(Hall's Estate Brook)          | 700                      | 2,500                                   | 70                       | 250                                     | 16       | 56                      | 1.2               | 4.1                    | 25                | 88                     | 34                         | 120                    |
| Moswansicut Reservoir Subbasin |                           |                                                                                 |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
| 19                             | 01115170                  | Moswansicut Reser-<br>voir (Moswansicut<br>Stream North, Mo-<br>swansicut Pond) | 2,800                    | 860                                     | 770                      | 240                                     | 260      | 80                      | 10                | 3                      | 61                | 19                     | 430                        | 130                    |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; N, nitrogen; P, phosphorus; kg/d, kilograms per day; kg/d/mi<sup>2</sup>, kilograms per day per square mile; g/d, grams per day; g/d/mi<sup>2</sup>, grams per day per square mile; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water]

| PWSB<br>station<br>number      | USGS<br>station<br>number | Station<br>name                                                                                            | Total coliform bacteria  |                                         | <i>E. Coli</i>           |                                         | Chloride |                         | Nitrite<br>(as N) |                        | Nitrate<br>(as N) |                        | Orthophos-<br>phate (as P) |                        |
|--------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------|--------------------------|-----------------------------------------|----------|-------------------------|-------------------|------------------------|-------------------|------------------------|----------------------------|------------------------|
|                                |                           |                                                                                                            | (CFU×10 <sup>6</sup> /d) | (CFU×10 <sup>6</sup> /mi <sup>2</sup> ) | (CFU×10 <sup>6</sup> /d) | (CFU×10 <sup>6</sup> /mi <sup>2</sup> ) | (kg/d)   | (kg/d/mi <sup>2</sup> ) | (g/d)             | (g/d/mi <sup>2</sup> ) | (g/d)             | (g/d/mi <sup>2</sup> ) | (g/d)                      | (g/d/mi <sup>2</sup> ) |
| 21                             | 01115165                  | Unnamed Tributary #2<br>to Moswansicut Res-<br>ervoir (Brook from<br>Kimball Reservoir)                    | 31,000                   | 110,000                                 | 1,200                    | 4,200                                   | 85       | 290                     | 5.7               | 20                     | 140               | 480                    | 140                        | 490                    |
| Regulating Reservoir           |                           |                                                                                                            |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
| 14                             | 01115110                  | Huntinghouse Brook                                                                                         | 25,000                   | 3,900                                   | 16,000                   | 2,500                                   | 250      | 39                      | 40                | 6.4                    | 160               | 25                     | 2,300                      | 360                    |
| 15                             | 01115115                  | Rush Brook                                                                                                 | 26,000                   | 5,500                                   | 2,600                    | 550                                     | 650      | 140                     | 30                | 6.4                    | 120               | 26                     | 1,000                      | 210                    |
| 16                             | 01115098                  | Peep-toad Brook (Har-<br>risdale Brook)                                                                    | 18,000                   | 3,600                                   | 4,200                    | 850                                     | 570      | 110                     | 22                | 4.4                    | 120               | 24                     | 720                        | 150                    |
| 18                             | 01115120                  | Unnamed Tributary to<br>Regulating Reservoir<br>(Unnamed Brook A)                                          | >100,000                 | >350,000                                | 1,800                    | 6,400                                   | 180      | 640                     | 8                 | 30                     | 42                | 150                    | 290                        | 1,000                  |
| Westconnaug Reservoir Subbasin |                           |                                                                                                            |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
| 10                             | 01115274                  | Westconnaug Brook                                                                                          | 4,000                    | 2,700                                   | 700                      | 470                                     | 120      | 78                      | 4.6               | 3.1                    | 26                | 18                     | 400                        | 270                    |
| 11                             | 01115273                  | Unnamed Tributary<br>to Westconnaug<br>Reservoir (Un-<br>named Brook South<br>of Westconnaug<br>Reservoir) | 620                      | 860                                     | 620                      | 860                                     | 120      | 170                     | 7                 | 9.7                    | 150               | 200                    | 43                         | 59                     |
| Scituate Reservoir Basin       |                           |                                                                                                            |                          |                                         |                          |                                         |          |                         |                   |                        |                   |                        |                            |                        |
|                                |                           | Minimum                                                                                                    | 570                      | 350                                     | 70                       | 220                                     | 15       | 18                      | 1.2               | 1.9                    | 13                | 11                     | 34                         | 59                     |
|                                |                           | Median                                                                                                     | 4,300                    | 2,500                                   | 1,800                    | 810                                     | 230      | 80                      | 10                | 6.3                    | 110               | 29                     | 610                        | 270                    |
|                                |                           | Maximum                                                                                                    | 290,000                  | >350,000                                | 160,000                  | 36,000                                  | 1,400    | 640                     | 92                | 30                     | 490               | 480                    | 4,600                      | 1,100                  |

## Bacteria

Median concentrations of total coliform and *E. coli* bacteria were above the detection limit (3 CFU/100 mL) at nearly all sites (table 8). Total coliform bacteria concentrations were in most cases equal to or greater than *E. coli* concentrations (as expected because total coliform is more inclusive); the median concentrations for all sites in the drainage basin were equal to 33 CFU/100 mL for total coliform bacteria and 23 CFU/100 mL for *E. coli* bacteria. Median concentrations of total coliform bacteria were highest at Cork Brook (PWSB station number 3; table 8) and at Unnamed Tributary to Regulating Reservoir (PWSB station number 18; table 8) at more than 2,400 CFU/100 mL. Median concentrations of *E. coli* bacteria were highest at Moswansicut Reservoir (PWSB station number 22; table 8) at 1,100 CFU/100 mL.

Concentrations of fecal indicator bacteria were lowest at sampling stations Regulating Reservoir (PWSB station number 13), Ponaganset Reservoir (PWSB station number 23), Unnamed Tributary to Ponaganset River (PWSB station number 27), and Fire Tower Stream (PWSB station number 37). In addition to these sampling stations, concentrations of *E. coli* bacteria also were relatively low at Dexter Pond (PWSB station number 17), Moswansicut Reservoir (PWSB station number 19), and Outflow from King Pond (PWSB station number 36). Median daily loads and yields of total coliform and *E. coli* bacteria varied by about three orders of magnitude; the highest median daily yield of total coliform bacteria was at Unnamed Tributary to Regulating Reservoir (PWSB station number 18; table 9), and the highest median daily yield of *E. coli* bacteria was at Cork Brook (PWSB station number 3; table 9). Although relatively high for sampling stations in the Scituate Reservoir Subbasin, median daily bacteria yields at this station 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 570 to 290,000 CFU $\times$ 10<sup>6</sup>/d, and yields ranged from 350 to greater than 350,000 CFU $\times$ 10<sup>6</sup>/d/mi<sup>2</sup>; *E. coli* loads ranged from 70 to 160,000 CFU $\times$ 10<sup>6</sup>/d, and yields ranged from 220 to 36,000 CFU $\times$ 10<sup>6</sup>/d/mi<sup>2</sup> (table 9). These median daily loads were substantially greater than the values in the previous water year, when the median daily loads of total coliform bacteria ranged from 360 to 29,000 CFU $\times$ 10<sup>6</sup>/d, and loads of *E. coli* bacteria ranged from 57 to 8,700 CFU $\times$ 10<sup>6</sup>/d (Smith and Breault, 2011).

## Chloride

The highest median chloride concentration (87.0 mg/L) was measured in the Direct Runoff

Subbasin at Toad Pond (PWSB station number 31; 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 chloride yield for the overall drainage area was about 80 kilograms per day per square mile (kg/d/mi<sup>2</sup>). Ponaganset River (PWSB station number 35) had the largest median daily chloride load (1,400 kilograms per day (kg/d)). The largest median daily chloride yield (640 kg/d/mi<sup>2</sup>) was determined for Unnamed Tributary to Regulating Reservoir (PWSB station number 18); this yield is greater than the mean daily chloride yield [64,000 kilograms per year per square mile (kg/yr/mi<sup>2</sup>)(table 6) or about 175 kg/d/mi<sup>2</sup>] estimated for that station by using continuously measured specific-conductance records. The mean annual yield of chloride and sodium for the drainage areas above the 14 USGS continuous-record streamgages, which represent nearly 66 percent of the Scituate watershed, was 113 kg/d/mi<sup>2</sup> and 70 kg/d/mi<sup>2</sup>, respectively.

## Nutrients

Median concentrations of nitrite and nitrate (table 8) were 0.002 and 0.01 mg/L as nitrogen (N), respectively. Higher concentrations of nitrite and nitrate at some monitoring sites, such as Moswansicut Reservoir (PWSB station number 22) in the Moswansicut Reservoir Subbasin (0.005 mg/L as N and 0.06 mg/L as N, respectively), may have been affected by nutrient-enriched runoff or groundwater (Nimiroski and others, 2008). The median concentration of orthophosphate for the entire study area (table 8) was 0.07 mg/L as P. The maximum median concentration of orthophosphate (0.15 mg/L as P) was measured in Windsor Brook (PWSB station number 26). Median daily nutrient loads from the Ponaganset River (PWSB station number 35) into the Scituate Reservoir—nitrite (88 g/d), nitrate (490 g/d), and orthophosphate (4,600 g/d)—were among the largest for all the sampled stations. Median daily nitrite loads for WY 2011 were larger at only one station, Barden Reservoir (PWSB station number 28; 92 g/d). The largest median daily yield for nitrite (30 g/d/mi<sup>2</sup>) was determined for Unnamed Tributary to Regulating Reservoir (PWSB station number 18). The largest median daily yield for nitrate (480 g/d/mi<sup>2</sup>) was determined for Unnamed Tributary 2 to Moswansicut Reservoir (PWSB station number 21), and the largest median daily yield for orthophosphate (1,100 g/d/mi<sup>2</sup>) was determined for Windsor Brook (PWSB station number 26; table 9). The median daily yield for orthophosphate for Unnamed Tributary to Regulating Reservoir (PWSB station number 18; 1,000 g/d/mi<sup>2</sup>) also was high compared with the other stations in the monitoring network.

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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, 2010, through September 30, 2011.

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|---------------------------|---------------------|------------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| Barden Reservoir Subbasin |                     |                  |          |                                            |                                                  |                                         |                 |                    |                    |                           |
| 24                        | 01115190            | Dolly Cole Brook | 10/29/10 | 1.4                                        | 51                                               | 51                                      | 52              | 10                 | 68                 | 34                        |
|                           |                     |                  | 11/05/10 | 5.6                                        | 63,000                                           | 63,000                                  | 300             | 41                 | 68                 | 1,200                     |
|                           |                     |                  | 12/03/10 | 21                                         | 48,000                                           | 48,000                                  | 1,200           | 100                | 260                | 2,600                     |
|                           |                     |                  | 01/07/11 | 5.7                                        | 560                                              | 1,300                                   | 450             | 28                 | 140                | 700                       |
|                           |                     |                  | 03/04/11 | 17                                         | 620                                              | 620                                     | 1,100           | 42                 | 420                | 2,500                     |
|                           |                     |                  | 04/01/11 | 9.1                                        | 53,000                                           | 53,000                                  | 640             | 45                 | 220                | 18,000                    |
|                           |                     |                  | 05/06/11 | 6.6                                        | 3,700                                            | 3,700                                   | 420             | 16                 | 81                 | 1,300                     |
|                           |                     |                  | 06/15/11 | 4.4                                        | 2,500                                            | 430                                     | 290             | 22                 | 650                | 650                       |
|                           |                     |                  | 07/01/11 | 1.6                                        | 900                                              | 59                                      | 100             | 12                 | 20                 | 270                       |
|                           |                     |                  | 09/02/11 | 4.2                                        | 47,000                                           | 47,000                                  | 190             | 21                 | 51                 | 920                       |
| 25                        | 01115200            | Shippee Brook    | 10/15/10 | 6.4                                        | 170,000                                          | 38,000                                  | 230             | 31                 | 160                | 630                       |
|                           |                     |                  | 04/15/11 | 8.6                                        | 3,200                                            | 1,900                                   | 240             | 42                 | 240                | 1,100                     |
|                           |                     |                  | 07/15/11 | 0.15                                       | 83                                               | 83                                      | 6.2             | 0.36               | 350                | 58                        |
| 26                        | 01115185            | Windsor Brook    | 10/15/10 | 9.7                                        | 260,000                                          | 57,000                                  | 240             | 24                 | 5.2                | 1,200                     |
|                           |                     |                  | 01/21/11 | 14                                         | 520                                              | 520                                     | 360             | 35                 | 81                 | 8,000                     |
|                           |                     |                  | 04/15/11 | 13                                         | 150,000                                          | 7,400                                   | 710             | 32                 | 280                | 250                       |
|                           |                     |                  | 07/15/11 | 0.21                                       | 120                                              | 120                                     | 12              | 0.52               | 1,100              | 81                        |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|---------------------|---------------------|----------------------------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| 28                  | 01115265            | Barden Reservoir (Hemlock Brook) | 10/12/10 | 3.3                                        | 190,000                                          | 12,000                                  | 210             | 48                 | 88                 | 7,300                     |
|                     |                     |                                  | 11/09/10 | 23                                         | >620,000                                         | >1,400,000                              | 1,100           | 110                | 220                | 18,000                    |
|                     |                     |                                  | 12/14/10 | 94                                         | >5,500,000                                       | 2,500,000                               | 3,800           | 920                | 3,700              | 1,200                     |
|                     |                     |                                  | 01/11/11 | 7.2                                        | 4,100                                            | 700                                     | 230             | 18                 | 120                | 440                       |
|                     |                     |                                  | 02/15/11 | 18                                         | 9,200                                            | 660                                     | 950             | 44                 | 130                | 240,000                   |
|                     |                     |                                  | 03/08/11 | 200                                        | 340,000                                          | 84,000                                  | 5,500           | 370                | 320                | 1,500                     |
|                     |                     |                                  | 04/12/11 | 0                                          | 5,600                                            | 370                                     | 640             | 24                 | 210                | 2,200                     |
|                     |                     |                                  | 05/10/11 | 11                                         | 12,000                                           | 12,000                                  | 790             | 27                 | 100                | 12,000                    |
|                     |                     |                                  | 06/14/11 | 26                                         | >1,500,000                                       | 290,000                                 | 1,000           | 250                | 3,500              | 3,500                     |
|                     |                     |                                  | 07/12/11 | 8.4                                        | 230,000                                          | 230,000                                 | 520             | 100                | 910                | 1,000                     |
|                     |                     |                                  | 08/09/11 | 8.5                                        | >500,000                                         | >500,000                                | 310             | 83                 | 910                | 6,700                     |
|                     |                     |                                  | 09/13/11 | 16                                         | 430,000                                          | 430,000                                 | 740             | 160                | 930                | 2,500                     |
| 35                  | 01115187            | Ponaganset River                 | 10/29/10 | 9.3                                        | 2,000                                            | 910                                     | 230             | 68                 | 490                | 13,000                    |
|                     |                     |                                  | 11/05/10 | 37                                         | 2,200,000                                        | 140,000                                 | 1,800           | 360                | 680                | 4,600                     |
|                     |                     |                                  | 12/03/10 | 38                                         | 430,000                                          | 430,000                                 | 2,000           | 190                | 440                | 2,000                     |
|                     |                     |                                  | 01/07/11 | 20                                         | 11,000                                           | 11,000                                  | 920             | 49                 | 310                | 9,600                     |
|                     |                     |                                  | 03/04/11 | 56                                         | 2,100                                            | 2,100                                   | 2,800           | 140                | 510                | 160,000                   |
|                     |                     |                                  | 04/01/11 | 36                                         | 20,000                                           | 20,000                                  | 1,500           | 88                 | 50                 | 3,700                     |
|                     |                     |                                  | 05/06/11 | 25                                         | 920                                              | 920                                     | 1,400           | 61                 | 3.9                | 3,600                     |
|                     |                     |                                  | 06/15/11 | 21                                         | 12,000                                           | 12,000                                  | 1,500           | 100                | 220                | 1,000                     |
|                     |                     |                                  | 07/01/11 | 4.1                                        | 900                                              | 150                                     | 81              | 30                 | 17                 | 70                        |
|                     |                     |                                  | 08/05/11 | 0.32                                       | 3,600                                            | 3,600                                   | 5.9             | 0.78               | 19                 | 3,500                     |
|                     |                     |                                  | 09/02/11 | 18                                         | 200,000                                          | 200,000                                 | 730             | 88                 | 92                 | 170                       |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|------------------------|---------------------|--------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| Direct Runoff Subbasin |                     |              |          |                                            |                                                  |                                         |                 |                    |                    |                           |
| 1                      | 01115180            | Brandy Brook | 10/05/10 | 1.4                                        | 800                                              | 800                                     | 7.3             | 3.5                | 72                 | 300                       |
|                        |                     |              | 11/16/10 | 1.5                                        | 1,600                                            | 110                                     | 65              | 3.8                | 160                | 1,300                     |
|                        |                     |              | 12/16/10 | 3.8                                        | 14,000                                           | 100,000                                 | 85              | 28                 | 79                 | 720                       |
|                        |                     |              | 01/04/11 | 2.9                                        | 6,700                                            | 6,700                                   | 87              | 22                 | 140                | 1,300                     |
|                        |                     |              | 03/01/11 | 6.5                                        | 24,000                                           | 1,400                                   | 280             | 32                 | 12                 | 1,400                     |
|                        |                     |              | 04/05/11 | 3.2                                        | 19,000                                           | 1,800                                   | 96              | 16                 | 10                 | 700                       |
|                        |                     |              | 05/03/11 | 2.8                                        | 17,000                                           | 1,500                                   | 84              | 7.0                | 0.43               | 190                       |
|                        |                     |              | 06/07/11 | 0.96                                       | 1,800                                            | 35                                      | 31              | 9.4                | 28                 | 140                       |
|                        |                     |              | 07/05/11 | 0.42                                       | 240                                              | 15                                      | 6.6             | 3.1                | 45                 | 5.2                       |
|                        |                     |              | 08/02/11 | 0.04                                       | 210                                              | 1.3                                     | 0.71            | <0.01              | 16                 | 610                       |
|                        |                     |              | 09/16/11 | 2.3                                        | 26,000                                           | 26,000                                  | 73              | 11                 | 140                | 450                       |
| 3                      | 01115280            | Cork Brook   | 10/07/10 | 3.7                                        | >100,000                                         | >220,000                                | 43              | 18                 | 78                 | 190                       |
|                        |                     |              | 11/04/10 | 1.3                                        | >35,000                                          | >76,000                                 | 7.6             | 3.2                | 75                 | 2,000                     |
|                        |                     |              | 12/02/10 | 5.7                                        | >330,000                                         | >330,000                                | 72              | 42                 | 150                | 200                       |
|                        |                     |              | 01/06/11 | 1.6                                        | 94,000                                           | 5,900                                   | 130             | 3.9                | 56                 | 75                        |
|                        |                     |              | 03/03/11 | 6.1                                        | >360,000                                         | >360,000                                | 600             | 15                 | 54                 | 2,600                     |
|                        |                     |              | 04/13/11 | 12                                         | >700,000                                         | 70,000                                  | 940             | 88                 | 13                 | 280                       |
|                        |                     |              | 05/15/11 | 2.3                                        | 62,000                                           | 8,400                                   | 170             | 5.6                | 0.49               | 54                        |
|                        |                     |              | 06/02/11 | 1.1                                        | >65,000                                          | 620                                     | 76              | 2.7                | 13                 | 120                       |
|                        |                     |              | 07/07/11 | 0.18                                       | 2,000                                            | 170                                     | 11              | 1.3                | 110                | 0.24                      |
|                        |                     |              | 08/04/11 | 0.02                                       | >1,200                                           | 11                                      | 2.1             | <0.01              | 5.1                | 350                       |
|                        |                     |              | 09/01/11 | 1.1                                        | >65,000                                          | >65,000                                 | 89              | 5.4                | 57                 | 480                       |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|---------------------|---------------------|-----------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| 4                   | 01115400            | Kent Brook      | 10/05/10 | 0.46                                       | 850                                              | 850                                     | 15              | 1.1                | 44                 | 61                        |
|                     |                     |                 | 11/16/10 | 0.42                                       | 15                                               | 15                                      | 3.8             | 1.0                | 110                | 170                       |
|                     |                     |                 | 12/16/10 | 2.3                                        | 14,000                                           | 14,000                                  | 19              | 11                 | 110                | 220                       |
|                     |                     |                 | 01/04/11 | 1.8                                        | 180                                              | 66                                      | 25              | 4.4                | 19                 | 210                       |
|                     |                     |                 | 02/08/11 | 8.7                                        | 850                                              | 320                                     | 130             | 43                 | 22                 | 440                       |
|                     |                     |                 | 03/01/11 | 9.1                                        | 53,000                                           | 330                                     | 220             | 44                 | 1.1                | 160                       |
|                     |                     |                 | 04/05/11 | 1.6                                        | 900                                              | 900                                     | 20              | 7.8                | 0.50               | 110                       |
|                     |                     |                 | 05/03/11 | 0.9                                        | 500                                              | 33                                      | 11              | 2.2                | 11                 | 20                        |
|                     |                     |                 | 06/07/11 | 0.09                                       | 52                                               | 3.4                                     | 1.5             | 0.23               | 13                 | 6.0                       |
|                     |                     |                 | 07/05/11 | 0.04                                       | 1,100                                            | 23                                      | 0.72            | 0.20               | 130                | 260                       |
|                     |                     |                 | 09/06/11 | 0.9                                        | 5,300                                            | 5,300                                   | 12              | 2.2                | 20                 | 40                        |
| 5                   | 01115184            | Spruce Brook    | 10/19/10 | 0.27                                       | 150                                              | 150                                     | 12              | 0.66               | 22                 | 640                       |
|                     |                     |                 | 04/19/11 | 5.2                                        | 2,900                                            | 2,900                                   | 200             | 25                 | 300                | 92                        |
|                     |                     |                 | 07/19/11 | 0.47                                       | 2,800                                            | 490                                     | 36              | 2.3                | 430                | 470                       |
| 6                   | 01115183            | Quonapaug Brook | 10/05/10 | 1.6                                        | >43,000                                          | >94,000                                 | 86              | 3.9                | 81                 | 750                       |
|                     |                     |                 | 11/16/10 | 1.8                                        | 1,900                                            | 1,900                                   | 200             | 4.4                | 320                | 1,500                     |
|                     |                     |                 | 12/16/10 | 6.2                                        | 70,000                                           | 70,000                                  | 450             | 30                 | 240                | 970                       |
|                     |                     |                 | 01/04/11 | 4.4                                        | 4,600                                            | 1,600                                   | 380             | 22                 | 310                | 160                       |
|                     |                     |                 | 02/08/11 | 6.6                                        | 1,800                                            | 3,700                                   | 66              | 32                 | 11                 | 1,900                     |
|                     |                     |                 | 03/01/11 | 13                                         | 48,000                                           | 24,000                                  | 1,200           | 32                 | 3.7                | 490                       |
|                     |                     |                 | 04/05/11 | 5.0                                        | 5,300                                            | 5,300                                   | 470             | 24                 | 33                 | 1,000                     |
|                     |                     |                 | 05/03/11 | 4.2                                        | 4,400                                            | 4,400                                   | 390             | 10                 | 120                | 250                       |
|                     |                     |                 | 06/07/11 | 0.94                                       | 340                                              | 34                                      | 100             | 14                 | 55                 | 100                       |
|                     |                     |                 | 07/05/11 | 0.3                                        | 3,400                                            | 3,400                                   | 5.0             | 9.5                | 130                | 730                       |
|                     |                     |                 | 09/06/11 | 2.7                                        | >160,000                                         | >160,000                                | 310             | 13                 | 150                | 2,000                     |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|---------------------|---------------------|--------------------------------------------------------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| 7                   | 01115297            | Wilbur Hollow Brook                                          | 10/07/10 | <0.01                                      | >270,000                                         | >590,000                                | 360             | 73                 | 210                | 1,200                     |
|                     |                     |                                                              | 11/04/10 | 4.5                                        | 4,700                                            | 4,700                                   | 160             | 11                 | 200                | 270                       |
|                     |                     |                                                              | 12/02/10 | 11                                         | >650,000                                         | >650,000                                | 450             | 81                 | 78                 | 1,200                     |
|                     |                     |                                                              | 01/06/11 | 6.1                                        | 600                                              | 600                                     | 590             | 30                 | 210                | 3,700                     |
|                     |                     |                                                              | 03/03/11 | 17                                         | 1,000,000                                        | 3,700                                   | 930             | 42                 | 5.5                | 1,200                     |
|                     |                     |                                                              | 04/07/11 | 8.2                                        | 4,600                                            | 4,600                                   | 250             | 40                 | 81                 | 940                       |
|                     |                     |                                                              | 05/15/11 | 6.4                                        | >170,000                                         | 33,000                                  | 170             | 47                 | 56                 | 310                       |
|                     |                     |                                                              | 06/02/11 | 4.2                                        | >250,000                                         | 2,400                                   | 330             | 10                 | 270                | 180                       |
|                     |                     |                                                              | 07/07/11 | 0.45                                       | 1,000                                            | 250                                     | 24              | 3.3                | 370                | 1,900                     |
|                     |                     |                                                              | 09/01/11 | 6.6                                        | >390,000                                         | >390,000                                | 130             | 48                 | 120                | 390                       |
| 8                   | 01115276            | Westconnaug Brook                                            | 10/08/10 | 2.3                                        | 2,200                                            | 2,200                                   | 55              | 5.6                | 99                 | 810                       |
|                     |                     |                                                              | 12/17/10 | 11                                         | 6,200                                            | 6,200                                   | 270             | 27                 | 430                | 3,300                     |
|                     |                     |                                                              | 03/11/11 | 15                                         | 1,500                                            | 550                                     | 510             | 37                 | 68                 | 2,800                     |
|                     |                     |                                                              | 04/08/11 | 9.7                                        | 360                                              | 360                                     | 310             | 24                 | 34                 | 590                       |
|                     |                     |                                                              | 05/13/11 | 8.1                                        | 1,800                                            | 300                                     | 390             | 20                 | 420                | 4,500                     |
|                     |                     |                                                              | 06/10/11 | 8.8                                        | 5,000                                            | 5,000                                   | 410             | 43                 | 12                 | 820                       |
|                     |                     |                                                              | 07/08/11 | 5.6                                        | 3,200                                            | 3,200                                   | 390             | 14                 | 390                | 550                       |
|                     |                     |                                                              | 08/12/11 | 2.8                                        | 1,600                                            | 1,600                                   | 180             | 6.8                | 240                | 14,000                    |
|                     |                     |                                                              | 09/09/11 | 17                                         | 620                                              | 620                                     | 820             | 42                 | 25                 | 72                        |
| 9                   | 01115275            | Bear Tree Brook                                              | 10/19/10 | 0.49                                       | 1,100                                            | 110                                     | 26              | 2.4                | 9.2                | 390                       |
|                     |                     |                                                              | 04/19/11 | 2.3                                        | 1,300                                            | 230                                     | 260             | 11                 | 160                | 26                        |
| 32                  | 01115178            | Unnamed Tributary 1 to Scituate Reservoir (Pine Swamp Brook) | 10/20/10 | 0.18                                       | 100                                              | 100                                     | 4.0             | 0.87               | 40                 | 300                       |
|                     |                     |                                                              | 01/20/11 | 1.1                                        | 12,000                                           | 1,200                                   | 40              | 2.7                | 1.0                | 220                       |
|                     |                     |                                                              | 04/21/11 | 1.0                                        | 570                                              | 98                                      | 38              | 2.5                | 930                | 9.2                       |

**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, 2010, through September 30, 2011.—Continued

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| PWSB station number            | USGS station number | Station name                                                                 | Date     | Daily mean streamflow (ft³/s) | Total coliform bacteria (CFU×10⁶/d) | <i>E. Coli</i> (CFU×10⁶/d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophos-<br>phate (g/d as P) |
|--------------------------------|---------------------|------------------------------------------------------------------------------|----------|-------------------------------|-------------------------------------|----------------------------|-----------------|--------------------|--------------------|--------------------------------|
| 33                             | 01115182            | Unnamed Tributary 3 to Scituate Reservoir (Hall’s Estate Brook)              | 10/27/10 | 0.13                          | 1,400                               | 120                        | 4.1             | 0.31               | 61                 | 59                             |
|                                |                     |                                                                              | 01/31/11 | 0.8                           | 29                                  | 29                         | 36              | 2.0                | 44                 | 93                             |
|                                |                     |                                                                              | 04/27/11 | 0.54                          | 300                                 | 20                         | 27              | 2.6                | 300                | 2.4                            |
|                                |                     |                                                                              | 07/27/11 | 0.02                          | >1,100                              | 110                        | 1.0             | 0.0                | 1,000              | 49                             |
| Moswansicut Reservoir Subbasin |                     |                                                                              |          |                               |                                     |                            |                 |                    |                    |                                |
| 19                             | 01115170            | Moswansicut Reservoir (Moswansicut Stream North, Moswansicut Pond)           | 10/14/10 | 2.0                           | 200                                 | 200                        | 170             | 4.9                | 340                | 430                            |
|                                |                     |                                                                              | 11/15/10 | 2.5                           | >67000                              | >150000                    | 210             | 6.1                | 49                 | 260                            |
|                                |                     |                                                                              | 12/09/10 | 1.8                           | 110,000                             | 6,600                      | 140             | 4.4                | 42                 | 300                            |
|                                |                     |                                                                              | 02/10/11 | 6.2                           | 230                                 | 230                        | 530             | 30                 | 37                 | 1,000                          |
|                                |                     |                                                                              | 03/10/11 | 21                            | 3,600                               | 770                        | 1,100           | 100                | 590                | 11,000                         |
|                                |                     |                                                                              | 04/14/11 | 14                            | 1,400                               | 510                        | 1,300           | 68                 | 61                 | 1,200                          |
|                                |                     |                                                                              | 05/12/11 | 4.0                           | 150                                 | 150                        | 350             | 9.8                | 280                | 170                            |
|                                |                     |                                                                              | 06/09/11 | 3.4                           | 7,700                               | 1,200                      | 260             | 8.3                | 0.82               | 290                            |
|                                |                     |                                                                              | 07/14/11 | 3.0                           | 1,700                               | 1,700                      | 220             | 7.3                | 13                 | 2,300                          |
|                                |                     |                                                                              | 08/16/11 | 12                            | 22,000                              | 22,000                     | 770             | 29                 | 590                | 980                            |
|                                |                     |                                                                              | 09/16/11 | 5.0                           | 2,800                               | 490                        | 260             | 12                 | 150                | 280                            |
| 21                             | 01115165            | Unnamed Tributary 2 to Moswansicut Res-ervoir (Brook from Kimball Reservoir) | 04/18/11 | 2.3                           | 61,000                              | 2,400                      | 170             | 11                 | 640                | 4.9                            |
|                                |                     |                                                                              | 07/18/11 | 0.03                          | 120                                 | 12                         | 0.68            | 0.33               | 3,100              | 220                            |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|-------------------------------|---------------------|--------------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| Regulating Reservoir Subbasin |                     |                    |          |                                            |                                                  |                                         |                 |                    |                    |                           |
| 14                            | 01115110            | Huntinghouse Brook | 10/04/10 | 1.1                                        | 4,000                                            | 40                                      | 30              | 2.7                | 160                | 2,900                     |
|                               |                     |                    | 11/18/10 | 24                                         | 25,000                                           | 25,000                                  | 480             | 120                | 120                | 1,200                     |
|                               |                     |                    | 12/06/10 | 6.0                                        | 22,000                                           | 14,000                                  | 120             | 15                 | 150                | 6,400                     |
|                               |                     |                    | 01/03/11 | 26                                         | 150,000                                          | 150,000                                 | 600             | 64                 | 2,800              | 62,000                    |
|                               |                     |                    | 03/07/11 | 300                                        | >14,800,000                                      | 460,000                                 | 4,300           | 1800               | 57                 | 2,900                     |
|                               |                     |                    | 04/04/11 | 13                                         | 12,000                                           | 1,300                                   | 380             | 32                 | 16                 | 1,600                     |
|                               |                     |                    | 05/02/11 | 9.5                                        | 10,000                                           | 10,000                                  | 280             | 46                 | 4,500              | 310                       |
|                               |                     |                    | 06/06/11 | 2.1                                        | 24,000                                           | 7,700                                   | 210             | 10                 | 120                | 15,000                    |
|                               |                     |                    | 08/15/11 | 29                                         | >1,700,000                                       | >1,700,000                              | 170             | 350                | 390                | 110                       |
|                               |                     |                    | 09/15/11 | 4.7                                        | >280,000                                         | 17,000                                  | 33              | 34                 | 3,600              | 320                       |
| 15                            | 01115115            | Rush Brook         | 10/04/10 | 1.3                                        | 4,800                                            | 730                                     | 140             | 3.2                | 120                | 1,000                     |
|                               |                     |                    | 11/18/10 | 14                                         | 26,000                                           | 1,700                                   | 700             | 100                | 77                 | 840                       |
|                               |                     |                    | 12/06/10 | 4.9                                        | >290,000                                         | 1,800                                   | 420             | 12                 | 81                 | 2,700                     |
|                               |                     |                    | 01/03/11 | 16                                         | 9,000                                            | 9,000                                   | 820             | 39                 | 1.0                | 32,000                    |
|                               |                     |                    | 03/07/11 | 100                                        | 540,000                                          | 860,000                                 | 6,800           | 1100               | 2,500              | 1,200                     |
|                               |                     |                    | 04/04/11 | 9.8                                        | 10,000                                           | 2,600                                   | 1,100           | 24                 | 48                 | 1,100                     |
|                               |                     |                    | 05/02/11 | 6.3                                        | 37,000                                           | 6,600                                   | 650             | 31                 | 44                 | 220                       |
|                               |                     |                    | 06/06/11 | 1.1                                        | 400                                              | 1,000                                   | 140             | 5.4                | 1,200              | 22                        |
|                               |                     |                    | 07/25/11 | 0.04                                       | 230                                              | 230                                     | 4.7             | <0.01              | 120                | 17,000                    |
|                               |                     |                    | 08/15/11 | 52                                         | >3,100,000                                       | >3,100,000                              | 2,300           | 1700               | 880                | 290                       |
|                               |                     |                    | 09/15/11 | 3.9                                        | 100,000                                          | 23,000                                  | 120             | 29                 | 7,900              | 350                       |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis 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 <sup>3</sup> /s) | Total coliform bacteria (CFU×10 <sup>6</sup> /d) | <i>E. Coli</i> (CFU×10 <sup>6</sup> /d) | Chloride (kg/d) | Nitrite (g/d as N) | Nitrate (g/d as N) | Orthophosphate (g/d as P) |
|--------------------------------|---------------------|-------------------------------------------------------------|----------|--------------------------------------------|--------------------------------------------------|-----------------------------------------|-----------------|--------------------|--------------------|---------------------------|
| 16                             | 01115098            | Peepetoad Brook (Harrisdale Brook)                          | 10/04/10 | 3.6                                        | 3,800                                            | 350                                     | 240             | 8.8                | 290                | 7,300                     |
|                                |                     |                                                             | 11/18/10 | 50                                         | 26,000                                           | 26,000                                  | 3,800           | 370                | 54                 | 720                       |
|                                |                     |                                                             | 12/06/10 | 4.9                                        | 18,000                                           | 130,000                                 | 410             | 12                 | 15                 | 2,600                     |
|                                |                     |                                                             | 01/03/11 | 18                                         | 33,000                                           | 33,000                                  | 1,500           | 44                 | 8.3                | 2,000                     |
|                                |                     |                                                             | 03/07/11 | 200                                        | >9,500,000                                       | >9,500,000                              | 11,000          | 1200               | 640                | 2,600                     |
|                                |                     |                                                             | 04/04/11 | 12                                         | 6,800                                            | 1,200                                   | 1,000           | 29                 | 57                 | 540                       |
|                                |                     |                                                             | 05/02/11 | 4.4                                        | 50,000                                           | 4,200                                   | 570             | 22                 | 42                 | 88                        |
|                                |                     |                                                             | 06/06/11 | 1.2                                        | 680                                              | 680                                     | 130             | 5.9                | 11                 | 220                       |
|                                |                     |                                                             | 07/25/11 | 0.68                                       | 1,200                                            | 1,200                                   | 86              | 1.7                | 47                 | 1,900                     |
|                                |                     |                                                             | 08/15/11 | 13                                         | 350,000                                          | 350,000                                 | 1,000           | 380                | 120                | 110                       |
|                                |                     |                                                             | 09/15/11 | 4.7                                        | 8,600                                            | 1,300                                   | 250             | 11                 | 29                 | 290                       |
| 18                             | 01115120            | Unnamed Tributary to Regulating Reservoir (Unnamed Brook A) | 04/18/11 | 1.7                                        | >100,000                                         | 1,800                                   | 180             | 8.3                | 260                | 11                        |
| Westconnaug Reservoir Subbasin |                     |                                                             |          |                                            |                                                  |                                         |                 |                    |                    |                           |
| 10                             | 01115274            | Westconnaug Brook                                           | 10/12/10 | 0.44                                       | 1,600                                            | 150                                     | 21              | 1.1                | 23                 | 560                       |
|                                |                     |                                                             | 11/09/10 | 3.8                                        | 22,000                                           | 22,000                                  | 200             | 19                 | 23                 | 970                       |
|                                |                     |                                                             | 12/14/10 | 10                                         | 18,000                                           | 18,000                                  | 580             | 24                 | 22                 | 270                       |
|                                |                     |                                                             | 01/11/11 | 1.2                                        | 71,000                                           | 120                                     | 100             | 2.9                | 4.0                | 2,300                     |
|                                |                     |                                                             | 03/08/11 | 11                                         | 6,000                                            | 390                                     | 500             | 52                 | 88                 | 47                        |
|                                |                     |                                                             | 04/12/11 | 1.9                                        | 1,100                                            | 70                                      | 140             | 4.7                | 290                | 320                       |
|                                |                     |                                                             | 05/10/11 | 1.9                                        | 68                                               | 68                                      | 130             | 4.5                | 1.6                | 790                       |
|                                |                     |                                                             | 06/14/11 | 1.8                                        | >110,000                                         | >110,000                                | 95              | 4.4                | 15                 | 48                        |
|                                |                     |                                                             | 07/12/11 | 0.33                                       | 1,900                                            | 1,900                                   | 18              | 0.80               | 10                 | 480                       |
|                                |                     |                                                             | 09/13/11 | 1.8                                        | 1,000                                            | 1,000                                   | 97              | 18                 | 14                 | 37                        |

**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, 2010, through September 30, 2011.—Continued

[Water-quality data are from samples collected and analyzed by Providence Water Supply Board (PWSB); USGS, U.S. Geological Survey; ft<sup>3</sup>/s, cubic feet per second; CFU×10<sup>6</sup>/d; millions of colony forming units per day; *E. coli*, *Escherichia coli*; kg/d, kilograms per day; g/d, grams per day; N, nitrogen; P, phosphorus; <, less than; >, greater than; shaded areas indicate values that were calculated with concentration data censored at half the detection level; alternate station names given in parenthesis for stations where different historical names were used for the same sampling location by Providence Water Supply Board]

| PWSB<br>station<br>number | USGS<br>station<br>number | Station<br>name                                                                                         | Date     | Daily<br>mean<br>streamflow<br>(ft <sup>3</sup> /s) | Total<br>coliform<br>bacteria<br>(CFU×10 <sup>6</sup> /d) | <i>E. Coli</i><br>(CFU×10 <sup>6</sup> /d) | Chloride<br>(kg/d) | Nitrite<br>(g/d as N) | Nitrate<br>(g/d as N) | Orthophos-<br>phate<br>(g/d as P) |
|---------------------------|---------------------------|---------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------|-----------------------------------------------------------|--------------------------------------------|--------------------|-----------------------|-----------------------|-----------------------------------|
| 11                        | 01115273                  | Unnamed Tributary to<br>Westconnaug Reser-<br>voir (Unnamed Brook<br>South of Westconnaug<br>Reservoir) | 10/26/10 | 0.25                                                | 140                                                       | 140                                        | 8.2                | 4.4                   | 83                    | 48                                |
|                           |                           |                                                                                                         | 04/26/11 | 2.0                                                 | 1,100                                                     | 1,100                                      | 240                | 9.6                   | 14                    | 820                               |

Prepared by the Pembroke Publishing Service Center.

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