Charles River Monthly Monitoring Program

2006 Year-End Report

Submitted by:

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1.0 Introduction

The Charles River Watershed Association (CRWA) is devoted to conducting and using sound science upon which to base its policy platforms, advocacy work, and public education. Monitoring the Charles River is extremely important because it helps us to understand the complex hydrological, biological and chemical interactions in the watershed, identify and resolve problem areas (hot spots), and track trends in water quality behavior over time and under different weather conditions. Water quality sampling is time and resource intensive and CRWA heavily relies upon volunteers to collect samples and make in-stream measurements. CRWA's Monthly Monitoring Program is essential to establishing baseline water quality information that helps us understand the overall health of the river, identify water quality issues and guide our management and restoration work. We greatly appreciate the time and effort you have put into making this type of work possible and hope that you will continue to feel closer to this beautiful and valuable natural resource that you are helping protect.

The Charles River Monthly Monitoring program involves river monitoring at 37 sampling sites, spanning the entire 80-mile stretch of the Charles River, and two tributary sites located on the Stop River in Medfield and Muddy River in Boston (Figure 1). A network of over 70 trained volunteers and CRWA staff collect samples and take *in situ* measurements at 6 am typically on the 3rd Tuesday of every month. Bacteria levels are monitored on a monthly basis at all sites while chlorophyll *a* and different chemical forms of nitrogen and phosphorus are monitored on a quarterly basis at 12 sites. *In situ* temperature and depth readings are taken at all sites on a monthly basis. In December 2006, two sites were assigned YSI 63 meters to take additional *in situ* readings including pH, temperature, salinity and conductivity. CRWA obtained these meters through US Environmental Protection Agency's (EPA) equipment loan grant program.

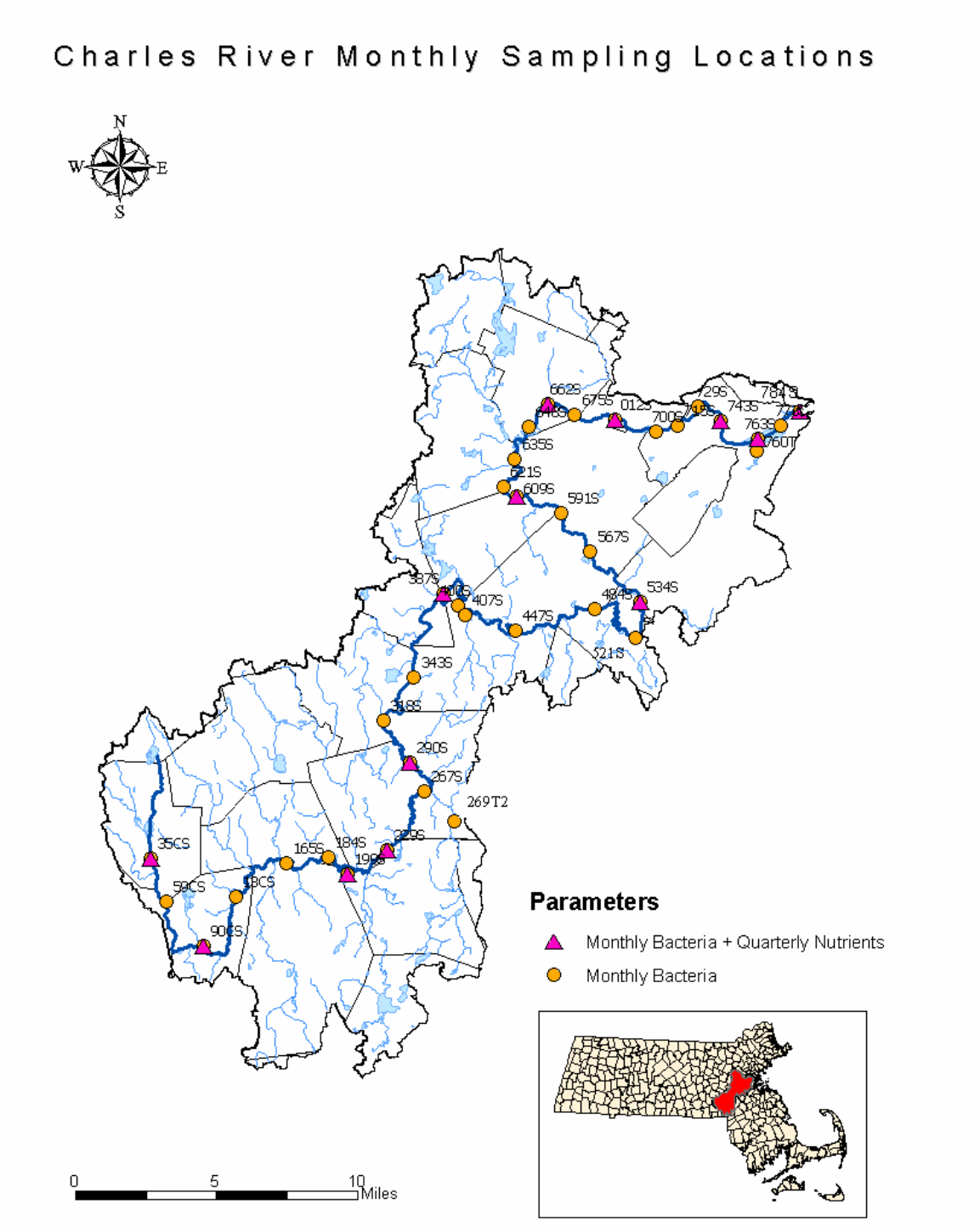

Figure 1: Charles River Watershed Sampling Locations

Table 1: Charles River Monthly Monitoring Locations

Site #	Description	Town
35CS	Central Street Bridge	Milford
35CD	Discharge Pipe at Central Street	Milford
35C2	Discharge Pipe at Central Street on left side looking upstream	Milford
59CS	Mellen Street Bridge	Bellingham
90CS	Route 126, North Main Street	Bellingham
130S	Maple Street Bridge	Bellingham
165S	Shaw Street Bridge/Elm Street	Medway/Franklin
199S	Populatic Pond Boat Launch	Norfolk
229S	Route 115, Baltimore Street	Millis
267S	Dwight Street Bridge	Millis
269T	Causeway Street/Stop River	Medfield
290S	Old Bridge Street	Medfield
318S	Route 27 Bridge	Medfield/Sherborn
343S	Farm Road/Bridge Street	Dover/Sherborn
387S	Cheney Bridge	Wellesley
400S	Charles River Road Bridge	Dover
447S	Dover Gage	Dover
484S	Dedham Medical Center	Dedham
521S	Ames Street Bridge	Dedham
534S	Route 109 Bridge	Dedham
567S	Nahanton Park	Newton
591S	Route 9 Gaging Station	Newton
609S	Washington Street/Hunnewell Bridge	Wellesley
621S	Leo J. Martin Golf Course/Park Road	Weston
635S	2391 Commonwealth Avenue	Newton
648S	Lakes Region	Waltham
662S	Moody Street Bridge	Waltham
675S	Farwell/North Streets	Newton/Waltham
012S	Watertown Dam Footbridge	Watertown
700S	North Beacon Street Bridge	Watertown/Brighton
715S	Arsenal Street	Watertown/Brighton
729S	Elliot Bridge	Cambridge
743S	Western Avenue Bridge	Cambridge
760T	Muddy River/Back Bay Fens	Boston
763S	Harvard Bridge	Boston
773S	Longfellow Bridge	Cambridge
784S	New Charles River Dam	Boston

2.0 Highlighted Water Quality Results

Samples were not collected in January or February due to cold temperatures and frozen river conditions. Below are highlights of the 2006 monitoring results.

Table 2 shows the "action limits" for all of the parameters tested at CRWA. Action limits are numerical values that would cause CRWA to act. In many cases, the action limits are based on a regulatory threshold such as the surface water quality criteria established by Massachusetts Department of Environmental Protection (MassDEP) and the recommended nutrient criteria by EPA (MassDEP 2006a, US EPA 2000).

Table 2: Water Quality Action Limits

Parameter	Action Limit
E. Coli (bacteria)	126 cfu/100 mL (swim) 630 cfu/100 mL (boat)
Total Phosphorus	0.0238 mg/l (as P)
Orthophosphate	0.0238 mg/l (as P)
Ammonia	0.3 mg/l
Nitrate/Nitrite	0.31 mg/l (as N)
Total Nitrogen	0.5 mg/l
Chlorophyll a*	0.0037 mg/l

*State has no established limit for phaeophytin, so the limit for Chlorophyll a is the limit for the total presence of Chlorophyll a & Phaeophytin combined.

E. Coli Bacteria

E. coli levels are compared to the State surface water quality standards for primary and secondary contact recreation. In January 2007, MassDEP revised and approved changes to the State standards which included switching the bacteria criteria from fecal coliform to *E.Coli*.

The strain of *E. coli* bacteria cultured for water quality analysis is not directly implicated in causing adverse health effects, but its presence indicates the likely presence of other harmful bacteria. In 2006, a total of 309 *E. coli* samples were collected; 31% of the samples were below the safe swimming standard (126 colonies per 100 milliliters of water (cfu/100mL)) and 94% of which fell under the safe boating requirements (630 colonies/100mL of water) (Table 2) (MassDEP, 2006a). Please note that for analysis and comparison purposes CRWA uses the geometric mean criteria established by MassDEP instead of the single sample criteria. CRWA applies this approach to be more conservative and protective of the public's health. Eighty one percent and 99% of samples taken during dry conditions, defined as less than 0.1 inch of rain falling within 72 hours before sampling at the rainfall gauge at Logan Airport, fell within safe swimming and boating standards, respectively, while 65% and 91% of samples taken in wet conditions fell within safe swimming and safe boating conditions, respectively.

In the Charles River Basin from Watertown Dam, Site 012S, to the New Charles River Dam, Site 784S, 46% of all samples fell within State limits for safe swimming and 88% fell within safe boating limits (Table 3). During seven wet weather events, 47% and 83% of samples taken in the Basin fell within safe swimming and boating standards, respectively. Water quality in the Basin improved slightly during three dry weather events with 45% and 100% of samples taken meeting State standards for safe swimming and boating, respectively (Table 3). Figure 2 shows the percentage of time that the river met the state standards for both swimming and boating. Figure 3 shows the average *E. coli* concentrations at each sampling location for 2006. Raw data and statistical analysis can be found in Water Quality Tables following the report.

Table 3: Charles River Basin Bacteria Trends

Percent of Time

CHARLES RIVER BASIN

Meets State Water Quality Standards

	Overall		Dry Weather		Wet Weather		River Grade
	Swimming	Boating	Swimming	Boating	Swimming	Boating	
1995	19	39					D
1996	21	57	40	94	15	45	C-
1997	34	70	56	87	22	61	C
1998	51	83	85	98	31	74	C+
1999	55	90	69	100	47	84	B-
2000	52	91	88	88	49	91	B
2001	69	87	87	96	36	71	B
2002 (a)	33	88	78	100	27	86	B
2003 (b)	50	89	48	90	56	89	B-
2004 (c)	53	98	48	96	57	100	B
2005	33	87	41	89	12	76	B+
2006	46	88	45	100	47	83	B+

(a) Only one dry weather event (rainfall less than 0.1 inches in previous 72 hours) occurred in 2002. Rainfall data collected at Logan Airport in Boston.

(b) In 2003, monthly water quality monitoring was conducted seven out of twelve months; of which, only two monthly monitoring events occurred during wet weather, which may have skewed the percentages of the time the river met the swimming and boating standards.

(c) Statistics from 1995 to 2003 based on CRWA monthly fecal coliform testing at in Charles River Basin. Since 2004, samples were analyzed for E. coli bacteria instead of fecal coliform bacteria and these results were compared to the State surface water quality standards for primary and secondary contact recreation.

Contact CRWA at (781) 788-0007 or visit the website at www.charlesriver.org for more information.

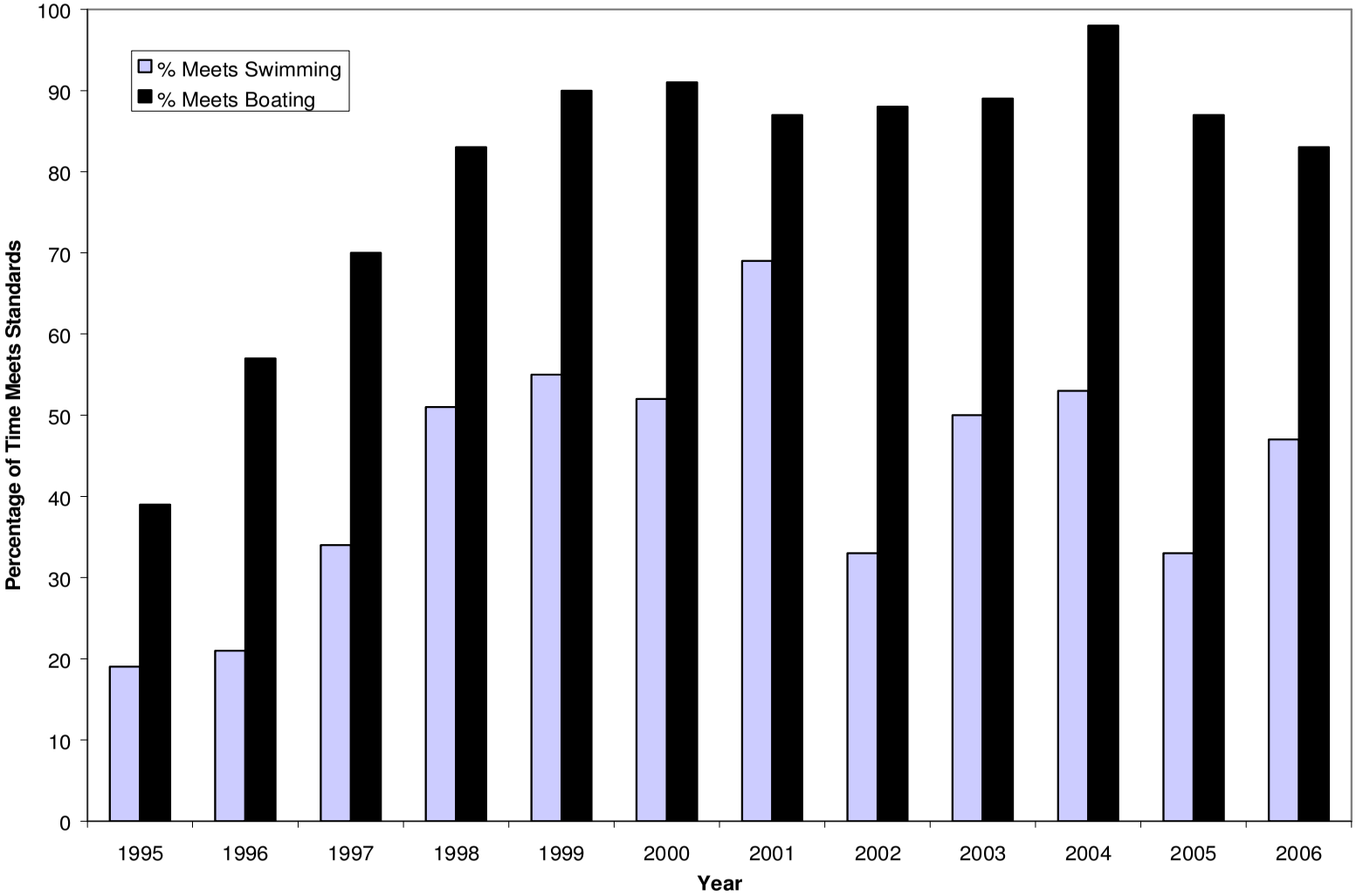

Figure 2: Charles River Basin Bacteria Graph

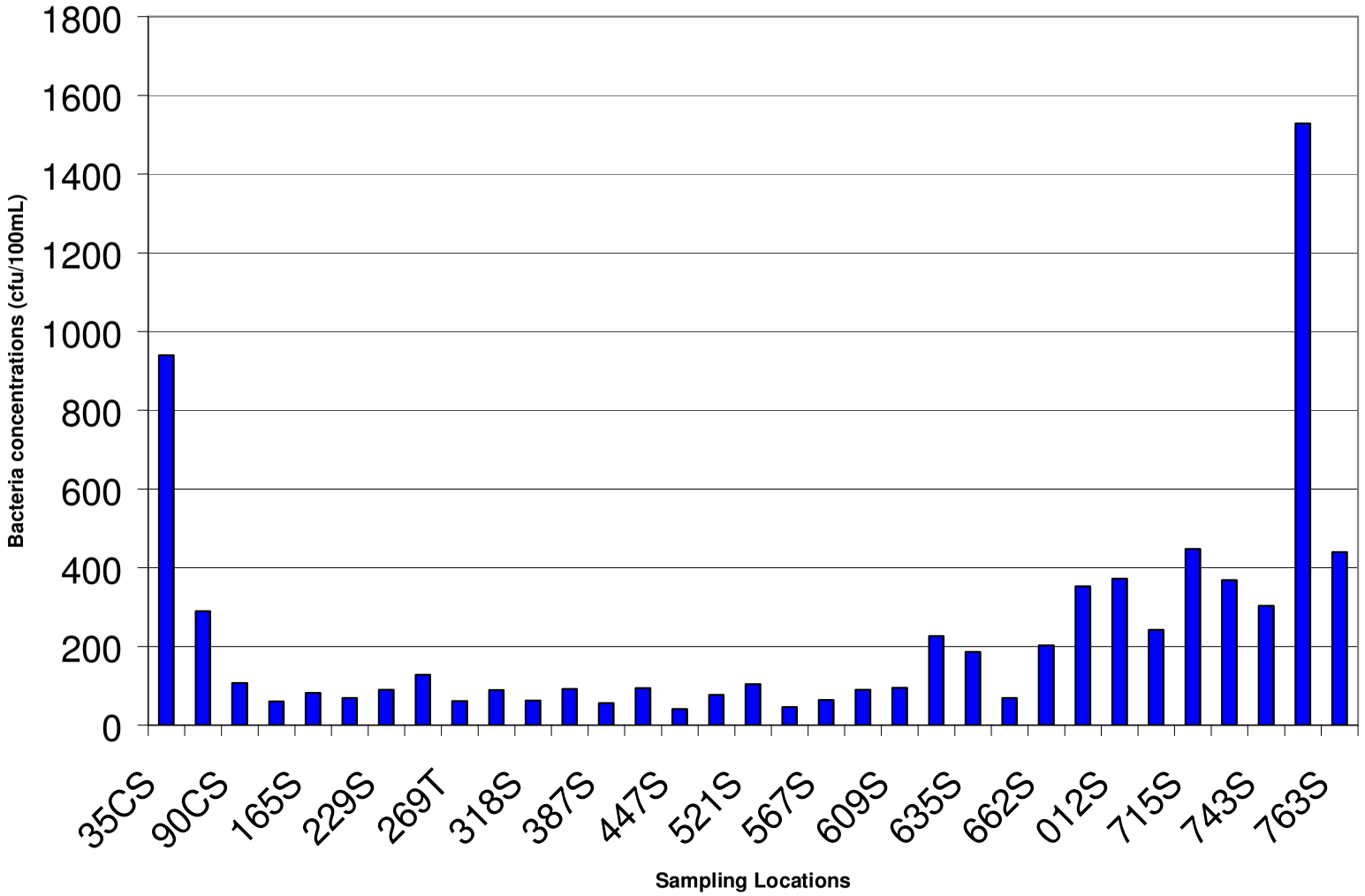

Figure 3: Average *E. coli* Concentrations by Site for 2006

Phosphorus

The primary sources for phosphorus in urban river systems are stormwater runoff of fertilizers applied to residential yards, playing fields and golf courses, discharges from wastewater treatment plants, and releases from contaminated bottom sediments. In the Charles River watershed, phosphorus is the limiting nutrient, meaning that the growth rates of plants including algae are limited by the relatively lower supply of phosphorus. Therefore even minor increases in phosphorus concentrations can cause eutrophication or overgrowth of vegetation including algal blooms. Many stretches of the Charles River are listed as impaired for nutrients in the Massachusetts Year 2006 Integrated List of Waters, which identifies those water bodies that do not meet surface water quality standards (MassDEP, 2006b).. CRWA is currently working on a project to assess current phosphorus concentrations and sources in the upper watershed and determine the total maximum daily load (TMDL) the river can receive and still attain its designated use. Data collected from this Monthly Monitoring program is invaluable to CRWA's TMDL work.

The Monthly Monitoring Program includes analyses of total phosphorus and orthophosphate (the amount of phosphorus immediately available for algal use). In 2006, 37 total phosphorus samples were collected, of which 97% exceeded the EPA recommended criterion of 0.0238 milligrams per liter (mg/L) (Figure 3) (US EPA, 2000). However, of the 42 orthophosphate tests, only 33% did not meet 0.0238 mg/L, EPA's recommended criterion for total phosphorus (Figure 3). Raw data and statistical analysis for total phosphorus and orthophosphate can be found in Water Quality Tables following the report.

Nitrogen

CRWA tests the river for total nitrogen, ammonia, and nitrate-nitrite which may originate from atmospheric deposition from automobile and electric power plant emissions, wastewater treatment plants, septic systems, animal wastes and fertilizers. Total nitrogen is the sum of all organic and inorganic nitrogen forms. Ammonia is commonly found in untreated sewage and its oxidation yields nitrite, which is quickly converted to nitrate, the nutrient form directly available to algae and other aquatic plants. Of the 42 ammonia samples taken, none exceeded EPA's recommended criterion (0.3 mg/L) for ambient waters in New England (Figure 4) (US EPA, 2000). Of the 42 nitrate-nitrite samples, 79% exceeded EPA recommended criterion for total nitrogen (0.57 mg/L) (Figure 4). Of the 40 total nitrogen samples, 95% exceeded EPA's recommended standard of 0.57mg/L for total nitrogen (Figure 4). Raw data and statistical analysis for ammonia, nitrate-nitrite, and total nitrogen can be found in Water Quality Tables following the report.

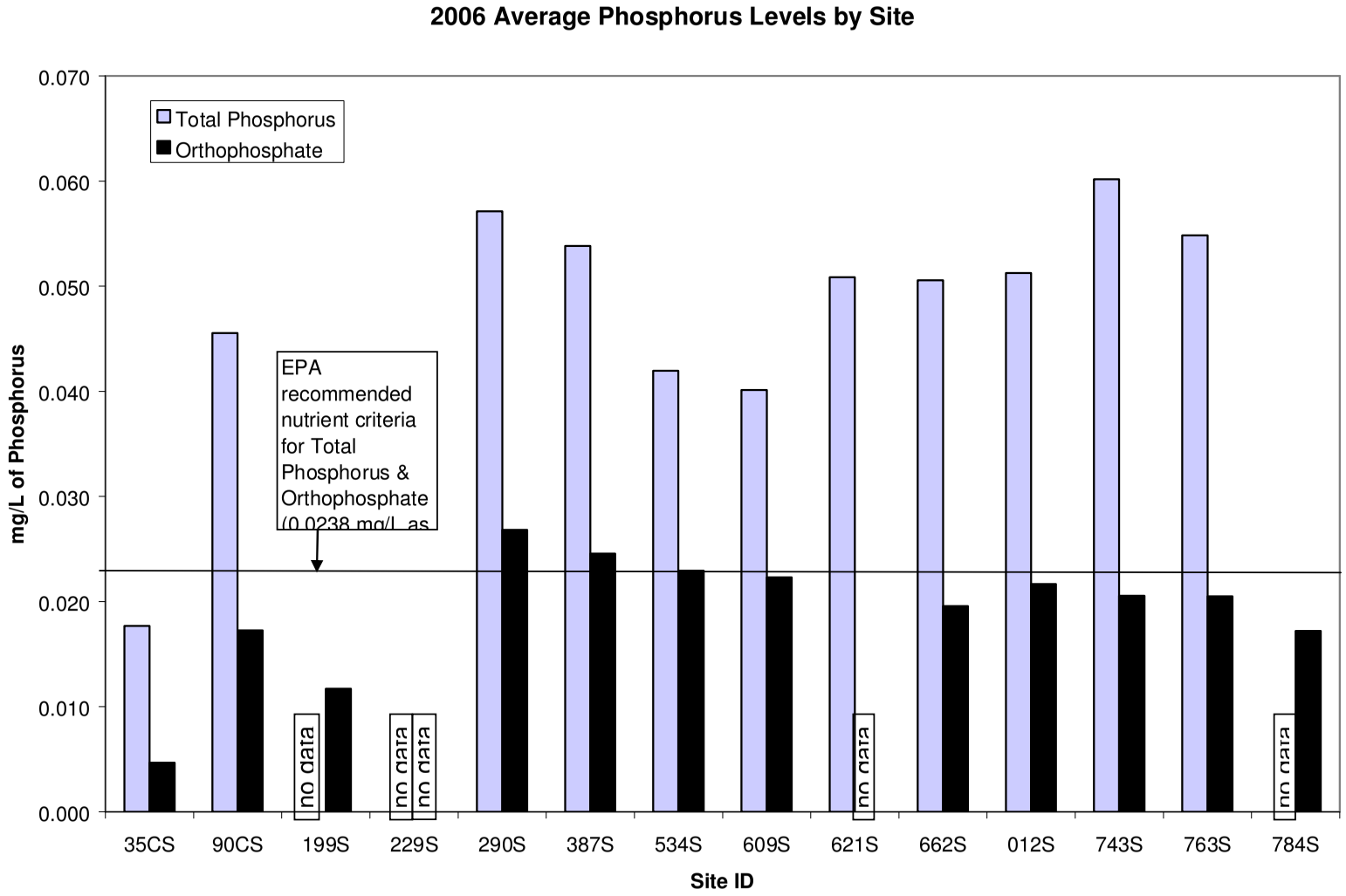

Figure 4: 2006 Phosphorus Trends

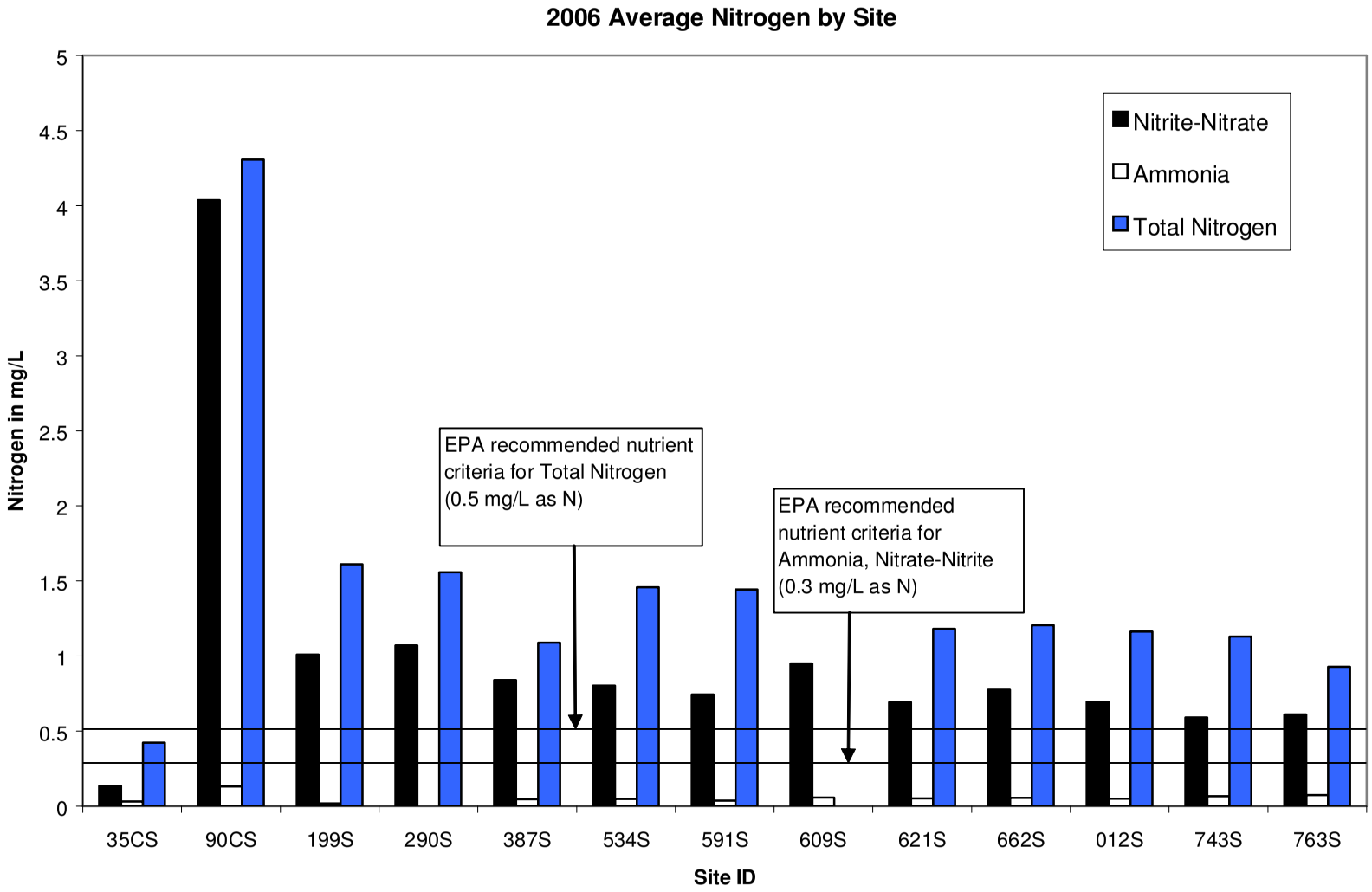

Figure 5: 2006 Nitrogen Trends

Chlorophyll a & Phaeophytin

Chlorophyll *a* is the principle photosynthetic pigment in algae and vascular plants. It is an indicator of algae concentrations in the water column. Increased algal content can lead to anoxic (no available oxygen) conditions detrimental to fish and other aquatic fauna as bacteria use oxygen to break algae down. In addition, it indicates the over-enrichment of nutrients in a river stretch. Of the 122 chlorophyll *a* samples, all failed to meet the EPA recommended limit of 0.00375 mg/L (US EPA, 2000). Raw data and statistical analysis of chlorophyll *a* can be found in Water Quality Tables following the report.

Phaeophytin are the end-products of the degradation of chlorophyll *a*. A high ratio of chlorophyll *a* to phaeophytin indicates active growth of vegetation while a low ratio indicates aging. Higher ratios signify the occurrence of eutrophication. The average ratios for chlorophyll *a*/phaeophytin ranged from 0.88 to 3.43. The sites with the highest chlorophyll *a*/phaeophytin ratios were sites 763S, the Massachusetts Avenue Bridge in Boston, and 784S, the New Charles River Dam in Boston. Raw data and statistical analysis of the chlorophyll *a*/phaeophytin ratios can be found in Water Quality Tables following the report.

Total Suspended Solids (TSS)

Starting in late winter through the spring, stormwater runoff is laden with sand and other types of materials to de-ice our roadways, parking lots and driveways. This influx of particles can often have adverse effects on our waterways, making the water muddy and murky. It can inhibit sunlight from reaching the river bottom and suspended algae. CRWA tests for TSS to determine areas where high levels of sand or silt are being washed off into the river and tributaries.

From March to May 2006, river samples were analyzed for TSS. Only the nine Charles River Basin sites were sampled for TSS in March and April while the entire river was sampled for TSS in May. May Results for TSS showed high levels in a few locations. At Site 290S, Old Bridge Street in Medfield, TSS levels were high, 18 mg/L. There are many major roadways crossing the river upstream of this site as well as residential properties abutting the river banks that may have been sources of sediment to this area. Also, a dramatic increase in TSS occurred from Site 521S, Ames St. Bridge in Dedham to Site 591S, Rte. 9 Gauging Station in Newton. TSS levels rose from not being detected at Site 521S to almost 9 mg/L at Site 591S. The Ames Street area is surrounded by wetlands adjacent to the river, providing a buffer from polluted runoff. As the river flows downstream to Site 591S, the adjacent land use is predominantly commercial and industrial, which typically has higher pollutant loading than other land use types. TSS levels were also higher starting from Site 675S, North Street Bridge in Brighton/Watertown to Site 763S, Harvard Bridge in Boston/Cambridge as compared to other upstream locations in the river. The highest TSS level in this section was 8.0 mg/L

at Site 729S, Eliot Bridge in Cambridge. Raw data can be found in Water Quality Tables following the report.

Optical Brighteners

Optical brighteners are fluorescent whitening agents found in human wash water that can be viewed under ultraviolet light. The presence of these whitening agents is an indicator of potential human sewage contamination. In 2006, the US EPA Laboratory in Chelmsford tested a new methodology for optical brighteners to determine its suitability for application in water quality monitoring. According to US EPA, optical brightener concentrations over 1,000 micrograms per liter (µg/L) may indicate raw sewage contamination, concentrations of 500-1,000 µg/L may be diluted sewage and septic, and levels less than 500 µg/L are difficult to distinguish. CRWA provided river samples to EPA in June, a wet weather monitoring event. Most of the results in June were between 500 and 600 µg/L with a few sites below 500 µg/L. These numbers indicate that there was uncertainty on what were the sources of contamination to the areas with elevated bacteria levels (Raw data can be found in Water Quality Tables following the report).

3.0 Conclusions

Data generated from this comprehensive water quality monitoring program helps to provide an indication of current overall stream health. Each month, we can identify new problems and refocus our efforts to tackle the most urgent water quality issues. Taken in conjunction with CRWA's other monitoring efforts including visual monitoring for our "Find It and Fix It" Stormwater Project, we can obtain a better picture of the river's health and target areas of the watershed for clean up and better watershed management.

As shown in Table 2, the bacteria results for the Charles River Basin have not improved from last year to this year and thus the river maintained a 'B+' grade for its water quality in 2006. The river's report card grade is determined by EPA using our monthly monitoring data making it essential to monitoring our progress towards achieving an A grade for the river by 2010.

Over the course of the twelve-year program, water quality in the Charles has been steadily improving in large part due to the monitoring work of CRWA staff and its volunteers which has identified the most problematic areas in the river and guided where remediation and management efforts should occur in the watershed.

4.0 References

MA Department of Environmental Protection, 2006a. *Massachusetts Surface Water Quality Standards.* Massachusetts Department of Environmental Protection, Division of

Water Pollution Control, Technical Services Branch. Westborough, MA (Revision of 314 CMR 4.00).

MA Department of Environmental Protection, 2006b. *Massachusetts Year 2006 Integrated List of Waters – Proposed listing of the condition of MA waters pursuant to Sections 303(d) and 305(b) Clean Water Act.* MassDEP, Division of Watershed Management. Worcester, MA.

U.S. Environmental Protection Agency, 2000. *Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion XIV*. EPA-822/B-00/022.US EPA Office of Water Regulations and Standards, Washington, DC.

Water Quality Tables

E. coli Bacteria Results

Charles River Watershed Association
Monthly Water Quality Sampling Data
Concentrations of Escherichia Coli (E. coli) Bacteria (#/100 ml)

Site #	Description	Town	River mile	1/10/2006	(f)	2/14/2006	(h)	3/21/2006	4/11/2006	5/16/2006	6/20/2006	7/18/2006	8/15/2006	9/19/2006	(j)	10/17/2006	11/21/2006	12/19/2006	Mean	Median	Std. Dev.	Min.	Max.
35CS	Central Street Bridge	Milford	3.5					35		500	270	825	920	> 2420		726	345	> 2420	940	726	884	35	2420
35CD	Mellen St. Bridge	Bellingham	5.9																no data	no data	no data	no data	no data
35C2	Rt. 126, N. Main St.	Bellingham	9.0																no data	no data	no data	no data	no data
59CS	Maple St. Bridge	Bellingham	12.9					195	15	1200	200	115		345		214	210	114	290	200	353	15	1200
90CS	Shaw St. Bridge	Franklin	16.5					5		200	210	180	90	88.2		47.2	102	44.3	107	90	73	5	210
13CS	Populatic Pond Boat Launch	Norfolk	19.9					10		100 (a)	90	55	110	60			35.4	23.3	60	58	37	10	110
165S	Rt. 115, Baltimore St.	Norfolk/Millis	22.9					5	15	100	147.5 (a)	210		73.3		111	33.2	45	82	73	67	5	210
199S	Dwight St. Bridge	Millis	26.7							200		62.5 (a)	10	18.7		22.3	98.7		69	42	72	10	200
229S	Causeway St. Stop River	Medfield	26.9				<	5	15	300	70	160	50 (a)	47.2			81.3	77.6	90	70	91	5	300
267S	Old Bridge St.	Medfield	29.0							600	50	75		45.3 (a)		20.1	45.7	59.1	128	50	209	20.1	600
269T	Rt. 27 Bridge	Medfield	31.8				<	5	10	100	20	55	110	192			22.8	30.5	61	31	62	5	192
290S	Farm Rd./Bridge St.	Sherborn/Dover	34.3				<	5	5	500	20	20	60	75.9		37.9	91.1 (a)	74.4	89	49	148	5	500
318S	Cheney Bridge	Wellesley	38.7				<	5	20	200	90	35	70	65		55.6	43.9	41.05 (a)	63	50	54	5	200
343S	Charles River Road Bridge	Dover	40.0				<	5	15	600	20	135 <	10	18.5		35.4	52	29.2	92	25	182	5	600
387S	Dover Gage	Dover	44.7					30	7.5 (a)		70	100	100	30.9		55.4	32.3	83.9	57	55	34	7.5	100
400S	Dedham Medical Center	Dedham	48.4						15	500	60	70	60	49.6		14.5	39.3	38.4	94	50	153	14.5	500
447S	Ames St. Bridge	Dedham	52.1					< 5	100	90	40 <	10	20.1			17.5	43.5		41	30	36	5	100
484S	Rt. 109 Bridge	Dedham	53.4					5		400	20	45	60	69.7		20.1	51.2	24	77	45	123	5	400
521S	Nahanton Park	Newton	56.7				<	5		300	100	45	260	75.4		38.9	79.2	34.5	104	75	104	5	300
534S	Rt. 9 Gaging Station	Newton	59.1					20	20	100	55	55	80	29.5		31.3	47.2	23.1	46	39	27	20	100
567S	Washington St. Hunnewell Bridge	Wellesley	60.9						20	300	90	25	20	16.9		22.9 (a)	34.1	48.1	64	25	91	16.9	300
591S	Leo J. Martin Golf Course/Park Rd.	Weston	62.1					16 (a)	5	500	50	120	70	32.7		29.4	51.2	21.6	90	41	148	5	500
609S	2391 Commonwealth Ave.	Newton	63.5					5	25	300	40	190	180	79.4		38.4	57.3	31.3	95	49	96	5	300
621S	Lakes Region	Waltham	64.8				<	5		900	240	200	380	147		73.3	68.9	21.3	226	147	279	5	900
635S	Moody St. Bridge	Waltham	66.2					35	27.5 (a)		70	320	640	111			101		186	101	223	27.5	640
648S	North St.	Waltham	67.6						5		60	120		85.7		56.5	85.7		69	73	39	5	120
662S	Watertown Dam Footbridge	Watertown	69.3						10	1200	72.5 (a)	60	70			66.9	76.6	65.7	203	68	404	10	1200
675S	N. Beacon St.	Newton	70.9						45	1300	70	267.5 (a)	490	345		365	178	117	353	268	385	45	1300
012S	Arsenal St.	Brighton	71.5						45	1700	175	205	70 (a)	186		517	205	249	372	205	516	45	1700
700S	Eliot Bridge	Cambridge	72.9					70	70	600	120	300	70	199.5 (a)		461	144	387	242	172	187	70	600
715S	Western Ave	Cambridge	74.3					75		1600		280	90			252.5 (a)		387	447	266	577	75	1600
729S	Muddy River at Comm. Ave.	Boston	76.0					55	85	1900	210	250	80	<1.0		154	258 (a)	326	369	210	582	55	1900
743S	Mass. Ave. at Harvard Bridge	Boston	76.3				<	5	25	2100	105	145	10	93.3		75.9	261	215.5 (a)	304	99	637	5	2100
760S	Longfellow Bridge	Cambridge	77.3					30	15	13700	440	420	320	25.6		185	90.9	59.8	1529	138	4280	15	13700
763S	New Charles River Dam	Boston	78.4					5		2400	305	160	80	9.8		118			440	118	870	5	2400
773S								15	110	6400	110	70	10	140		63.7	142	138					
784S								25	20	5800	140	40	10	17.5		47.2	148						
																			Wet		Dry	Total	
# sites swimable								25	25	5	23	19	24	24		23	24	22	143		71	**214**	
# sites boatable								26	25	20	33	34	29	31		30	33	28	202		87	**289**	
# sites sampled								26	25	32	33	35	31	34		31	33	29	221		88	**309**	
% of sites swimable								96%	100%	16%	70%	54%	77%	71%		74%	73%	76%	65%		81%	**69%**	
% of sites boatable								100%	100%	63%	100%	97%	94%	91%		97%	100%	97%	91%		99%	**94%**	
QA/QC Samples																							
	Equipment Blank							<1	<1	<1	<1	<1		<1.0		<1.0	38.8	<1.0					
	Site No.							729S	743S	760S	763S	773S		521S		534S	567S	165S					
	Equipment Blank										<1	<1					<1.0	<1.0					
	Site No.										400S	447S					130S	521S					
Rainfall At Logan International Airport (inches)								DRY	WET	WET	WET	WET	WET	WET		WET	DRY	DRY					
	3 Days Prior to Sampling							Trace	0.12	3.84	Trace	0	0	0 (g)		0	0	0.01					
	2 Days Prior to Sampling							Trace	0	3.77	0	0	0	0 (g)		0	0	0					
	1 Day Prior to Sampling							0	0	0.36	0	0	0	0 (g)		0	0	0.02					
	Day of Sampling							0	0	0.52	0.37	0.22 (i)	0.53 (i)	0.14 (i)		0.13 (i)	0	0					

Samples are analyzed at MWRA Central Laboratory

(a) Average of duplicates

(b) Watertown Dam recorded a short, intense rainfall of 0.14 inches and Wellesley College recorded 0.88 inches of rain; (c) Watertown Dam recorded 0.08 inches of rain and Wellesley College recorded 0.07 inches of rain from 7am 8/19/02 through 7am 8/20/02; (d) The relative percent difference for duplicate samples was 108%; (e) Sampling cancelled due to laboratory shutdown; (f) MWRA analyzed for fecal coliform this month. See fecal2006 spreadsheeet; (g) Rainfall information not available from Logan, so USGS Muddy River gauge used instead; (h) Sampling cancelled due to harsh temperatures, frozen river, inaccessible sites; (i) Rainfall took place after 06:30

Total Phosphorus Results

Site #	Description	Town	River mile	3/21/2006		6/20/2006		10/17/2006		12/19/2006		Mean	Median	Stnd Dev	Min
35CS	Central Street Bridge	Milford	3.5	0.012		0.025		0.030		<0.0034		0.022	0.025	0.009	0.012
90CS	Rt. 126, N. Main St.	Bellingham	9.0	0.041		0.064		0.037		0.039		0.046	0.040	0.013	0.037
199S	Populatic Pond Boat Launch	Norfolk	19.9									no data	no data	no data	no data
229S	Rt. 115, Baltimore St.	Norfolk/Millis	22.9									no data	no data	no data	no data
290S	Old Bridge St.	Medfield	29.0	0.057		0.078		0.050		0.044		0.057	0.054	0.015	0.044
387S	S. Natick Dam	Natick	37.8	0.038		0.083		0.052		0.042		0.054	0.047	0.020	0.038
534S	Rt. 109 Bridge	Dedham	53.4	0.038						0.046		0.042	0.042	0.006	0.038
591S				0.034						0.046		0.040	0.040	no data	0.034
609S	Washington St. Hunnewell Bridge	Wellesley	60.9	0.035		0.077	(b)	0.045		0.047		0.051	0.046	0.018	0.035
662S	Moody St. Bridge	Waltham	66.2	0.037		0.077		0.039		0.049		0.051	0.044	0.019	0.037
012S	Watertown Dam Footbridge	Watertown	69.3	0.039	(b)	0.079		0.038		0.048		0.051	0.044	0.019	0.038
743S	Western Ave	Cambridge	74.3	0.047		0.088		0.046				0.060	0.047	0.024	0.046
763S	Mass. Ave. at Harvard Bridge	Boston	76.3			0.068		0.041				0.055	0.055	0.019	0.041
784S	New Charles River Dam	Boston	78.4									#DIV/0!	#NUM!	#DIV/0!	0.000
Total # of Samples exceeding action limit		36		9		9		9		9					
Total # of Samples		37		10		9		9		9					
% of samples exceeding action limit		97%		0.9		1		1		1					
QA/QC Samples															
	Equipment Blank							<0.11							
	Site No.							534S							
Rainfall At Logan International Airport (inches)															
	3 Days Prior to Sampling			trace		trace		0		0.01					
	2 Days Prior to Sampling			trace		0		0		0					
	1 Day Prior to Sampling			0		0		0		0.02					
	Day of Sampling			0		0.37		0.13	(i)	0					

Samples analyzed at Massachusetts Water Resources Authority's Central Laboratory.

(a) Concentrations reported in table is equal to less than twice of reported concentration.
(b) Average of duplicate samples.
(c) Equipment blank sample was collected incorrectly. It was observed that the sample appeared like river water instead of distilled water.

Orthophosphate Results

Site #	Description	Town	River mile		3/21/2006		6/20/2006		10/17/2006		12/19/2006		Mean	Median	Stnd Dev	Min	Max
35CS	Central Street Bridge	Milford	3.5		0.005		0.006		0.007		0.001		0.005	0.005	0.003	0.001	0.007
90CS	Rt. 126, N. Main St.	Bellingham	9.0		0.017		0.018		0.015		0.018		0.017	0.018	0.002	0.015	0.018
199S	Populatic Pond Boat Launch	Norfolk	19.9						0.012				0.012	0.012	N/A	0.012	0.012
229S	Rt. 115, Baltimore St.	Norfolk/Millis	22.9														
290S	Old Bridge St.	Medfield	29.0		0.033		0.035		0.018		0.022		0.027	0.027	0.008	0.018	0.035
387S	S. Natick Dam	Natick	37.8		0.020		0.038		0.017		0.022		0.025	0.021	0.009	0.017	0.038
534S	Rt. 109 Bridge	Dedham	53.4		0.018		0.037		0.014		0.023		0.023	0.020	0.010	0.014	0.037
609S	Rt. 9 Gaging Station	Newton	59.1		0.016		0.033		0.014		0.027		0.022	0.021	N/A	0.014	0.033
621S	Washington St. Hunnewell Bridge	Wellesley	60.9										no data	no data	no data	0.000	0.000
662S	Leo J. Martin Go	Weston			0.016		0.028	(a)	0.009		0.025						
012S	Moody St. Bridge	Waltham	66.2		0.018		0.033		0.010		0.026		0.022	0.022	0.010	0.010	0.033
743S	Watertown Dam Footbridge	Watertown	69.3		0.018	(a)	0.029		0.006		0.029		0.021	0.023	0.011	0.006	0.029
763S	Western Ave.	Cambridge	74.3		0.021		0.033		0.007			(e)	0.020	0.021	0.013	0.007	0.033
784S	Mass. Ave. at Harvard Bridge	Boston	76.3				0.029		0.005				0.017	0.017	0.017	0.005	0.029
Total # of Samples exceeding action limit		14			1		9		0		4						
Total # of Samples		42			10		11		12		9						
% of samples exceeding action limit		33%			10%		82%		0%		44%						
QA/QC Samples																	
	Equipment Blank																
	Site No.																
Rainfall At Logan International Airport (inches)																	
	3 Days Prior to Sampling				trace		trace		0		0.01						
	2 Days Prior to Sampling				trace		0		0		0						
	1 Day Prior to Sampling				0		0		0		0.02						
	Day of Sampling				0		0.37		0.13		0						

(a) Analysis performed at National Environmental Testing, Inc.
(b) Analysis performed by Analytical Balance
(c) Analysis performed by MWRA's Central Lab from 12/1997 to present.
(d) Concentration reported here is half of less than concentration reported originally.
(e) Average of duplicate samples
(f) Equipment blank sample was collected incorrectly. The sample appeared like river water instead of distilled water.

Ammonia Results

Site #	Description	Town	River mile	3/21/2006	(a)	6/20/2006	(a)	10/17/2006	(a)	12/19/2006	Mean	Median	Stnd Dev	Min	Max
35CS	Central Street Bridge	Milford	3.5	0.022		0.067		0.035		0.005	0.032	0.028	0.026	0.005	0.067
90CS	Rt. 126, N. Main St.	Bellingham	9.0	0.136		0.206		0.076		0.105	0.131	0.121	0.056	0.076	0.206
199S	Populatic Pond Boat Launch	Norfolk	19.9					0.018			0.018	0.018		0.018	0.018
229S	Rt. 115, Baltimore St.	Norfolk/Milli	22.9												
290S	Old Bridge St.	Medfield	29.0	0.034		0.061		0.025		0.063	0.046	0.047	0.019	0.025	0.063
387S	S. Natick Dam	Natick	37.8	0.035		0.059		0.030		0.072	0.049	0.047	0.020	0.030	0.072
534S	Rt. 109 Bridge	Dedham	53.4	0.016		0.060		0.019		0.053	0.037	0.036	0.023	0.016	0.060
609S	Washington St. Hunnewell Bridge	Wellesley	60.9	0.042		0.062		0.032		0.092	0.057	0.052	0.026	0.032	0.092
662S	Moody St. Bridge	Waltham	66.2	0.031		0.064	(d)	0.018		0.093	0.052	0.048	0.034	0.018	0.093
012S	Watertown Dam Footbridge	Watertown	69.3	0.031		0.067		0.035		0.087	0.055	0.051	0.027	0.031	0.087
743S	Western Ave.	Cambridge	74.3	0.019	(d)	0.073		0.016		0.096	0.051	0.046	0.040	0.016	0.096
763S	Mass. Ave. at Harvard Bridge	Boston	76.3	0.032		0.113		0.057			0.067	0.057	0.041	0.032	0.113
784S	New Charles River Dam	Boston	78.4			0.108		0.038			0.073	0.073	0.049	0.038	0.108
Total # of Samples exceeding action limit		0		0		0		0		0					
Total # of Samples		42		10		11		12		9					
% of samples exceeding action limit		0%		0%		0%		0%		0%					
QA/QC Samples															
	Equipment Blank					0.005		0.002							
	Site No.					763S		534S							
Rainfall At Logan International Airport (inches)				dry		wet		wet		dry					
	3 Days Prior to Sampling			trace		trace		0		0.01					
	2 Days Prior to Sampling			trace		0		0		0					
	1 Day Prior to Sampling			0		0		0		0.02					
	Day of Sampling			0		0.37		0.13		0					

(a) Analysis performed at Massachusetts Water Resources
(b) Analysis performed at National Environmental Testing, Inc.
(c) Analysis performed at Analytical Balance Corp.
(d) Average of duplicates
(e) Scattered showers throughout the watershed
(f) Not collected
(g) Samples not collected due to very cold temperatures and frozen river.

Nitrate/Nitrite Results

Site #	Description	Town	River mile	3/18/2006		6/20/2006		10/17/2006		12/19/2006		Mean	Median	Stnd Dev	Min	Max
35CS	Central Street Bridge	Milford	3.5	0.283		0.091		0.148		0.016		0.135	0.120	0.113	0.016	0.283
90CS	Rt. 126, N. Main St.	Bellingham	9.0	3.824		4.734		2.745		4.846		4.038	4.279	0.976	2.745	4.846
199S	Populatic Pond Boat Launch	Norfolk	19.9					1.010				1.010	1.010	#DIV/0!	1.010	1.010
290S	Old Bridge St.	Medfield	29.0	1.527		0.294		1.200		1.261		1.070	1.231	0.537	0.294	1.527
387S	S. Natick Dam	Natick	37.8	1.140		0.188		0.782		1.249		0.840	0.961	0.478	0.188	1.249
534S	Rt. 109 Bridge	Dedham	53.4	0.989		0.203		0.959		1.060		0.803	0.974	0.402	0.203	1.060
591S	Rt. 9 Gaging Station	Newton	59.1			0.233		0.980		1.020		0.744	0.980	0.444	0.233	1.020
609S	Washington St. Hunnewell Bridge	Wellesley	60.9	0.950								0.950	0.950	#DIV/0!	0.950	0.950
621S	Leo J. Martin Golf Course/Park Rd.	Weston				0.265	(a)	0.852		0.957						
662S	Moody St. Bridge	Waltham	66.2	0.931		0.317		0.859		0.991	(a)	0.774	0.895	0.310	0.317	0.991
012S	Watertown Dam Footbridge	Watertown	69.3	0.947		0.356		0.497		0.980		0.695	0.722	0.316	0.356	0.980
743S	Western Ave.	Cambridge	74.3	1.005	(a)	0.366		0.396				0.589	0.396	0.361	0.366	1.005
763S	Mass. Ave. at Harvard Bridge	Boston	76.3	1.130		0.366		0.333				0.610	0.366	0.451	0.333	1.130
784S	New Charles River Dam	Boston	78.4													
Total # of Samples exceeding action limit		33		9		5		11		8						
Total # of Samples		42		10		11		12		9						
% of samples exceeding action limit		79%		90%		45%		92%		89%						
QA/QC Samples																
	Equipment Blank							0.006								
	Site No.							534S								
Rainfall At Logan International Airport (inches)				dry		wet		dry		dry						
	3 Days Prior to Sampling			trace		trace		0		0.01						
	2 Days Prior to Sampling			trace		0		0		0						
	1 Day Prior to Sampling			0		0		0		0.02						
	Day of Sampling			0		0.37		0.13	(c)	0						

* Analyzed at Massachusetts Water Resource Authority's Central Lab

(a) Average of duplicates

(b) Scattered showers throughout watershed.

(c) Rainfall occurred after 06:30am

Total Nitrogen Results

Site #	Description	Town	River mile	3/21/2006		6/20/2006		10/17/2006		12/19/2006		Mean	Median	Stnd Dev	Min	Max
35CS	Central Stree	Milford	3.5	0.55		0.50		0.60		0.04		0.422	0.525	0.256	0.042	0.597
90CS	Rt. 126, N. M	Bellinghar	9.0	4.31		4.66		3.52		4.73		4.307	4.489	0.559	3.516	4.734
199S	Populatic Po	Norfolk	19.9					1.61				1.611	1.611	#DIV/0!	1.611	1.611
290S	Old Bridge S	Medfield	29.0	1.96		0.76		1.83		1.67		1.557	1.751			
387S	S. Natick Da	Natick	37.8	1.58		0.69		0.53		1.55		1.089	1.123	0.558	0.529	1.583
534S	Rt. 109 Bridg	Dedham	53.4	1.38				1.50		1.50		1.459	1.499	0.069	1.380	1.499
609S	Washington S	Wellesley	60.9	1.32				1.55		1.46		1.444	1.457	0.118	1.319	1.555
621S	Leo J. Martin	Weston	62.1									#DIV/0!	#NUM!	N/A	0.000	0.000
662S	Moody St. Br	Waltham	66.2	1.25		0.76	(a)	1.32		1.40		1.182	1.284	0.289	0.758	1.401
012S	Watertown D	Watertow	69.3	1.33		0.73		1.34		1.43		1.206	1.336			
743S	Western Ave	Cambridg	74.3	1.35	(a)	0.78		1.07		1.45	(a)	1.163	1.210	0.299	0.784	1.450
763S	Mass. Ave. a	Boston	76.3	1.53		0.90		0.97				1.130	0.966	0.345	0.896	1.527
784S	New Charles	Boston	78.4			0.84		1.02				0.929	0.929	0.129	0.838	1.020
												#DIV/0!	#NUM!	#DIV/0!	0.000	0.000
Total # of Samples exceeding action limit			38	10		8		12		8						
Total # of Samples			40	10		9		12		9						
% of samples exceeding action limit			95.0%	100.0%		88.9%		100.0%		88.9%						
QA/QC Samples						FDUP										
	Equipment Blank					EQBL										
	Site No.															
Rainfall At Logan International Airport (inches)																
	3 Days Prior to Sampling				0.00				0							
	2 Days Prior to Sampling				0.00				0							
	1 Day Prior to Sampling				0.00				0							
	Day of Sampling				0.13				0							

* Samples analyzed at Massachusetts Water Resources Authority's Central Lab.

(a) Average of duplicates
(b) Scattered showers throughout watershe
(c) Rainfall took place after 06:30

Chlorophyll a Results

Site #	Town	River mile		3/21/2006		6/20/2006		10/17/2006		12/19//2006		Mean	Median	Stnd Dev	Min	Max
				Chlorophyll a		Chlorophyll a		Chlorophyll a		Chlorophyll a						
35CS	Milford	3.5										no data	no data	no data	no data	no data
90CS	Bellingham	9.0		1.15		1.72		4.12	<	0.1		1.773	1.435	1.703	0.100	4.120
199S	Norfolk	19.9		1.54		1.69		2.1		1.05		1.595	1.615	0.434	1.050	2.100
290S	Medfield	29.0						5.82				5.820	5.820	N/A	5.820	5.820
387S	Natick	37.8		1.67		2.19		2.05		0.89		1.700	1.860	0.583	0.890	2.190
534S	Dedham	53.4		1.39		2.33		2.66		0.78		1.790	1.860	0.862	0.780	2.660
609S	Wellesley	60.9		2.2		4.86		5.96		1.97		3.748	3.530	1.974	1.970	5.960
621S	Weston	62.1.		3.76		5.49		5.46		1.52		4.058	4.610	1.875	1.520	5.490
662S	Waltham	66.2										no data	no data	no data	no data	no data
012S	Watertown	69.3		4.58		7.2	(a)	16.6		1.65		7.508	5.890	6.472	1.650	16.600
743S	Cambridge	74.3		4.86		5.22		7.97		0.98		4.758	5.040	2.876	0.980	7.970
763S	Boston	76.3		6.145	(a)	7.19		19.5		1.115	(a)	8.488	6.668	7.806	1.115	19.500
784S	Boston	78.4		11.6		7.55		14.1				11.083	11.600	3.305	7.550	14.100
		all samples exceed limit by a great margin														
QA/QC Samples																
	Equipment Blank															
	Site No.															
	Equipment Blank															
	Site No.															
Rainfall At Logan International Airport (inches)				dry		wet		wet		dry						
	3 Days Prior to Sampling			trace		trace		0		0.01						
	2 Days Prior to Sampling			trace		0		0		0						
	1 Day Prior to Sampling			0		0		0		0.02						
	Day of Sampling			0		0.37		0.13	(c)	0						

* Samples analyzed at Massachusetts Water Resources
(a) Average of duplicates
(b) Scattered showers throughout watershed
(c) Rainfall occurred after 06:30

Chlorophyll *a*/ Phaeophytin Ratios

Site #	Town	River mile		3/21/2006		6/20/2006		10/17/2006		12/19//2006						
				Chloro/Phaeo		Chloro/Phaeo		Chloro/Phaeo		Chloro/Phaeo		Mean	Median	Stnd Dev	Min	Max
35CS	Milford	3.5														
90CS	Bellingham	9.0		1.20		0.79		1.81		0.05		0.960	0.992	0.738	0.050	1.807
199S	Norfolk	19.9		0.99		0.54		1.01		0.95		0.872	0.967	0.223	0.540	1.014
290S	Medfield	29.0														
387S	Natick	37.8		1.27		0.46		1.49		0.78		0.999	1.028	0.468	0.455	1.486
534S	Dedham	53.4		1.38		0.77		1.19		0.74		1.022	0.983	0.313	0.743	1.376
609S	Wellesley	60.9		2.16		1.09		2.38		1.12		1.689	1.638	0.678	1.095	2.384
621S	Weston	62.1.		2.51		1.09		1.50		1.32		1.604	1.409	0.624	1.091	2.507
662S	Waltham	66.2														
012S	Watertown	69.3		3.32		2.19	(a)	2.69		1.53		2.433	2.443	0.760	1.528	3.319
743S	Cambridge	74.3		2.34		1.40		1.02		0.68		1.360	1.213	0.716	0.676	2.337
763S	Boston	76.3		3.31	(a)	2.23		6.44		1.04	(a)	3.253	2.769	2.316	1.037	6.436
784S	Boston	78.4		5.00		2.37		2.93				3.431	2.925	1.387	2.367	5.000
		all samples exceed limit by a great margin														
QA/QC Samples																
	Equipment Blank															
	Site No.															
	Equipment Blank															
	Site No.															
Rainfall At Logan International Airport (inches)				dry		wet		wet		dry						
	3 Days Prior to Sampling			trace		trace		0		0.01						
	2 Days Prior to Sampling			trace		0		0		0						
	1 Day Prior to Sampling			0		0		0		0.02						
	Day of Sampling			0		0.37		0.13	(c)	0						

* Samples analyzed at Massachusetts Water Resources
(a) Average of duplicates
(b) Scattered showers throughout watershed
(c) Rainfall occurred after 06:30

Total Suspended Solids Results

Total Suspended Solids mg/L

Site #	Description	Town	River Mile	1/10/2006 *	3/21/2006†		4/11/2006		5/16/2006	
35CS	Central Street Bridge	Milford	3.5						ND	
35CD	Discharge Pipe @ Central St.	Milford	3.5							
35C2	2nd Discharge Pipe @ Central St.	Milford	3.5							
59CS	Mellen St. Bridge	Bellingham	5.9						ND	
90CS	Rt. 126, N. Main St.	Bellingham	9.0						ND	
130S	Maple St. Bridge	Bellingham	12.9						ND	(a)
165S	Shaw St. Bridge	Franklin	16.5						ND	
199S	Populatic Pond Boat Launch	Norfolk	19.9						ND	
229S	Rt. 115, Baltimore St.	Norfolk/Millis	22.9						ND	
267S	Dwight St. Bridge	Millis	26.7						ND	
269T	Causeway St. Stop River	Medfield	26.9						ND	
290S	Old Bridge St.	Medfield	29.0						18.0	
318S	Rt. 27 Bridge	Medfield	31.8							
343S	Farm Rd./Bridge St.	Sherborn/Dover	34.3						ND	
387S	S. Natick Dam	Natick	37.8							
400S	Charles River Road Bridge	Dover	40.0							
447S	Dover Gage	Dover	44.7						ND	
484S	Dedham Medical Center	Dedham	48.4						5.6	
521S	Ames St. Bridge	Dedham	52.1						ND	
534S	Rt. 109 Bridge	Dedham	53.4						ND	
567S	Nahanton Park	Newton	56.7						9.0	
591S	Rt. 9 Gaging Station	Newton	59.1						8.6	
609S	Washington St. Hunnewell Bridge	Wellesley	60.9						7.5	
621S	Leo J. Martin Golf Course/Park Rd.	Weston	62.1						7.8	
635S	2391 Commonwealth Ave.	Newton	63.5							
648S	Lakes Region	Waltham	64.8							
662S	Moody St. Bridge	Waltham	66.2						ND	
675S	North St.	Waltham	67.6						5.8	
012S	Watertown Dam Footbridge	Watertown	69.3		ND		5.3		6.4	
700S	N. Beacon St.	Newton	70.9		ND		5.2		6.6	
715S	Arsenal St.	Brighton	71.5		ND				7.3	
729S	Eliot Bridge	Cambridge	72.9		ND		5.5		8.0	
743S	Western Ave.	Cambridge	74.3		ND	(a)	6.4		7.0	
760S	Muddy River at Comm. Ave.	Boston	76.0		ND		10.9	(a)	5.9	
763S	Mass. Ave. at Harvard Bridge	Boston	76.3		ND				ND	
773S	Longfellow Bridge	Cambridge	77.3		ND		ND		ND	
784S	New Charles River Dam	Boston	78.4				ND	(a)	ND	

QA/QC Samples

Equipment Blank	ND	<1	
Site No.	729s	743s	
Equipment Blank			
Site No.			

Rainfall At Logan International Airport (inches)

3 Days Prior to Sampling	Trace	0.12	3.84
2 Days Prior to Sampling	Trace	0	3.77
1 Day Prior to Sampling	0	0	0.36
Day of Sampling	0	0	0.52

*** Total suspended solids results reported in milligrams per liter (mg/L).**

(a) Average of duplicate sample results

ND = Not Detected

Optical Brightener Results

Charles River Watershed Association
Monthly Water Quality Sampling Data
Concentrations of Optical Brighteners in µg/L

Site #	Description	Town	River mile	6/20/2006
35CS	Central Street Bridge	Milford	3.5	404
35CD	Discharge Pipe @ Central St.	Milford	3.5	ND
35C2	2nd Discharge Pipe @ Central St.	Milford	3.5	ND
59CS	Mellen St. Bridge	Bellingham	5.9	436
90CS	Rt. 126, N. Main St.	Bellingham	9.0	470
130S	Maple St. Bridge	Bellingham	12.9	541
165S	Shaw St. Bridge	Franklin	16.5	584 (a)
199S	Populatic Pond Boat Launch	Norfolk	19.9	ND
229S	Rt. 115, Baltimore St.	Norfolk/Millis	22.9	521
267S	Dwight St. Bridge	Millis	26.7	549
269T	Causeway St. Stop River	Medfield	26.9	527
290S	Old Bridge St.	Medfield	29.0	545
318S	Rt. 27 Bridge	Medfield	31.8	565
343S	Farm Rd./Bridge St.	Sherborn/Dover	34.3	572
387S	Cheney Bridge	Wellesley	38.7	572
400S	Charles River Road Bridge	Dover	40.0	569
447S	Dover Gage	Dover	44.7	ND
484S	Dedham Medical Center	Dedham	48.4	565
521S	Ames St. Bridge	Dedham	52.1	569
534S	Rt. 109 Bridge	Dedham	53.4	576
567S	Nahanton Park	Newton	56.7	568
591S	Rt. 9 Gaging Station	Newton	59.1	558
609S	Washington St. Hunnewell Bridge	Wellesley	60.9	566
621S	Leo J. Martin Golf Course/Park Rd.	Weston	62.1	563
635S	2391 Commonwealth Ave.	Newton	63.5	559
648S	Lakes Region	Waltham	64.8	542
662S	Moody St. Bridge	Waltham	66.2	551
675S	North St.	Waltham	67.6	556
012S	Watertown Dam Footbridge	Watertown	69.3	563
700S	N. Beacon St.	Newton	70.9	559
715S	Arsenal St.	Brighton	71.5	ND
729S	Eliot Bridge	Cambridge	72.9	553
743S	Western Ave.	Cambridge	74.3	552
760S	Muddy River at Comm. Ave.	Boston	76.0	263
763S	Mass. Ave. at Harvard Bridge	Boston	76.3	543
773S	Longfellow Bridge	Boston	77.3	538
784S	New Charles River Dam	Boston	78.4	545
QA/QC Samples				
	Equipment Blank			1.46
	Site No.			400S
	Equipment Blank			-4.8
	Site No.			763S

(a) Average of Field Duplicates