

City of Cambridge, Water Department
 250 Fresh Pond Parkway, Cambridge, MA 02138
 Monthly Water Quantity and Quality Report
 June 2009



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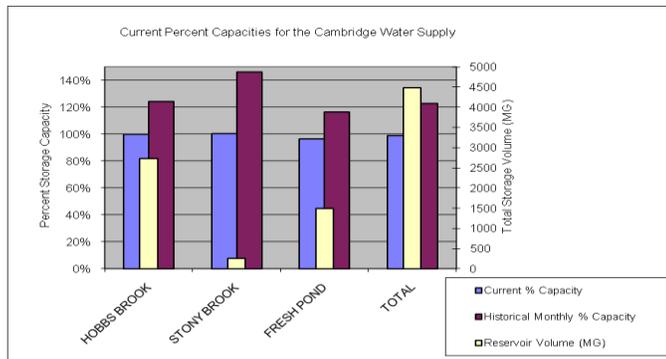
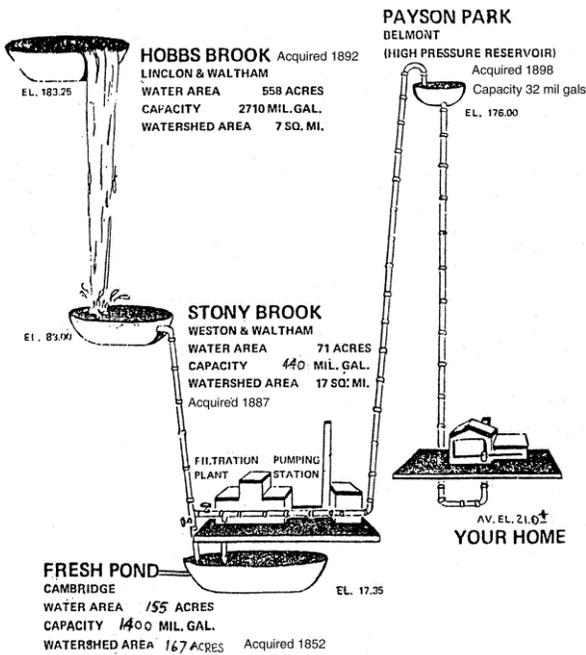
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Water Supply

The Cambridge water supply system consists of four reservoirs and their tributaries located in Lexington, Waltham, Lincoln, Weston, Cambridge and Belmont. The two primary water sources, Hobbs Brook Reservoir and Stony Brook Reservoir, flow to the terminal reservoir, Fresh Pond, located in Cambridge, via the Stony Brook conduit. The water is then purified and pumped to Payson Park Reservoir, two 16 million gallon drinking water clearwells located in Belmont at a maximum elevation of 181 feet, where it is further disinfected with chloramines and distributed to the city. The largest of the reservoirs, Hobbs Brook, reaches its maximum elevation at 181.3 feet above sea level, its maximum depth at approximately 25 feet, and at full capacity, holds approximately 2.5 billion gallons of water. Stony Brook Reservoir reaches its maximum elevation at 80.6 feet above sea level, its deepest point is at approximately 35 feet, and at full capacity, it contains roughly 255 million gallons of water. Fresh Pond Reservoir reaches its maximum elevation at 17 feet above sea level, its maximum depth at 50 feet, and at full capacity, holds roughly 1.5 billion gallons.

While the Watershed's primary storage reservoir is Hobbs Brook, in the winter and spring months it is largely unused. Due to its vast size, and relatively small watershed, Hobbs Brook is slow to fill up. This winter hiatus is necessary for Hobbs to regain the water it uses in the summer months. Conversely, Stony Brook is relatively small compared to its large watershed and fills much faster than Hobbs Brook. Due to this condition, Stony Brook is used in place of Hobbs during the winter months. During times of high water flow, the Cambridge Watershed, via Stony Brook, overflows its surplus water into the Charles River.

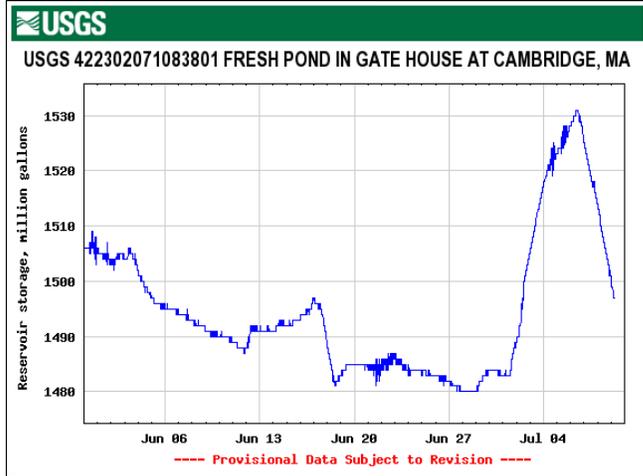
**SOURCE of
 CAMBRIDGE
 WATER SUPPLY**



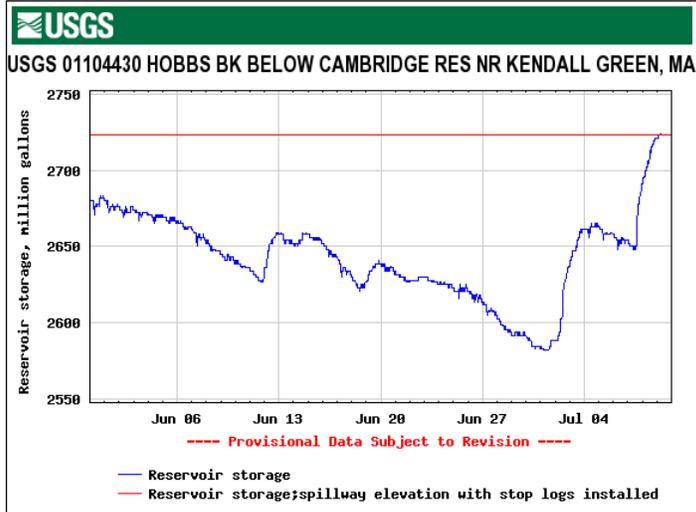
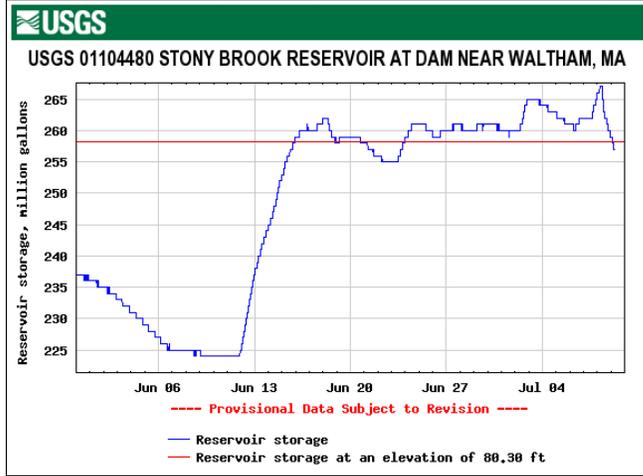
Current Conditions: 07/09/09

The reservoir system is at 99% capacity. The reservoir system is currently at 122% of historical capacity for this time of year. Hobbs Brook Reservoir current storage volume is 2,723 Million Gallons (MG) or 100%, Stony Brook Reservoir current storage volume is 257 MG or 101% and Fresh Pond Reservoirs current storage volume is 1,497 MG or 97%. The average daily demand is 13.6 Million Gallons per Day (MGD). Days of supply remaining without recharge: 253 or 8.4 months.

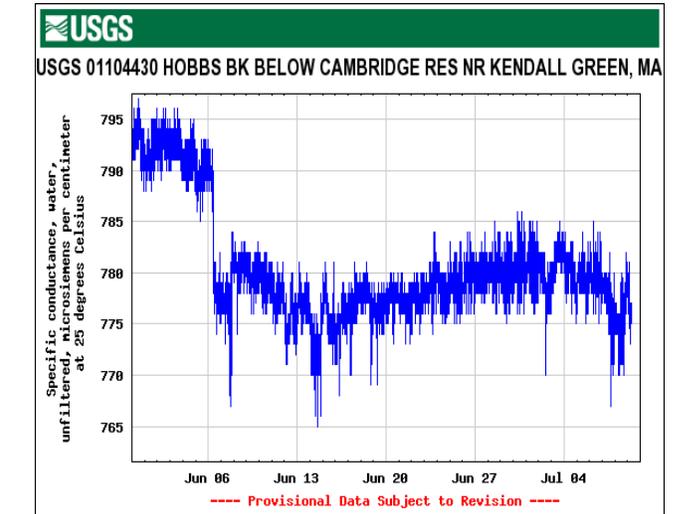
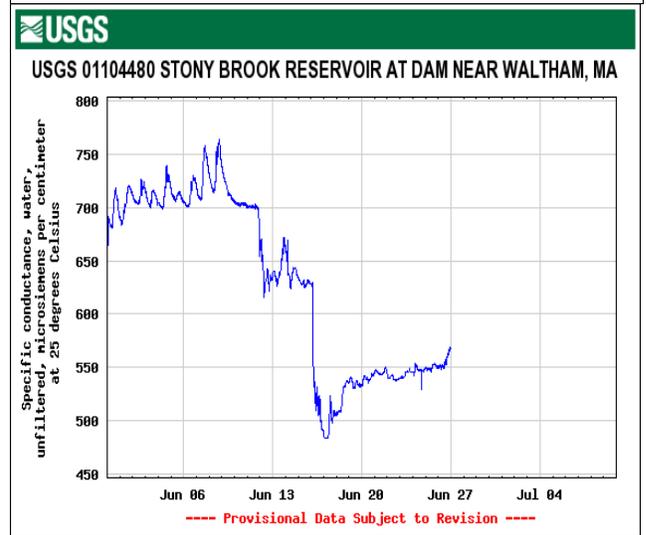
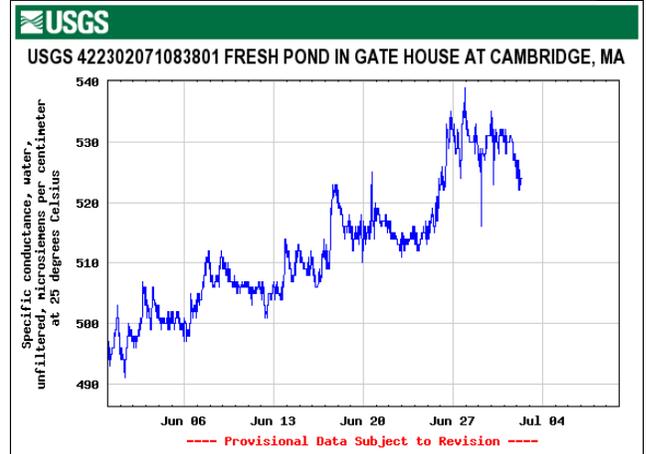
Reservoir storage levels



Conduit from Stony Brook just down for camera inspection.



Reservoir Water Specific Conductance



Water Demand

-Cambridge City Population: 101,355

Million Gallons (MG) - Gallons per Minute (GPM)
(Partial record-communications down)

Maximum instantaneous demand:

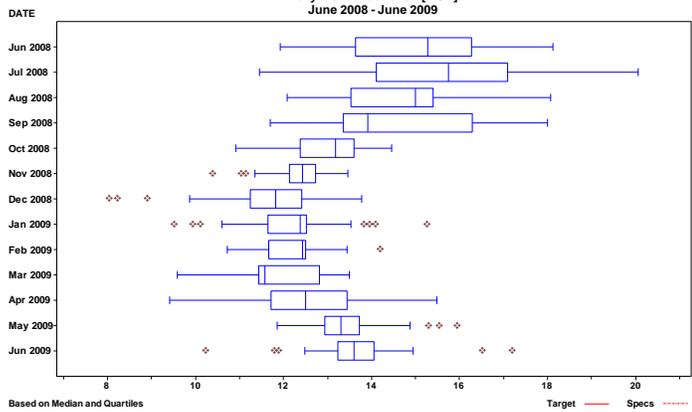
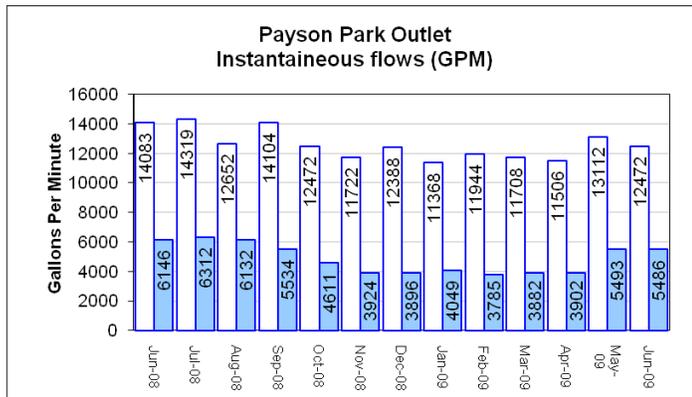
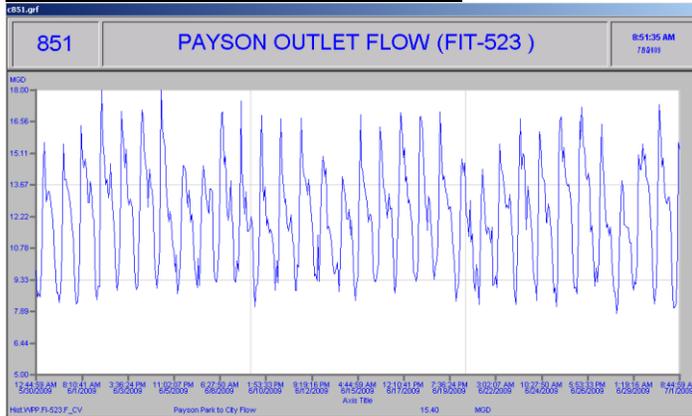
06/02/09 at 08:03am: 12,472 GPM
Hydrant/Water main flushing program

Minimum instantaneous demand:

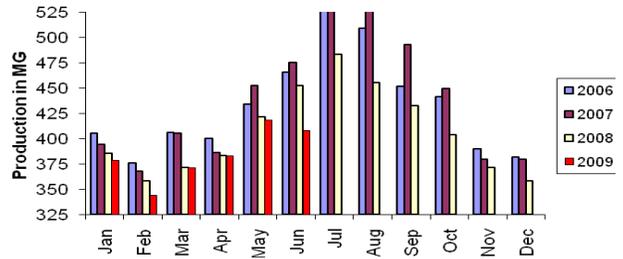
06/28/09 at 05:06am: 5,486 GPM

Average daily water demand for 2009 (to date): 12.72 MG
Average daily water demand 2008: 13.33 MG
Average daily water demand June 2009: 13.60 MG
Average daily water demand June 2008: 15.10 MG
Monthly Water Demand June 2009: 408 MG
Monthly Water Demand June 2008: 452 MG
Water produced for 2009 (to date): 2,302 MG
Total water produced for 2008: 4,878 MG

Daily Payson Reservoir Outlet Flow:



Monthly Plant Production



Source Water Quality

Hobbs Brook Reservoir at intake

E-Coli Bacteria- Average: 5 CFU/100mL
TOC Average: 3.9 mg/L
UV 254 Average: 0.100 A/cm
Aluminum: Average: 0.02 mg/L
Sodium: Average: 126
Chloride Average: 225
Bromide: Average: 0.12
Turbidity- Average: 0.70
Conductivity- Average: 675 umhos/cm
pH- Average: 7.3

Stony Brook Reservoir at intake

E-Coli Bacteria- Average: 6 CFU/100mL
TOC Average: 4.8 mg/L
UV 254 Average: 0.180 A/cm
Aluminum Average: 0.012 mg/L
Sodium Average: 55
Chloride Average: 122
Bromide Average: 0.064
Turbidity Average: 0.77 NTU
Conductivity- Average: 462 umhos/cm
pH- Average: 7.08

Fresh Pond Reservoir at intake

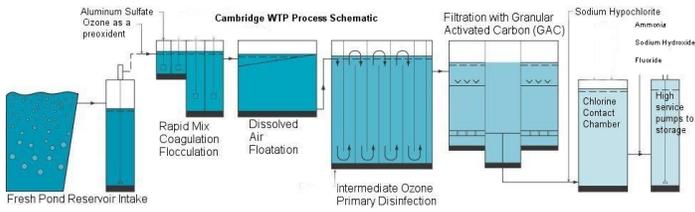
E-Coli Bacteria- Average: 3 CFU/100mL
TOC Average: 3.63 mg/L
UV254 Average: 0.118 A/cm
SUVA Average: 3.25
Sodium Average: 63 mg/L
Chloride Average: 132 mg/L
Bromide Average: 0.068 mg/L
Alkalinity (as CaCO3) Average: 30 mg/L
Aluminum Average: 0.048 mg/L
Turbidity- Average: 0.61 NTU
Conductivity- Average: 450 umhos/cm
pH- Average: 6.92
Temperature: Average: 21°C

Cryptosporidium and Giardia

As part of the Long Term 2 Enhanced Surface Water Treatment Rule monitoring Cambridge has collected 24 samples for *Cryptosporidium* and *Giardia* since February 2006. The monitoring is population based. Hence systems with populations >100,000 must collect 24 raw water samples over a two year period. The *Cryptosporidium* results are the basis for *bin assignment* on the Running Annual Average (RAA). Bin Classification: Systems with an RAA *Crypto* concentrations of <0.75 (Oo) cysts per liter are placed in Bin 1 for which no additional treatment is required. To date none of the samples have detected any *Cryptosporidium* and one sample out of 24 detected *Giardia* at 0.1 cysts/L.

Endocrine Disruptors, Pharmaceuticals, Personal Care Products

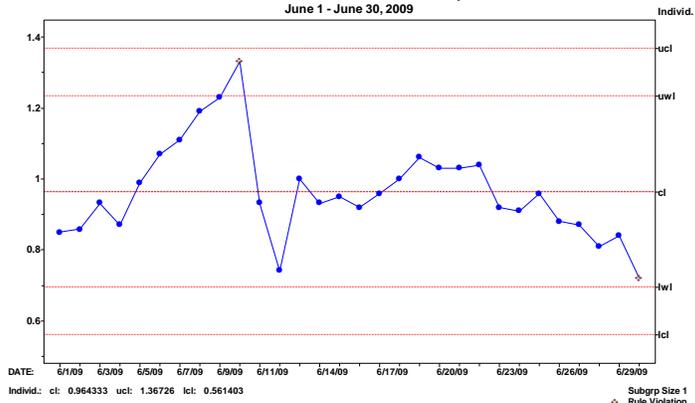
In response to the concern about the possibility of these unregulated compounds in municipal tap water, the Water Department tested the tap water in March 2008 for 86 compounds and did not detect any in the tap water. Follow up sampling in September 2008 detected the following compounds in the tap water: Acetaminophen at 0.019 micrograms per liter (ug/L) and Nicotine at 0.007 ug/L, Monitoring will continue twice a year.



Turbidity

Turbidity is a measure of suspended and colloidal particles including clay, silt, and inorganic matter, algae, and microorganisms. Turbidity is determined by a technique involving the measurement of light scattered at right angles in a water sample. The more of the source light that is scattered the more (the higher) the turbidity. The units of measurement for turbidity are Nephelometric Turbidity Units (NTU's).

Fresh Pond Intake - Untreated Water Turbidity - NTU
June 1 - June 30, 2009



Finished Water Quality

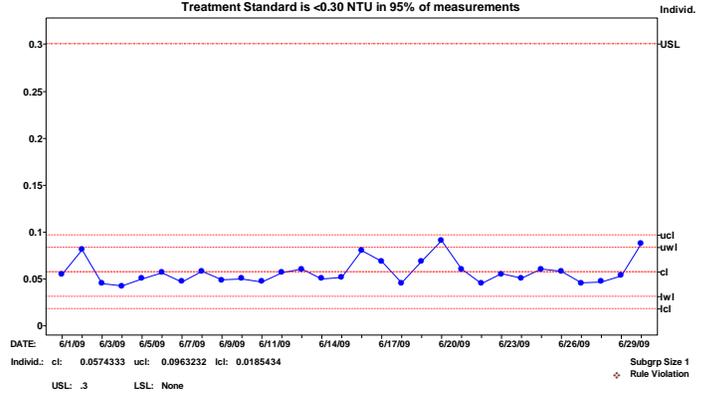
Turbidity

The Surface Water Treatment Rule (SWTR) establishes performance goals for finished water turbidity. The pretreatment turbidity goal is to be less than 1 NTU. A conventional filtration plant is considered in compliance if the filtered water turbidity is less than 0.3 NTU in 95 % of its samples.

Turbidity is measured through the treatment process as a measure of treatment effectiveness. In the watershed and in the reservoirs turbidity may indicate the presence of silt from storm events or the presence of algae. In the pretreatment e.g. rapid mix, flocculation, and Dissolved Air Flotation (DAF) portion of the plant turbidity is used indicator of process efficiency. Turbidity of the filter effluent is used both as a process efficiency and regulatory indicator of performance.

The effects of turbidity depend on the nature of the matter that causes the turbidity. High levels of particulate matter may have higher chlorine demand or may protect bacteria from the disinfectant effects of ozone and chlorine, thereby interfering with the disinfectant residual throughout the distribution system. The turbidity through the cycle of each filter run is an indicator of the overall effectiveness of the filter process.

Combined Filter Effluent Turbidity - NTU
June 1 - June 30, 2009
Treatment Standard is <math>< 0.30</math> NTU in 95% of measurements

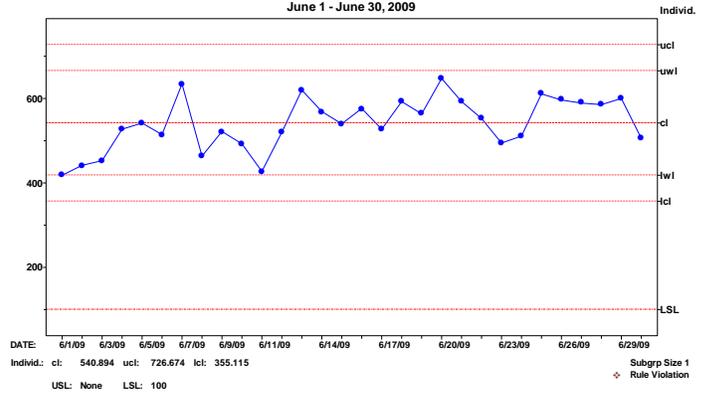


Primary Disinfection - Ozone

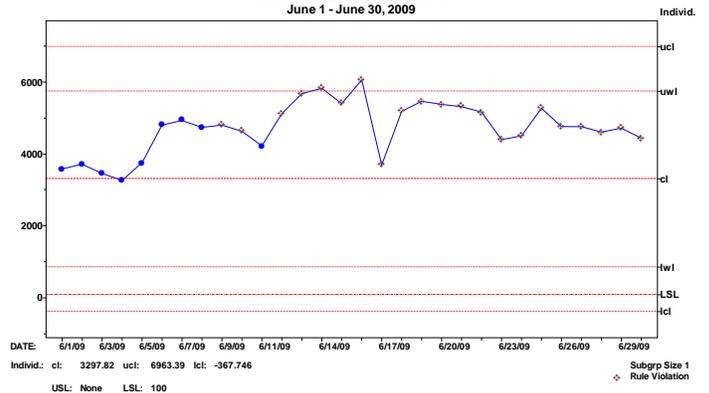
The CWD provides disinfection to achieve the EPA requirement for 99.9% inactivation of Giardia cysts and 99.99% inactivation of viruses in drinking water. Instead of measuring or counting Giardia and viruses, compliance is determined by a system operational standard, the measurement of the disinfection process. EPA has established a set of criteria for each disinfectant (ozone, free chlorine, and chloramines).

They are stated as CT values where C is concentration and T is time. The concentration C of the disinfectant in the water over time T yields a measure of the effectiveness of disinfection, CT. The required CT varies with the disinfectant type, water temperature, pH, and other factors. CWD measures CT in three places, intermediate ozone, free residual chlorine in the clearwell, and chloramines through the Payson Park Reservoir. The goal is to meet the minimum CT requirements with the intermediate ozone system at a concentration of 1.5 mg/L (milligram per liter) Ozone. The CT credited from the other two sources provides redundancy to the system. The following two graphs show the combined ozone and free chlorine CT.

Giardia CT Inactivation in percent
Combined Ozone and Chlorine CT
June 1 - June 30, 2009



Virus CT Inactivation in percent
Combined Ozone and Chlorine CT
June 1 - June 30, 2009



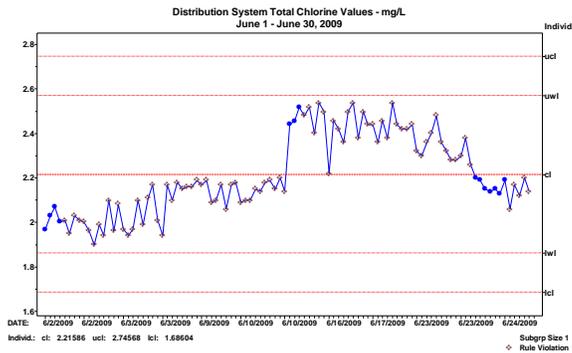
Secondary Disinfection - Chloramines

Secondary disinfection provides a minimum of a 0.2 mg/L concentration of residual (chloramines) into the distribution system. The higher values shown below reflect the operational need for disinfection after the biological filters and the need to maintain a measurable residual throughout the distribution system. A 15% solution of Sodium Hypochlorite is added at a concentration of 3.5 mg/L at the entrance the clearwell. The typical chlorine demand is approximately 1 mg/L this leaves a free residual chlorine concentration of 2.5 mg/L available for disinfection in the clearwell. The second week of June, the residual was increased temporarily during Ozone system repairs.

Chloramination

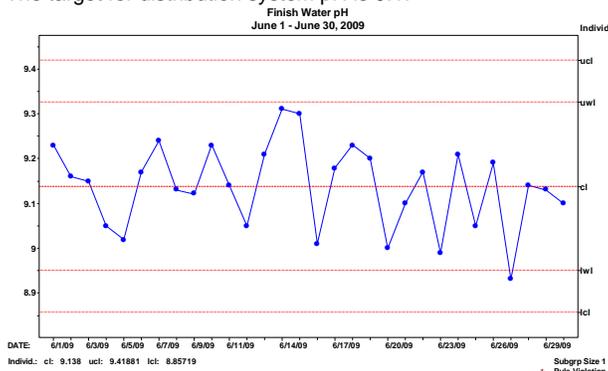
The practice of adding ammonia to chlorinated water is called Chloramination. This process is recognized for taste and odor control to reduce the undesirable medicinal taste of chlorinated water. It was first used in Greenville, Tennessee in 1926. This process can contribute to taste and odor control problems if not properly controlled. The formation of di- and trichloramines species is minimized by controlling the chlorine and ammonia ratios (3 to 4:1). A 30% solution of Ammonium Hydroxide is added at a concentration of 0.5 mg/L. CWD's target chlorine to ammonia ratio is 4.5:1

Distribution Chlorine Residual – mg/L

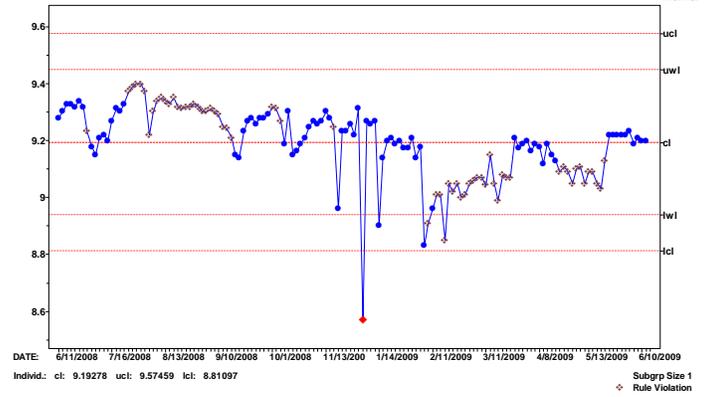


Corrosion Control – pH adjustment

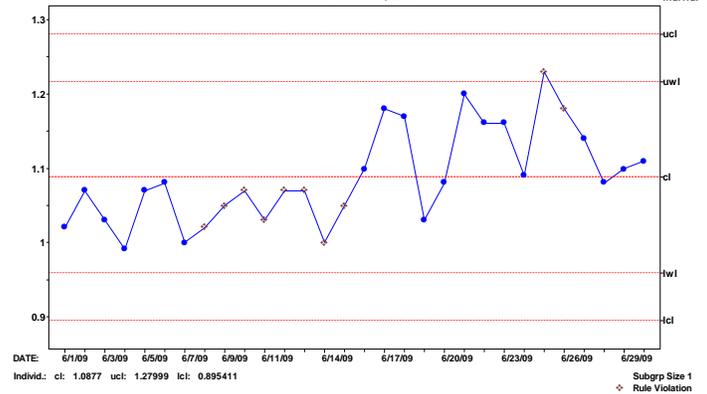
The National Primary Drinking Water Regulations (NPDWR) - Lead and Copper Rule establishes limits to the amount of lead and copper that may be in drinking water at the consumers tap. The Action Level for Lead is 15 ug/L (micrograms per liter). CWD is in compliance with the 2008 round of reduced sampling. CWD's 90th percentile is 9 ug/L. The Action Level for Copper is 1300 ug/L. CWD's 90th percentile was 32ug/L. Cambridge meets the requirements by reducing corrosiveness of the water by adjusting the pH to 9 with a 50% solution of Sodium Hydroxide (as of 1/26/09) at a concentration of 22 mg/L. This combined with the natural occurring alkalinity, hardness and dissolved minerals in the water minimizes the leaching of lead and copper from service lines and home plumbing systems, the source of lead and copper at the consumer tap. The target for distribution system pH is 9.1.



Distribution system pH Values
June 2008 - June 2009



Finish Water Fluoride - mg/L
June 1 - June 30, 2009



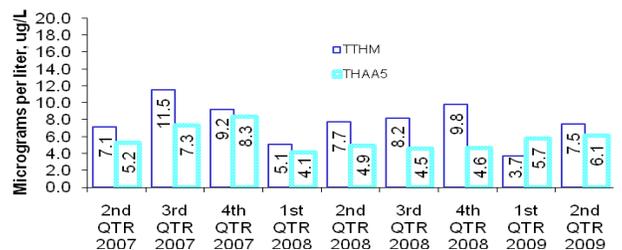
Fluoridation

The Massachusetts Department of Health mandates that Drinking Water Systems fluoridate for the prevention of dental cavities. CWD adds a solution of 23% Hydrofluocyclic acid at a concentration of 1.0 mg/L. CWD targets the concentration at 1.1 mg/L. The Fluoride addition was stopped to determine the length of time the fluoride remains in the system. Estimated maximum water age is 12 days

Disinfection By-Products

The incidence of waterborne diseases has been greatly reduced since the widespread implementation of drinking water disinfection. While a measurable public health benefit has been achieved, other potential risks may have been introduced. The presence of chloroform and other trihalomethanes (THMs) in finished drinking water was first associated with the chlorination of drinking water in 1974. It was discovered that in, addition to killing microorganisms disinfectants react with organic and inorganic substances naturally present in the water to produce a variety of disinfection by-products (DBPs), which include THMs. The DBPs associated with chlorination are THMs, haloacetic acids, haloacetonitriles and halopicrins. Ozonation may result in bromate formation. Nitrosodimethylamine (NDMA) is a by product of chloramination.

Cambridge Water Department
Quarterly Trihalomethanes (limit 80 ppb) and Total Haloacetic acids (limit 60 ppb)



Total Organic Carbon(TOC) Survey															
CWD - TOC Removal Performance Summary															
Date	a. Raw mg/L	b. DAF Train 1 mg/L	DAF Train #1		DAF Train #2		Post- Ozone Train #1		Post- Ozone Train #2		f. Finished Water mg/L	In/Out Percent Removal Efficiency 1-f/a*100 %	Pretreatment Percent Removal Efficiency ((b+d)+(c+e))/2 %	Filter Percent Removal Efficiency (in/out-pretreat) %	Alum dose mg/L
			Percent removal efficiency 1-b/a*100 %	c. DAF Train 2 mg/L	Percent removal efficiency 1-c/a*100 %	d. Filter Influent Train 1 mg/L	Percent removal efficiency 1-d/b*100 %	e. Filter Influent Train 2 mg/L	Percent removal efficiency 1-e/c*100 %						
6/9/2008	3.61	1.88	48	1.84	49	1.88	0.5	1.83	0.6	1.54	57.4	49.0	8.4	26	
7/8/2008	3.70	2.13	42	2.13	42	1.99	6.5	1.90	10.8	1.69	54.4	51.0	3.4	25	
7/31/2008	4.38	2.45	44	2.40	45	2.24	8.6	2.07	13.7	1.96	55.3	55.8	-0.5	26	
8/27/2008	4.12	2.40	42	2.35	43	2.04	14.8	2.22	5.7	1.84	55.3	52.7	2.6	24	
9/29/2008	3.95	2.30	42	2.17	45	1.92	16.8	1.98	8.7	1.72	56.5	56.2	0.3	26	
10/7/2008	4.19	2.26	46	2.39	43	1.92	15.2	2.07	13.3	1.80	57.0	58.8	-1.8	33	
10/14/2008	4.27	2.32	46	2.39	44	1.94	16.4	2.20	8.2	1.75	58.9	57.1	1.9	29	
10/23/2008	4.34	2.60	40	2.20	49	2.26	12.8	2.02	8.2	1.76	59.4	55.3	4.2	32	
11/13/2008	4.19	2.27	46	2.10	50	2.28	-0.6	2.11	-0.3	1.64	60.8	47.5	13.4	31	
12/1/2008	4.29	2.41	44	2.14	50	2.69	-11.3	2.20	-3.1	1.73	59.7	39.8	19.9	31	
12/8/2008	4.35	2.19	50	2.11	52	2.34	-6.8	2.25	-6.8	1.76	59.6	43.8	15.8	32	
1/7/2009	4.11	2.04	50	2.02	51	2.06	-1.2	2.01	0.7	1.65	59.8	50.4	9.4	34	
2/2/2009	4.14	2.09	50	2.03	51	2.02	3.2	2.07	-1.8	1.63	60.6	50.9	9.7	33	
3/2/2009	3.97	2.27	43	2.11	47	2.03	10.4	2.05	2.8	1.75	56.0	51.4	4.6	25	
4/7/2009	3.52	1.78	49	1.79	49	1.76	1.0	1.79	-0.2	1.45	58.7	49.7	9.0	26	
5/7/2009	3.65	1.90	48	1.84	50	1.75	8.2	1.52	17.5	1.56	57.3	61.5	-4.3	26	
6/1/2009	3.69	1.97	47	1.98	46	1.94	1.4	1.91	3.5	1.63	55.8	49.0	6.8	33	
6/29/2009	3.54	1.82	48	1.88	47	1.70	7.0	1.73	8.0	1.49	57.9	55.2	2.7	30	
Average	4.0	2.2	45.8	2.1	47.4	2.0	5.7	2.0	5.0	1.7	57.8	51.9	5.9	29.0	

Units: Milligrams per Liter(mg/L)
Percentages do not add up to 100%
TOC samples a grab samples taken across the plant at a single time and not a single cohort of water
SUVA means the UV absorption at 254 nanometers (measured in 1/meters) divided by the dissolved organic carbon concentration (measured in mg/L).

Cambridge Water Department Laboratory								
Massachusetts Certification Number M-MA149								
		Monthly Average Chlorine Residual (mg/L)	Monthly minimum Chlorine Residual (mg/L)	Samples tested for Coliform	Total samples Coliform positive	Percent Total samples Coliform positive	Fecal Coliform positive	Public Notification required
2008	June	1.93	1.70	100	0	0	0	no
	July	2.29	1.74	100	0	0	0	no
	August	1.98	1.24	100	0	0	0	no
	September	2.19	1.94	100	0	0	0	no
	October	2.17	1.62	100	0	0	0	no
	November	2.38	2.07	100	0	0	0	no
	December	2.30	1.84	100	0	0	0	no
2009	January	2.01	1.77	100	0	0	0	no
	February	2.09	1.94	100	0	0	0	no
	March	2.08	1.93	100	0	0	0	no
	April	2.06	1.89	100	0	0	0	no
	May	2.05	1.86	100	0	0	0	no
	June	2.21	1.93	100	0	0	0	no

Plant Discharge Permits

Massachusetts Water Resource Authority (MWRA) Toxic Reduction And Control (TRAC) program regulates discharge to the sewer system. The TRAC program classifies CWD as a Significant Industrial User (SIU) and has three permits for discharge: 0101 Residuals, 0102 Laboratory, and 0103 Truck Wash.

The EPA regulates discharge of clarified backwash water to Fresh Pond under the National Pollution Discharge Elimination System (NPDES) Act

Parameter	Daily Maximum Limit - mg/L Report Max. #	Monthly	Monthly	Semi-annual	Semi-annual	Semi-annual	Semi annual	Quarterly
		Residuals - 0101	Residuals - 0101	Lab Waste - 0102	Lab Waste - 0102	Truck Wash - 0103	Truck Wash - 0103	NPDES 2nd QTR 2009
Aluminum (NPDES)	0.1	NR	NR	NR	NR	NR	NR	1.5
Cadmium	1.5	<0.005	<0.005	NR	NR	<0.005	<0.005	NR
Copper	1	0.202	0.185	<0.010	0.052	0.022	0.041	NR
Chromium	1	0.03	0.02	NR	NR	<0.01	<0.01	NR
Lead	0.2	0.04	0.027	<0.01	0.027	0.027	0.016	NR
Nickel	1	0.054	0.054	<0.025	<0.025	<0.025	0.026	NR
Silver	2	<0.007	<0.07	NR	NR	NR	NR	NR
Zinc	1	0.309	0.242	NR	NR	0.228	0.309	NR
Arsenic	0.5	0.029	0.016	NR	NR	NR	NR	NR
Selenium	5	0.015	0.022	NR	NR	NR	NR	NR
Antimony	10	<0.05	<0.05	NR	NR	NR	NR	NR
Mercury	Prohibited	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	NR
Total Residual Chlorine	Report Max.	NR	NR	NR	NR	NR	NR	0.05
Total Suspended Solids	<=3%	0.52%	0.45%	NR	NR	NR	NR	NR
TSS (NPDES)	50 (max)	NR	NR	NR	NR	NR	NR	10
PH (NPDES)	8.5 (max)	NR	NR	NR	NR	NR	NR	6.5
pH	5.5 - 10.5	6.21	6.16	7.17	7.59	7.35	7.66	NR
Cyanide	0.5	NR	NR	<0.005	<0.005	NR	NR	NR
Total Fats, Oil & Grease	<= 300	NR	NR	NR	NR	4.9	18	NR
Flow - Gallons/Day	1.0 MGD NPDES Reg.	43,680	36,000	232	25	50	50	0.68 MG
TTO (VOC)	Any analyte not to exceed 1 mg/L	NR	NR	NR	NR	All < 1mg/L	All < 1 mg/L	NR
TTO (ABN)	Any analyte not to exceed 1 mg/L	NR	NR	NR	NR	All < 1mg/L	All < 1mg/L	NR

NR= Not Required

*Starting June 1st, 2008 the operation of the Lamella Inclined Plate Settlers (used to concentrate the solids from the filter backwash and recycle the water used back to Fresh Pond) was modified to reduce the amount of water used to flush the accumulated residuals that was added to the 0101 Residuals Discharge Holding Tank. This modification resulted in a 50% reduction in the sewer discharge. By concentrating the residuals, there is an increase in metals content.

CWD Monthly Water Quality Analysis

COMPARISON OF CAMBRIDGE TAP WATER With EPA & STATE STANDARDS							
PARAMETER	Cambridge mg/L	Primary (Health Related) Maximum Contaminant Level(MCL) mg/L	Secondary (Aesthetic Related) MCL mg/L	PARAMETER	Cambridge mg/L	Primary (Health Related) Maximum Contaminant Level(MCL) mg/L	Secondary (Aesthetic Related) MCL mg/L
Alkalinity (as CaCO ₃)	34.5			Magnesium	4.3		
Aluminum	0.014		0.05-0.2	UV254 A/cm	0.028		
Arsenic	<0.0005	0.05		Manganese	0.014		0.05
Barium	0.036	2		Mercury	<0.0001	0.002	
Cadmium	<0.0005	0.005		Nitrate (as Nitrogen)	0.564		
Calcium	19			pH	9.13		
Chloride	134.6		250	Selenium	<0.0005	0.05	
Chlorine, Free	0.01	4.0 MRDL+		Silver	<0.00015		0.1
Chlorine, Total	2.32	4.0 MRDL+		Sodium	73		
Chromium	0.001	0.1		Specific Conductance, umhos/cm @25C	479		
Color	1		15 color units	Standard Plate Count	0	500 C.F.U./1ml *	250
Copper	0.003	1.3		Sulfate	30.9		
Dissolved Solids, Total	263		500	Total Coliform	0	0 C.F.U./100ml	
Fluoride	1.02	4		Total Haloacetic acids	6.1	60 ug/L (four quarter avg.)	
Hardness (as CaCO ₃)	47			Total Trihalomethanes	7.5	80 ug/L (four quarter avg.)	
Iron	0.03		0.3	Turbidity	0.046	0.5 N.T.U filtered, 1.0	5
Saturation Index (SI)	+0.36			Zinc	<0.001		
Lead	0	0.015					
+ MRDL = Maximum Residual Disinfectant Level				* C.F.U./1ML = Colony Forming Units per 1 milliliter			
Hardness in grains per gallon = 3				CWD FINISHED WATER SAMPLE COLLECTED:06/08/09			
NA = Not Analyzed				Analyzed by Cambridge Lab.			