

Hydrologic, Water-Quality, and Meteorological Data for the Cambridge, Massachusetts, Drinking-Water Source Area, Water Year 2006

By Kirk P. Smith

Prepared in cooperation with the
City of Cambridge, Massachusetts, Water Department

Open-File Report 2008–1175

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

U.S. Department of the Interior
DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

U.S. Geological Survey, Reston, Virginia: 2008

For product and ordering information:

World Wide Web: <http://www.usgs.gov/pubprod>

Telephone: 1-888-ASK-USGS

For more information on the USGS--the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:

World Wide Web: <http://www.usgs.gov>

Telephone: 1-888-ASK-USGS

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

Suggested citation:

Smith, K.P., 2008, Hydrologic, water-quality, and meteorological data for the Cambridge, Massachusetts, drinking-water source area, water year 2006: U.S. Geological Survey Open-File Report 2008-1175, 164 p.

Contents

Abstract	1
Introduction.....	2
Purpose and Scope	2
Description of Monitoring Network.....	4
Continuous Data Collection and Computation	5
Hydrologic Data.....	5
Water-Quality Data	6
Meteorological Data.....	6
Sample Collection and Analysis.....	7
Presentation of Data	8
Station History.....	8
Streamflow Data	8
Daily Mean Values.....	8
Annual Summary Statistics.....	9
Reservoir Data.....	9
Meteorological Data and Physical Parameters	9
Water-Quality Data	9
Data for the Cambridge Drinking-Water Source Area	9
Surface-water data	9
Specific Conductance.....	11
Water-Quality Data	17
Quality-Control Samples.....	18
Meteorological data.....	19
References Cited.....	21
Tables 4–17.....	25
Glossary.....	161

Figures

1. Map showing the monitoring network for Cambridge, Massachusetts, drinking-water source area for water year 2006, eastern Massachusetts.....3
- 2–8. Graphs showing:
 2. (A) Discharge from the Hobbs Brook Reservoir as a percentage of water entering the Stony Brook Reservoir, and discharge from the Stony Brook Reservoir to the Charles River as a percentage of total inflow to the Stony Brook Reservoir for water year 2006; (B) monthly precipitation totals at the Cambridge Reservoir, Stony Brook Reservoir, and Fresh Pond Reservoir in the Cambridge drinking-water source area, water year 2006.....10
 3. Monthly mean reservoir storage as a percentage of capacity for water year 2006 shown as percent capacity for the Cambridge Reservoir, Stony Brook Reservoir, and Fresh Pond Reservoir, near Cambridge, Massachusetts.....12

4. Monthly mean specific conductance for water year 2006 for U.S. Geological Survey station 01104415, Cambridge Reservoir, unnamed tributary 2, near Lexington, Massachusetts; period-of-record maximum and minimum monthly mean specific conductance; and median monthly specific conductance for water years 1997–98 and 2004–05	13
5. Monthly mean specific conductance for water year 2006 for U.S. Geological Survey station 01104430, Hobbs Brook below Cambridge Reservoir near Kendal Green, Massachusetts; period-of-record maximum and minimum monthly mean specific conductance; and the median, 25th percentile, and 75th percentile monthly specific conductance for water years 1998 through 2005.....	14
6. Monthly mean specific conductance for water year 2006 for U.S. Geological Survey station 01104460, Stony Brook at Route 20 at Waltham, Massachusetts; period-of-record maximum and minimum monthly mean specific conductance; and the median, 25th percentile, and 75th percentile monthly specific conductance for water years 1997–98 and 2002–05.....	15
7. Monthly mean specific conductance for water years 2005 and 2006 for U.S. Geological Survey station 422302071083801, Fresh Pond Reservoir at Cambridge, Massachusetts.....	16
8. Monthly mean air temperatures for water year 2006 for the Cambridge Reservoir, Massachusetts, period-of-record maximum and minimum monthly mean air temperatures, and the median monthly air temperatures for water years 2002–05	20

Tables

1. Names, locations, drainage areas, and period of records for U.S. Geological Survey monitoring stations in the drinking-water source area for Cambridge, Massachusetts, water year 2006.....	4
2. Hydrologic, water-quality, and meteorological parameters measured at each continuous-monitoring station during water year 2006, in the drinking-water source area for Cambridge, Massachusetts, water year 2006	5
3. Rating classifications for continuous records of hydrologic, water quality, and meteorologic parameters.	6
4. Daily, monthly, and annual statistics for discharge for U.S. Geological Survey stations in the drinking-water source area for Cambridge, Massachusetts, for water year 2006	26
5. Daily, monthly, and annual statistics for reservoir altitude for U.S. Geological Survey station numbers 01104430, Hobbs Brook below Cambridge Reservoir near Kendal Green, 01104480, Stony Brook Reservoir in Waltham, and 422302071083801, Fresh Pond Reservoir at Cambridge, for water year 2006.....	39
6. Daily, monthly, and annual statistics for reservoir capacity for U.S. Geological Survey station 01104430, Hobbs Brook below Cambridge Reservoir near Kendal Green; 01104480, Stony Brook Reservoir in Waltham; and 422302071083801, Fresh Pond Reservoir at Cambridge, Massachusetts, water year 2006	52
7. Daily, monthly, and annual statistics for precipitation for U.S. Geological Survey stations 01104430, Hobbs Brook below Cambridge Reservoir near Kendal Green; 01104480, Stony Brook Reservoir in Waltham; and 422302071083801, Fresh Pond Reservoir at Cambridge, Massachusetts, water year 2006.....	65

8.	Daily, monthly, and annual statistics for air temperature for U.S. Geological Survey stations 01104430, Hobbs Brook below Cambridge Reservoir near Kendal Green; 01104480, Stony Brook Reservoir in Waltham; and 422302071083801, Fresh Pond Reservoir at Cambridge, Massachusetts, water year 2006.....	77
9.	Daily, monthly, and annual statistics for water temperature for U.S. Geological Survey stations in the drinking-water source area for Cambridge, Massachusetts, for water year 2006	89
10.	Daily, monthly, and annual statistics for specific conductance for U.S. Geological Survey stations in the drinking-water source area for Cambridge, Massachusetts, for water year 2006.....	102
11.	Extreme measurements of physical parameters for U.S. Geological Survey stations in the drinking-water source area for Cambridge, Massachusetts.....	116
12.	Extreme and median constituent concentrations measured in water samples for each U.S. Geological Survey water-monitoring station in the drinking-water source area for Cambridge, Massachusetts, for the period of record	118
13.	Physical properties and concentrations of calcium, sodium, chloride, sulfate, total nutrients, and polar pesticides and metabolites for base-flow and stormflow water samples collected in eleven subbasins and for water samples collected from the Fresh Pond intake structure in the Cambridge drinking-water source area in water year 2006	120
14.	Physical properties of and concentrations of dissolved calcium, sodium, chloride, sulfate, total nutrients, and polar pesticides and metabolites in quality-control samples collected in water year 2006.....	141
15.	Characteristics of selected pesticides detected in base-flow and stormflow water samples collected in the Hobbs Brook and Stony Brook Basins, water year 2006	155
16.	Frequency of detection and maximum concentration of selected pesticides and caffeine in six samples of base-flow and seven samples of stormflow collected in the Hobbs Brook and Stony Brook Basins and collected in three samples of raw water collected from the intake of the water-treatment facility at Fresh Pond, Cambridge Massachusetts, water year 2006	157
17.	Analyte recovery statistics for field matrix spikes in environmental samples and the frequency of detection for available analytes in about 70 environmental samples collected in the Hobbs Brook and Stony Brook Basins, Massachusetts, for water year 2006	158

Conversion Factors, Datums, and Abbreviations

Multiply	By	To obtain
Length		
foot (ft)	0.3048	meter (m)
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
inch (in.)	25,400	micron (μ)
inch (in.)	25,400,000	nanometer (nm)
mile (mi)	1.609	kilometer (km)
Area		
square inch (in ²)	6.452	square centimeter (cm ²)
square mile (mi ²)	2.590	square kilometer (km ²)
Volume		
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m ³)
million gallons (Mgal)	3,785.4	cubic meter (m ³)
Flow rate		
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m ³ /s)

Temperature in degrees Celsius ($^{\circ}\text{C}$) may be converted to degrees Fahrenheit ($^{\circ}\text{F}$) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

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

Water- and sediment-quality constituents are expressed in milligrams per liter (mg/L), micrograms per liter ($\mu\text{g/L}$), parts per million (ppm), and parts per billion (ppb). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand milligrams per liter is equivalent to one gram per liter. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in ppm.

Specific conductance of water is expressed in microsiemens per centimeter at 25 degrees Celsius ($\mu\text{S/cm}$ at 25°C).

ABBREVIATIONS USED IN REPORT

ASTM	American Society for Testing and Materials
COV	Coefficient of variation
CWD	City of Cambridge, Massachusetts, Water Department
HPLC	High-performance liquid chromatography
ISO	International Organization for Standardization
NIST	National Institute of Standards and Technology
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

of the respective samples also exceeded the USEPA secondary drinking-water standard of 250 mg/L. Concentrations of dissolved chloride in several composites of water collected during storms at USGS stations 01104415 and 01104433 also exceeded the USEPA recommended freshwater quality criterion and secondary drinking-water standard. Concentrations of dissolved sulfate in all water samples were below the USEPA secondary drinking-water standard of 250 mg/L.

Twenty pesticides and caffeine were detected in water samples collected from the primary streams and tributaries to the Cambridge Reservoir and Stony Brook Reservoir, and in raw water collected from the Cambridge water-treatment facility intake from the Fresh Pond Reservoir in water year 2006. Caffeine was detected in 77 percent of all water samples. Imidacloprid, siduron, and carbaryl were the most frequently detected pesticides. The compounds 2,4-D, MCPA, and triclopyr were detected only in samples of stormwater. Caffeine, metalaxyl, and siduron were detected more frequently in water samples collected during storms than in water samples collected during base-flow conditions. Caffeine, 2-hydroxy-4-isopropylamino-6-ethylamino-s-triazine, carbaryl, imidacloprid, norflurazon, and siduron also were detected in raw water from the Fresh Pond Reservoir.

Introduction

Hydrologic and water-quality monitoring is important for the effective management and protection of drinking-water supplies. Both the quantity and the quality of water are monitored because these factors determine the physical, chemical, and biological state of the water supply. Without accurate information on the past and current condition of the water supply, effective preservation and remediation programs cannot be implemented or evaluated.

The U.S. Geological Survey (USGS) works closely with municipal water suppliers throughout the nation to address specific water problems by conducting hydrologic- and water-quality-monitoring programs and detailed investigations (Patterson, 1997). One such program, conducted during 1997–98 by the USGS in cooperation with the city of Cambridge, Massachusetts, Water Department (CWD), was designed to identify sources of contaminants in the drinking-water source area for the city (Waldron and Bent, 2001). Subsequently the USGS, in cooperation with the CWD, designed and implemented a water-monitoring network in the drinking-water source area. Data from this network have been published annually in various USGS reports (Smith, 2005 and 2007; Socolow and others, 1999, 2000, 2001, 2002, 2003, and 2004).

The CWD supplies approximately 15 Mgal/d (**millions of gallons per day**¹) (Waldron and Bent, 2001) to more than 100,000 customers. Most of this water is obtained from three

primary storage reservoirs (Cambridge Reservoir (also known as the Hobbs Brook Reservoir), Stony Brook Reservoir, and Fresh Pond Reservoir), in parts of Lexington, Lincoln, Waltham, Weston, and Cambridge (fig. 1). The **drainage basin** for the Cambridge Reservoir includes Hobbs Brook and three unnamed tributaries that **discharge** directly into the reservoir. Water is discharged from the southern end of the Cambridge Reservoir into Hobbs Brook, which receives additional water from an unnamed tributary about 0.5 mi below the reservoir. Hobbs Brook joins with Stony Brook about 1.6 mi downstream from the reservoir and flows south to the Stony Brook Reservoir. Two unnamed tributaries flow into Stony Brook about a 0.25 mi north of the Stony Brook Reservoir. In addition to Stony Brook, an unnamed tributary flows directly into the Stony Brook Reservoir on the southwest side of the reservoir. Additional water enters both reservoirs from other minor tributaries and highway and parking-lot storm drains. Water from Stony Brook Reservoir is piped through an aqueduct by the CWD directly to Fresh Pond Reservoir, where it is stored prior to treatment. Overflow and controlled discharges from the Stony Brook Reservoir flow into the Charles River in Waltham.

The drainage basin contributing water to these reservoirs has undergone rapid development since the 1990s and encompasses major transportation corridors (Interstate 95, Routes 2, 2A, 20, and 117), as well as large areas of industrial, commercial, and high-density residential land use. Because the city of Cambridge owns less than 5 percent of the land in the basin contributing to its water supply, the CWD relies heavily on monitoring to provide information for optimizing the management of its reservoirs for water quality and quantity. The USGS monitoring network provides near-real-time information that assists the CWD in responding rapidly to water-quality changes caused by accidental or intentional contamination. This information also benefits the CWD, other municipalities, and state agencies involved with water-resource development and management in the Charles River Basin by enhancing their understanding of the relation between local drinking-water-management practices and regional issues of water supply and hydrologic-system response.

Purpose and Scope

This report presents records of water quantity, water quality, and meteorological parameters collected in the Cambridge, Massachusetts, drinking-water source area during **water year 2006** (October 2005 through September 2006). It describes the monitoring network, data-collection methods for all types of data, and computation methods. It also describes the chemical characteristics of water samples collected during **base-flow** conditions and during storms from nearly all of the streams and tributaries to Hobbs Brook and Stony Brook in the Stony Brook Basin, and of water samples collected from the raw-water intake at the Cambridge water-treatment facility.

¹ Terms listed in the glossary at the back of this report are in bold type where first used in the text.

