Clean Charles 2005 Water Quality Report
2000 Core Monitoring Program
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Purpose and Scope

In 1995, the U.S. Environmental Protection Agency - New England (EPA) established the Clean Charles 2005 Initiative to restore the Charles River Basin to a swimmable and fishable condition by Earth Day in the year 2005. The ongoing initiative incorporates a comprehensive approach for improving water quality through: Combined Sewer Overflow (CSO) controls, illicit sanitary connection removals, stormwater management, public outreach, education, monitoring, enforcement and technical assistance.

In 1998, EPA's Office of Environmental Measurement and Evaluation (OEME) initiated the Clean Charles 2005 Core Monitoring Program that will continue until 2005. The purpose of the program is to track water quality improvements in the Charles River Basin (defined as the section between the Watertown Dam and the New Charles River Dam) and to identify where further pollution reductions or remediation actions are necessary to meet the Clean Charles 2005 Initiative goals. The program is designed to sample during the summer months that coincide with peak recreational uses.

The program monitors twelve "Core" stations. Ten stations are located in the Basin, one station is located on the upstream side of the Watertown Dam and another is located immediately downstream of the South Natick Dam (to establish upstream boundary conditions). Five of the ten sampling stations are located in priority resource areas which are identified as potential wading and swimming locations. Six of the twelve stations are monitored during wet weather conditions.

In the year 2000, the following parameters were measured: dissolved oxygen, temperature, pH, specific conductance, turbidity, clarity, chlorophyll a, total organic carbon, total suspended solids, apparent and true color, nutrients, bacteria, total metals and dissolved metals. In addition, EPA conducted a color and visibility study throughout the watershed and a filter fabric evaluation pilot project. The results from these two projects will be presented in separate reports.

Conclusions of the 2000 Core Monitoring Program

The conclusions below summarize the 2000 Core Monitoring Program data and evaluate water quality conditions over the past three years. These data will provide a baseline for determining long term trends. **Because the Program has only three years of data and water quality was influenced by yearly fluctuations in weather and river flows, short term trends could not be determined.** From July through September daily average flows at the Waltham gaging station were generally between 1998 and 1999 flows. In 1998, the summer conditions were wetter with higher flows and in 1999 conditions were drier with lower flows.

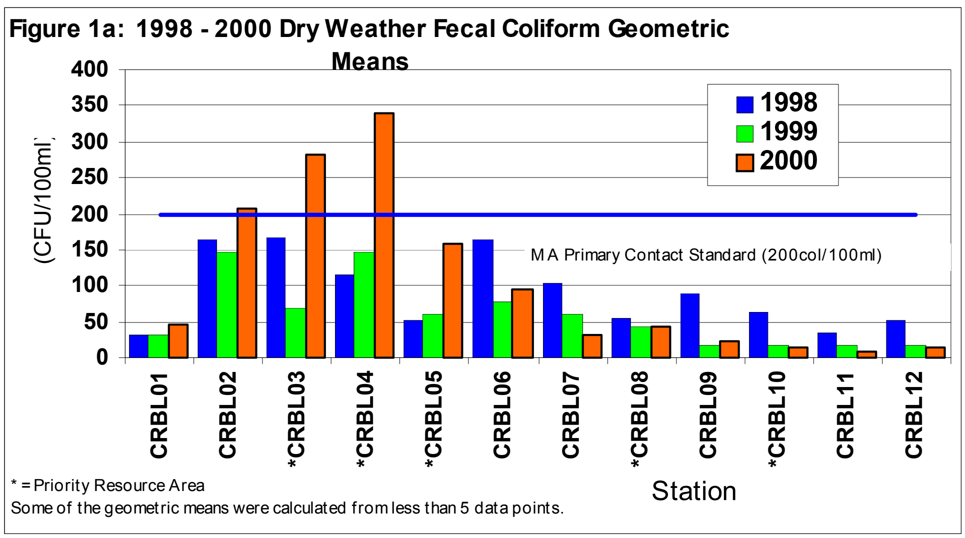
Three dry weather and three wet weather events were sampled from July to September. Comparing these data to the data collected in 1998 and 1999 reveals no definitive trends. However, bacteria concentrations generally increased in the upper part of the Basin from the Watertown Dam to Magazine Beach when compared to data of previous years. The three years of data shows the section near the mouth of the River (Mass Ave. Bridge to the New Charles River Dam, excluding the Pond at the Esplanade) met the swimming standards more often than any other part of the Basin. Total phosphorus concentrations in 2000 decreased at the South Natick Dam compared to 1998 and 1999.

Clarity and Color
Water clarity was directly measured in the field using a Secchi disk. Mean Secchi disk readings were generally between 1998 and 1999 values. The greatest clarity was recorded near the mouth of the Basin (Longfellow Bridge to the New Charles River Dam) and met the previous Massachusetts Department of Public Health's bathing beach visibility standard 80% of the time.

True and apparent color were generally highest in July and decreased throughout the summer. Color was lower than the previous two years. As identified in a previous report (EPA 1999) it appears that part of the color was associated with particulate matter. This implies that controlling algae growth and preventing particulates from being discharged could enhance the clarity of the water and help achieve the bathing beach visibility standard.

Bacteria
Fecal coliform concentrations were lower near the mouth of the Basin (Mass Ave. Bridge to the New Charles River Dam; CRBL07 - CRBL12), which was typical of the data collected in 1998 and 1999. Near the mouth of the Basin, dry weather geometric means[1] were equal to or slightly less than 1998 and 1999 values (Figure 1a). In the upper part of the Basin, from Watertown Dam (CRBL02) to Magazine Beach (CRBL05), the dry weather geometric means[1] were somewhat higher than in 1998 and 1999 (Figure 1a). The wet weather data were similar.

The three highest wet weather concentrations were recorded at the Watertown Dam. Here the wet weather geometric mean exceeded the boating criteria[2]. All wet weather samples collected at the Watertown Dam, Magazine Beach and Herter Park exceeded the swimming criteria[3] of less than 200 colonies/100 ml.



During dry weather, approximately 23% of the core monitoring samples exceeded the fecal coliform swimming criteria[3] (compared to 8% in 1999). During wet weather conditions approximately 63% of the

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[1]Some of the dry weather geometric means were calculated from less than five data points, the actual criteria is based on a geometric mean of five samples or more.

[2]The Massachusetts fecal coliform boating criteria is less than 1000 colonies/100ml and is based on a geometric mean of five samples or more.

[3]The Massachusetts fecal coliform swimming criteria of less than 200 colonies/100ml is actually based on a geometric mean of five samples or more. For this report individual concentrations were compared to this criteria.

fecal coliform samples exceeded the standard (compared to 50% in 1999).

Dissolved Oxygen (DO) and pH
The continuous monitoring data revealed several violations of the Massachusetts class B water quality criteria[4]. In the Charles River, at the mouth of the Muddy River, DO violations were recorded on four of the five days it was monitored during July. On the Cambridge side of the River near the Mass Ave. Bridge, pH frequently exceeded the water quality criteria during a four day period in August (coinciding with super saturated DO conditions). During this same period, Magazine Beach violated the pH criteria for a short time on one of the days.

The data from all the dry and wet weather manual measurements showed pH violated the criteria nineteen times or approximately 20% of all field measurements (compared to 8% in 1999). These violations occurred downstream from the Mass Ave. Bridge. Dissolved oxygen field measurements did not show any violations (compared to 3% in 1999) of the MA class B water quality criteria.

Nutrients
Phosphorus was the most significant nutrient in this system. Elevated phosphorus concentrations at many of the sampling stations indicated highly eutrophic conditions. Mean total phosphorus concentrations at most stations, were less than 1998 levels and slightly higher than the 1999 levels. During rain events, total phosphorus concentrations generally increased throughout the Basin. At the South Natick Dam, the three dry weather sampling events showed a reduction in the total phosphorus when compared to the 1998 and 1999 data.

Metals
Copper was the only metal that exceeded the acute Ambient Water Quality Criteria (AWQC). The one exceedance occurred at the Watertown Dam during a wet weather event (copper criteria were not exceeded in 1999). Copper and lead were the only metals that exceeded the chronic AWQC. In addition to the acute AWQC exceedance, copper exceeded the chronic AWQC twice. One exceedance occurred in the Pond at the Esplanade and the other downstream of BU Bridge. The lead chronic AWQC was exceeded twenty two times over multiple sampling events. Exceedances occurred at every station except at the South Natick Dam. Lead exceedances occurred 27% of the time during dry weather (compared to 8% in 1999) and 25% of the time during wet weather (compared to 72% of the time in 1999).

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[4]The Massachusetts water quality criteria for Class B water for DO is $\geq$ 5 mg/l and $\geq$60% saturation and for pH between 6.5 and 8.3.

2.0 BACKGROUND

The Charles River watershed is located in eastern Massachusetts and drains 311 square miles from a total of 24 cities and towns. Designated as a Massachusetts class B water, the Charles is the longest river in the state and meanders 80 miles from its headwaters at Echo Lake in Hopkinton to its outlet in Boston Harbor. From Echo Lake to the Watertown Dam, the River flows over many dams and drops approximately 340 feet. From the Watertown Dam to the New Charles River Dam in Boston, the River is primarily flat water (EPA 1997). This section, referred to as "the Basin", is the most urbanized part of the River and is used extensively by rowers, sailors and anglers. A Metropolitan District Commission (MDC) park encompasses the banks of the River and creates excellent outdoor recreational opportunities with its open space and bicycle paths.

The lower basin (defined as the section between the Boston University Bridge and the New Charles River Dam), once a tidal estuary, is now a large impoundment. During low flow conditions of the summer, the basin consists of fresh water overlying a wedge of saltwater. Sea walls define a major portion of the banks and shoreline of this section.

The Charles River shows the effects of pollution and physical alteration that has occurred over the past century. The water quality in the Basin is influenced by point sources, storm water runoff and CSOs. An EPA survey identified over 100 outfall pipes in the Basin (EPA 1996).

3.0 INTRODUCTION

In 1995, EPA established the Clean Charles 2005 Initiative, with a taskforce and numerous subcommittees, to restore the Charles River to a swimmable and fishable condition by Earth Day in the year 2005. The Initiative's strategy was developed to provide a comprehensive approach for improving water quality through CSO controls, removal of illicit sanitary connections, stormwater management planning and implementation, public outreach, education, monitoring, enforcement and technical assistance.

In 1998, EPA's Office of Environmental Measurement and Evaluation (OEME) implemented a water quality monitoring program (Core Monitoring Program) in the Charles River that will continue until at least 2005. EPA and its partners on the Taskforce's water quality subcommittee developed a study design to track improvements in the Charles River Basin and to identify where further pollution reductions or remediation actions were necessary to meet the swimmable and fishable goals. Members of the subcommittee included EPA-New England, U.S. Geological Survey (USGS), U.S. Army Corps of Engineers - New England District (ACE), Massachusetts Executive Office of Environmental Affairs (EOEA), Massachusetts Department of Environmental Protection (DEP), Massachusetts Department of Environmental Management (DEM), Massachusetts Water Resources Authority (MWRA), Boston Water and Sewer Commission (BWS), Charles River Watershed Association (CRWA) and the MDC. In addition to the Core Monitoring Program, EPA and its partners continue to support other water quality studies in the Charles River to further identify impairment areas and to evaluate storm water management techniques.

OEME's Core Monitoring Program was designed to sample twelve stations during three dry weather periods and six (of the twelve) stations during three different wet weather events. The monitoring was focused in the Boston and Cambridge areas of the River during peak recreational usage in July, August and September. To establish a boundary condition, one station was located immediately downstream from the South Natick Dam or 30.5 miles upstream from the Watertown Dam. One station was located above the Watertown Dam and the other ten stations were located in the Basin. Five of these ten sampling stations were located in priority resource areas (potential wading and swimming locations). The project map (Figure 1) shows the locations of the: dry and wet weather fixed sampling stations, priority resource areas, CSOs, and stormwater discharge pipes. Table 1 describes the stations monitored in 2000.

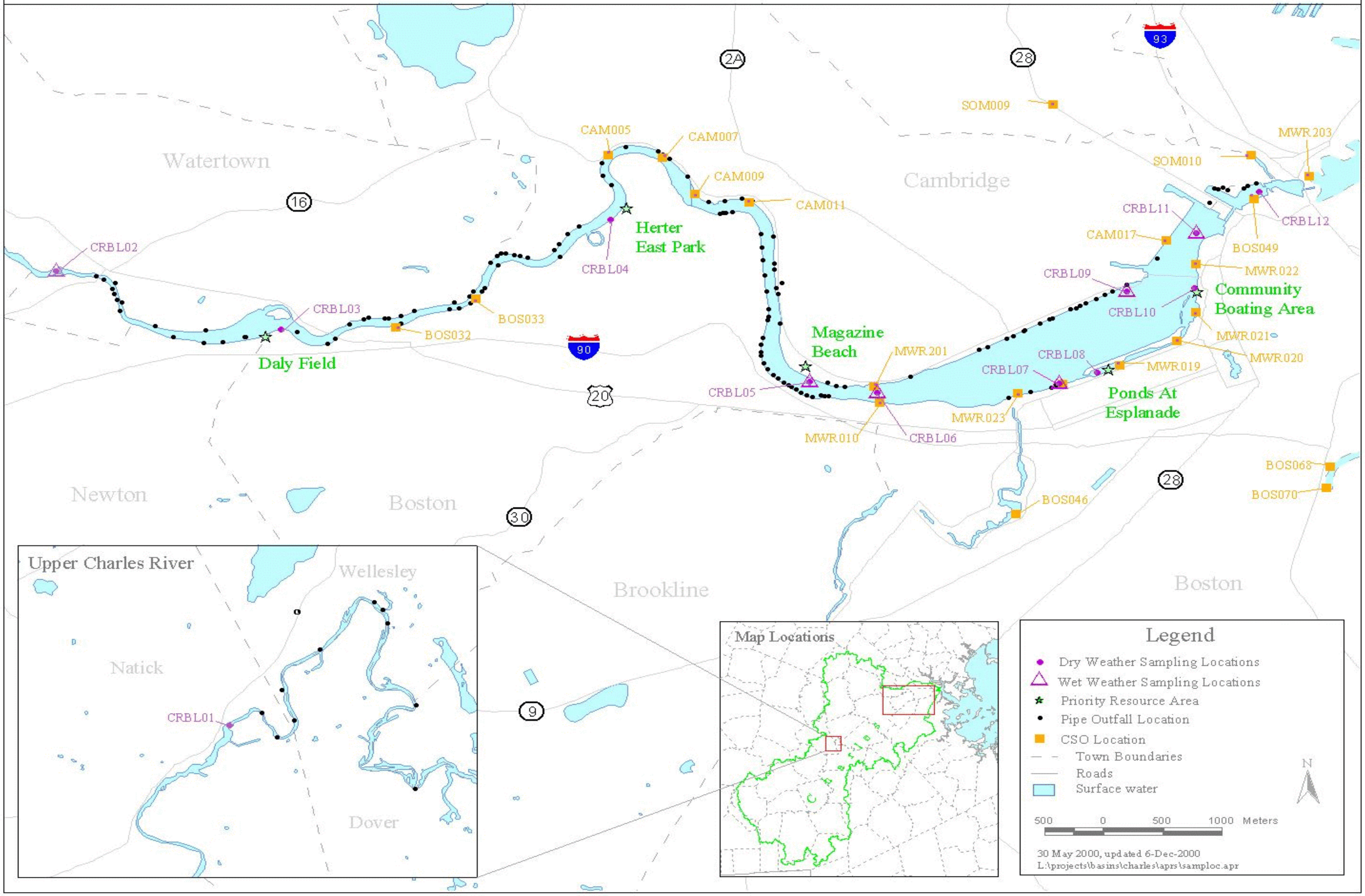
The 1998 monitoring program included measurements of dissolved oxygen (DO), temperature, pH, specific conductance, chlorophyll a, total organic carbon (TOC), total suspended solids (TSS), apparent color, clarity, turbidity, nutrients, bacteria and total metals. Chronic toxicity was also tested during dry weather conditions. In 1999, dissolved metals and true color were added to the analyte list. Dissolved metals were added to better assess the metals concentration in relationship to the AWQC, which are based on the dissolved metals fraction. True color was added to help determine the causes of reduced clarity. In 2000, the analyte list was unchanged.

Table 1: Sampling Station Description

PRIMARY CORE MONITORING STATION DESCRIPTIONS	STATION #
Downstream of S. Natick Dam	CRBL01
Upstream of Watertown Dam	CRBL02 WW
Daly Field, 10 m off south bank	**CRBL03**
Herter East Park, 10 m off south bank	**CRBL04**
Magazine Beach, 10 m off north bank	**CRBL05 WW**
Downstream of BU Bridge, main stem	CRBL06 WW
Downstream of Stony Brook & Mass Ave, 10 m off S. shore	CRBL07 WW
Pond at Esplanade	**CRBL08**
Upstream of Longfellow Bridge, Cam. side	CRBL09 WW
Community boating area	**CRBL10**
Between Longfellow Bridge & Old Dam	CRBL11 WW
Upstream of railroad Bridge	CRBL12
Supplemental Sampling Stations Used	
Mouth of Laundry Brook	LAUD01
Mouth of Faneuil Brook	FANE01
Mouth of Muddy River	MUDD01
Downstream of Harvard Club boat house~ 500ft	ELOI01

Bold = Priority resource area station
WW = Wet weather sampling station

Figure 1: EPA Core Monitoring Locations and Priority Resource Areas



4.0 PROJECT DESCRIPTION

Sampling was conducted during three dry weather periods and three wet weather events from July through September 2000. Dry weather sampling days were preplanned for the months of July, August, and September. The dry weather sampling goal was to sample on days that were preceded by three days during which a total of less than 0.20 inches of rain had fallen. Dry weather sampling was conducted on July 18, August 23, and September 12. However, the July 18 sampling did not meet the dry weather goal. On July 16, 0.027 inches of rain fell[1]. Since little run off occurred from this event two days prior to sampling, these data were considered representative of dry weather conditions.

The approach for each wet weather event was to sample six stations during four storm periods; pre-storm, first flush, peak flow and post-storm. The pre-storm was sampled before the rain began. The first flush sampling began when the rain became steady and one hour after the measured stage in the Laundry Brook culvert increased by at least 0.5 inches. The peak flow sampling began when rain intensity peaked and the stage reading was greatest in the Laundry Brook culvert. In previous sampling years, it was identified that peak rain intensity coincide with maximum stage or peak flow in Laundry Brook (Figure A-5 & A-6). Post-storm sampling occurred when the rain ceased and the flow at Laundry Brook returned to near pre-storm conditions.

The first wet weather sampling event began on July 26. This storm which started on July 26 intensified on July 27 and produced 1.8 inches of rainfall[1] (Figure A-5). A second wet weather sampling event was initiated on August 14. Because the rain event produced less precipitation than was predicted (0.35inches of rainfall[1] was recorded), the sampling event was terminated after the pre-storm samples were collected. A reduced number of analytes were measured for this pre-storm event. A third rainfall event was sampled on August 16. Because this rain event was unpredicted and did not meet the wet weather criteria (since there was rain on August 14), samples were collected for only bacteria and field measurements at selected stations. This sampling represented peak flow conditions. The storm produced 0.46 inches of precipitation[1]. A fourth storm was sampled on September 15. The associated storm dropped 1.46 inches of rainfall[1] (Figure A-6).

The parameters measured during each dry weather event are specified in Table 2. Except for *Enterococcus,* all parameters were measured during the full wet weather sampling events. Chlorophyll a was analysed only during pre-storm and post-storm. The August 14 pre-storm sampling event was sampled for field measurements, fecal coliform bacteria, true and apparent color. The August 16 peak flow sampling event was sampled for field measurements and fecal coliform. The EPA OEME's field staff conducted all the sampling and field measurements. Samples were analysed by OEME's Laboratory and contract laboratories.

Table 2: Parameters Analyzed During the 2000 Sampling Events

Field Measurements	Bacteria	Nutrients	Total Metals	Dissolved Metals	Other Parameters
dissolved oxygen, temperature, pH, specific conductance, turbidity, Secchi disk	fecal coliform *Enterococcus*	total phosphorus(TP), ortho-phosphorus(OP), nitrate+nitrite(NO_2+NO_3), ammonia(NH_3)	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn, Hg	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Mg, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn	TSS, chlorophyll a, TOC, apparent + true color

5.0 DATA ANALYSIS

[1] Rainfall data was collected by USGS in Watertown and is reported as preliminary data.

The third year of the Core Monitoring Program was completed in 2000. These data will provide a baseline for determining long term trends. Because the Program has only three years of data and water quality was influenced by year to year fluctuations in weather and river flows, short term trends could not be determined. From July through September daily average flows at the Waltham gaging station were generally between 1998 and 1999 flows (Figure A-3). In 1998, the summer conditions were wetter with higher flows and in 1999 conditions were drier with lower flows.

Comparing 2000 data to the data collected in 1998 and 1999 reveals no definitive trends. However, bacteria concentrations generally increased in the upper part of the Basin from the Watertown Dam to Magazine Beach when compared to data of previous years. The three years of data shows the section near the mouth of the River (Mass Ave. Bridge to the New Charles River Dam, excluding the Pond at the Esplanade) met the swimming standards more often than any other part of the Basin. Total phosphorus concentrations decreased at the South Natick Dam compared to 1998 and 1999. Continued monitoring will help identify trends in the River.

5.1 Clarity, Apparent color, True color, TSS, Turbidity, TOC and Chlorophyll a

Secchi disk was used to measure visibility/clarity. The Massachusetts Department of Health has recently amended the minimum standards for bathing beaches (105 CMR 445.00). The new standards amend the four foot numeric standard with a narrative standard. To maintain consistency with previous reports, Secchi disk measurements were compared to the previous four foot standard.

Clarity could not be measured at the South Natick Dam (CRBL01) and Watertown Dam (CRBL02) because of the shallow water at these stations. The greatest clarity was recorded near the mouth of the Basin (Longfellow Bridge to the New Charles River Dam; CRBL11- CRBL12) and met the previous Massachusetts Department of Public Health's bathing beach visibility standard 80% of the time (Figure 2). The arithmetic means for 1998 to 2000 shows water clarity improves closer to the mouth of the Basin and the lowest clarity readings were measured in the pond at the Esplanade (CRBL08). Generally, the mean concentrations were between 1998 and 1999 values (Figure 3).

Apparent color measures the color of the water which may contain suspended matter. Generally, apparent color was highest in July and decreased throughout the summer. For unexplained reasons, mean apparent color was slightly less than 1998 and 1999 means.

True color measures the stain in the water after the suspended particulates have been removed by centrifuging. Generally true color was less than apparent color and at each station the true color mean value was 10 to 40% lower than the apparent color mean value. As identified in 1999 Core monitoring Program Report (EPA 2000) it appears that part of the color was associated with suspended matter. This implies that reducing suspended matter and nutrients that stimulate algae growth could enhance the clarity of the water. Other sources of suspended matter include non-point and point sources, such as storm water and CSOs, and resuspended bottom sediments.

In general, TSS concentrations were lowest near the mouth of the Basin during both wet and dry weather conditions. Except for two samples collected at CRBL02 during a peak flow on September 15 and at CRBL08 on July 8, all measured TSS concentrations were less than the Massachusetts water quality standard (Table 3).

Turbidity generally coincided well with the TSS concentrations. Elevated concentrations of turbidity and TSS were recorded during peak flow at CRBL02 on September 15. These elevated levels were most likely caused by particulates from storm water entering the River. Total Organic Carbon (TOC) concentrations were highest during the July sampling event and at most station concentrations steadily decreased throughout the summer.

Chlorophyll a was one of the parameters measured to assess eutrophication in the Basin. Because Massachusetts does not have numeric nutrient or chlorophyll a criteria for assessing eutrophication of lakes and rivers, the total phosphorus and chlorophyll a concentrations were compared to the state of Connecticut's Lake Trophic Classifications - Water Quality Standards[2]. More than 50% of the chlorophyll a samples collected in the Basin were considered highly eutrophic. With the exception of three stations sampled during the September rain event, chlorophyll a concentrations decreased after a storm. Mean chlorophyll a concentrations were between 1998 and 1999 values at seven of the 12 stations.

Table 3: Massachusetts Class B Surface Water Quality Standards and Guidelines for Warm Waters

Parameter	MA Surface Water Quality Standards (314 CMR 4.00) and Guidelines
Dissolved Oxygen	$\geq$ 5 mg/l and $\geq$ 60%
Temperature	$\leq$ 83ºF (28.3ºC) and) 3ºF (1.7ºC) in Lakes,) 5ºF (2.8ºC) in Rivers
pH	Between 6.5 and 8.3
Fecal coliform	See Table 4
Solids	Narrative and TSS $\leq$ 25.0 mg/l (for aquatic life use support)
Color and Turbidity	Narrative Standard
Nutrients	Narrative "Control of Eutrophication" Site Specific

5.2 Bacteria

The Massachusetts Department of Public Health (DPH) Minimum Standards for Bathing Beaches and the DEP Surface Water Quality Standards (314 CMR 4.00) establish maximum allowable bacteria criteria. These are summarized in Table 4.

[2]The Connecticut Water Quality Lake Trophic Classification Criteria during mid summer conditions for chlorophyll a: Oligotrophic (0 - 2 ug/l), Mesotrophic (2 - 15 ug/l), Eutrophic (15 - 30 ug/l), and Highly Eutrophic (>30 ug/l).

Table 4: Massachusetts Freshwater Bacteria Criteria

Indicator organism	MA DPH Minimum Criteria for Bathing Beaches (105 CMR 445.00)	MA DEP Surface Water Quality Standards (314 CMR 4.00) and water quality guidelines	
	Bathing beaches	Primary contact	Secondary contact
E.coli or	≤235 colonies/100ml and a geometric mean of most recent five samples ≤126 col/100ml	NA	NA
Enterococci	≤61 colonies/100ml and a geometric mean of most recent five samples≤33 col/100ml		
Fecal coliform	NA	a geometric mean ≤200 col/100ml for ≥5 samples ≤400/100ml for not more than 10 % of the samples	a geometric mean ≤1000 col/100ml for ≥5 samples ≤2000/100ml for not more than 10 % of the samples
		≤400 col/100ml for <5 samples	≤2000 col/100ml for <5 samples

Note: NA = not applicable

Fecal coliform concentrations were measured during each sampling event. *Enterococcus* bacteria were measured during the three dry weather events. For the purpose of this report, the fecal coliform counts of individual samples were compared to the Massachusetts DEP geometric mean criteria of less than or equal to 200 colonies/100ml for primary contact recreation (swimming) and less than or equal to 1000 colonies/100ml for secondary contact recreation (boating).

None of the fecal coliform samples collected at the Core Monitoring stations during dry weather exceeded 1000 colonies/100ml although, approximately 23% of samples exceeded 200 colonies/100ml (compared to 8% in 1999). During wet weather conditions approximately 63% of the fecal coliform samples exceeded 200 colonies/100ml (compared to 50% in 1999). Fecal coliform concentrations were lower near the mouth of the Basin (Mass Ave. Bridge to the New Charles River Dam; CRBL07 - CRBL12), which was typical of the data collected in 1998 and 1999. Near the mouth of the Basin, dry weather geometric means[3] were equal to or slightly below 1998 and 1999 values (Figure 5). In the upper part of the Basin, from Watertown Dam (CRBL02) to Magazine Beach (CRBL05), the dry weather geometric means[3] were somewhat higher than in 1998 and 1999 (Figure 5). The wet weather data was similar.

The three highest fecal coliform counts were recorded during wet weather at the Watertown Dam. Here the wet weather geometric mean exceeded the boating criteria (Figure 6). These data and data collected by USGS (USGS 2001) identifies the mainstem of the River at the Watertown Dam to be significant load of fecal coliform to the basin during wet and dry weather. All wet weather samples collected at the Watertown Dam (CRBL02), Magazine Beach (CRBL05) and Herter East Park (CRBL04) exceeded 200 colonies/100ml.

[3]Some of the dry weather geometric means were calculated from less than five data points, the actual criteria is based on a geometric mean of five samples or more.

The DPH *Enterococcus* single sample criteria was exceeded once at CRBL02 on August 23. In addition to this violation, on August 23, the count exceeded 33 colonies/ 100ml at CRBL01.

5.3 Dissolved Oxygen and pH

Automated instruments were deployed from July 17 to July 21 at three stations (Figure A-1 and Table A-1) and from August 22 to August 25 at two stations (Figure A-2 and Table A-2). The instruments measured temperature, specific conductance, DO, pH, and turbidity. Data that did not meet the quality control criteria were not reported. The continuous monitoring data revealed several violations of the Massachusetts class B water quality criteria (Table 3). In the Charles River, at the mouth of the Muddy River (MUDD01), DO violations were recorded on four of five days in July. These DO violations were attributed to low DO water flowing from the Muddy River. On the Cambridge side of the River near the Mass Ave. Bridge, pH frequently exceeded the water quality criteria during a four day period in August (coinciding with super saturated DO conditions). During this same time period, on August 22, pH criteria was violated at CRBL05.

The data from all the dry and wet weather manual measurements showed pH violated the criteria nineteen times or approximately 20% of all field measurements (compared to 8% in 1999). These violations occurred downstream from the Mass Ave. Bridge. The cause of these elevated values was unable to be determined but may be, in part, due to the photosynthesis of algae and the uptake of carbon dioxide from the water. Dissolved oxygen field measurements did not show any violations (compared to 3% in 1999) of the MA class B water quality criteria.

5.4 Nutrients

Nutrient analyses included measurements of total phosphorus, ortho-phosphorus, nitrate+nitrite and ammonia. Elevated phosphorus concentrations at many of the sampling stations indicated highly eutrophic conditions. Mean total phosphorus concentrations at most stations, were below 1998 levels and slightly higher than the 1999 levels (Figure 7). In general, during rain events, total phosphorus concentrations increased throughout the Basin. At the South Natick Dam, the three dry weather sampling events showed a slight reduction in total phosphorus when compared to the 1998 and 1999 data. Upstream point sources include wastewater treatment plants operated by: Charles River Pollution Control District, the Massachusetts Correctional Institute (MCI) in Norfolk, Wrentham State School, and the towns of Medfield and Milford. At most stations, total phosphorus concentrations increased during wet weather.

Since Massachusetts uses a narrative site-specific water quality criteria for total phosphorus, measured concentrations were compared to Connecticut's numeric Lakes Trophic Classifications[4]. These classifications indicated that approximately 80% of the dry weather (compared to 80% in 1999) and 73 % of the wet weather (compared to 100% in 1999) total phosphorus concentrations were associated with highly eutrophic waters. Many of the ortho-phosphorus samples were reported as less than 8.15ug/l (not detected). Overall the highest concentrations were at CRBL02.

Nitrate+nitrite (the total nitrate and nitrite) concentrations ranged from less than 0.023 mg/l (not detected) to 0.76 mg/l as nitrogen. Concentrations were lowest at CRBL08. These lower concentrations may be caused

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[4]The Connecticut Water Quality Lake Trophic Classification Criteria during the spring and summer conditions for total phosphorus are: Oligotrophic (0 - 0.010 mg/l), Mesotrophic (0.010 - 0.030 mg/l), Eutrophic (0.030 - 0.050 mg/l), and Highly Eutrophic (>0.050 mg/l).

by a greater assimilation from the biota rather than lower input. Ammonia (as nitrogen) concentrations, ranged from less than 0.075 mg/l (not detected) to 0.957 mg/l.

5.5 Metals

Twenty elements were included in total recoverable and dissolved metal analyses. In addition, total recoverable mercury was analyzed. Ten of these were EPA priority metals and have associated Ambient Water Quality Criteria (AWQC)[5]. Seven of these AWQC's were dependent on the water hardness. Hardness dependent AWQC were calculated using the hardness of the water at the time of sampling. The hardness was calculated using the dissolved fraction of calcium and magnesium. Except for mercury, all AWQC's were based on the dissolved metals fraction. Because only total recoverable mercury was measured, the AWQC's for mercury were converted to a total recoverable AWQC. The metals concentrations and the associated criteria are presented in Tables 5 and 6 for dry and wet weather, respectively. The concentrations of all the metals analyzed are presented in Appendix A.

Copper was the only metal that exceeded the acute AWQC. The one exceedance occurred at CRBL02 during a wet weather peak flow sampling event on September 15 (copper criteria were not exceeded in 1999). Copper and lead were the only metals that exceeded the chronic AWQC. In addition to the acute AWQC exceedance, the copper chronic AWQC was exceeded twice. Once at CRBL06 during a wet weather peak flow on September 15 and the other at CRBL08 during a dry weather on July 18. The lead chronic AWQC was exceeded twenty two times over multiple sampling events. Exceedances occurred at every station except at the South Natick Dam (CRBL01). Twenty seven percent of the dry weather samples (compared to 8% in 1999) and 25% of the wet weather samples (compared to 72% in 1999) exceeded the lead AWQC.

5.6 Special Study

On July 18 and September 12, samples were collected at multiple depths for total phosphorus and chlorophyll a. One meter chlorophyll a depth integrated core samples were collected at CRBL06, CRBL11 and CRBL12 on July 18 and at CRBL06 and CRBL11 on September 12 (Table A-27). Core samples were compared to surface grabs at the same stations to evaluate the two methods of collecting chlorophyll a samples in the Charles River. Relative percent differences between the two methods ranged from 10% to 20%, which was not a significant difference.

On July 18 and September 12, samples were collected directly above the halocline at CRBL11 and CRBL 12. Except for at station CRBL12 on July 18, samples were also collected below the halocline (Table A-27). The purpose for collecting these samples was to evaluate the total phosphorus gradation above and below the halocline and to compare these concentrations to surface concentrations. None of the samples collected immediately above the halocline were significantly difference from surface concentrations. At CRBL11 on July 18, concentrations below the halocline where double the concentration above the halocline.

[5]EPA's Clean Water Act Section 304(a) Criteria for Priority toxic Pollutants (40 CFR Part 131.36)

5.6 Data Usability

Quality control criteria were established for all data presented in this report. The criteria specify holding times, sample preservation, and precision and accuracy limits. Except for one total phosphorus sample, all samples were preserved in the field. The un-preserved sample was analyzed and the results were reported as estimated. Holding times were met for all samples. The quality control requirements for this project were documented in the Project Work/QA Plan - Charles River Clean 2005 Water Quality Study June 2,1999.

Continuous monitoring data that partially met the established quality control criteria were reported as estimated data. Continuous monitoring data not meeting any of the quality control criteria were not reported. Chemistry data that partially met laboratory quality control criteria or concentrations that were less than the associated reporting limit were considered estimated values and identified with a swung dash (~) preceding the value.

Field duplicate samples were collected during each of the thirteen sampling events to evaluate sampling and analytical precision. No data were deleted for not meeting the duplicated quality control criteria. The data not meeting the criteria are described below. Ten of the 115 duplicate samples (excluding metals and field measurements) analyzed during the sampling events did not meet the precision quality control goal of less than 35 relative percent difference established in the Project Work/QA Plan. However, the project use of these data was not limited for the reason specified below. Two of the samples were associated with estimated values which would not be required to have met quality control limits. Four of the ten samples that did not meet the quality control goal were for fecal coliform and *Enterococcus* analyses. These variations among duplicate bacteria samples may have occurred because of the bacteria variability that exist in ambient water. Apparent color analyses had two duplicate samples not meeting the quality control limit and true color and total phosphorus analyses each had one duplicate sample with a relative percent difference above 35%. The review of the field and laboratory quality control data for each of the ten duplicate samples that did not meet the precision goal, showed no abnormalities.

Fourteen of 243 duplicate samples for total and dissolved metals analyzed during the eleven sampling events did not meet the precision quality control goal of less than 35 relative percent difference. However, the use of these data were not limited for this project for the reason specified below. Four of these duplicate analyses were associated with estimated values or concentrations near the detection limit. The review of the field and laboratory quality control data, for the ten remaining out-of-range duplicate samples showed no abnormalities.

For the low level metals analyses, trip blanks were used to evaluate any contamination caused by the: sample container, sample preservation, sampling method, and/or transporting to the laboratory. The trip blank, a bottle of ultra pure water, was collected prior to sampling and brought on the sampling trip. Some of the dissolved antimony, arsenic, chromium, copper, and zinc values were reported as maximum values. On September 12, a blank was analyzed for the other chemical analyses and nothing was detected. The Appendix contains all the validated data for this report.

6.0 2001 STUDY DESIGN

In 2001 continuous monitoring will be conducted only in August which is typically a worst case scenario. In the past, continuous monitoring was conducted in the Basin at numerous stations during different months of the summer. The results indicate few exceedances. Therefore, continuous monitoring will only be conducted in August, during the week of the dry weather sampling period.

In 2001 salinity, temperature, and DO profiles will be conducted in the basin during July, August, and

September. This will be conducted to document the changes in the salt water wedge caused by the following changes. The New Charles River Dam has recently been modified to reduce saltwater intrusion. In addition, Southern Energy is proposing a deep water discharge that will mix the lower basin and reduce the salt water wedge.

This year the program will discontinue the analysis of total metals and continue monitoring dissolved metals for the following reasons. There are currently three years of total metals data. The water quality criteria is based on dissolved metals. The hardness (used to compute the AWQC) calculated form total calcium and magnesium is equivalent to the hardness calculated from the dissolved portion of calcium and magnesium.

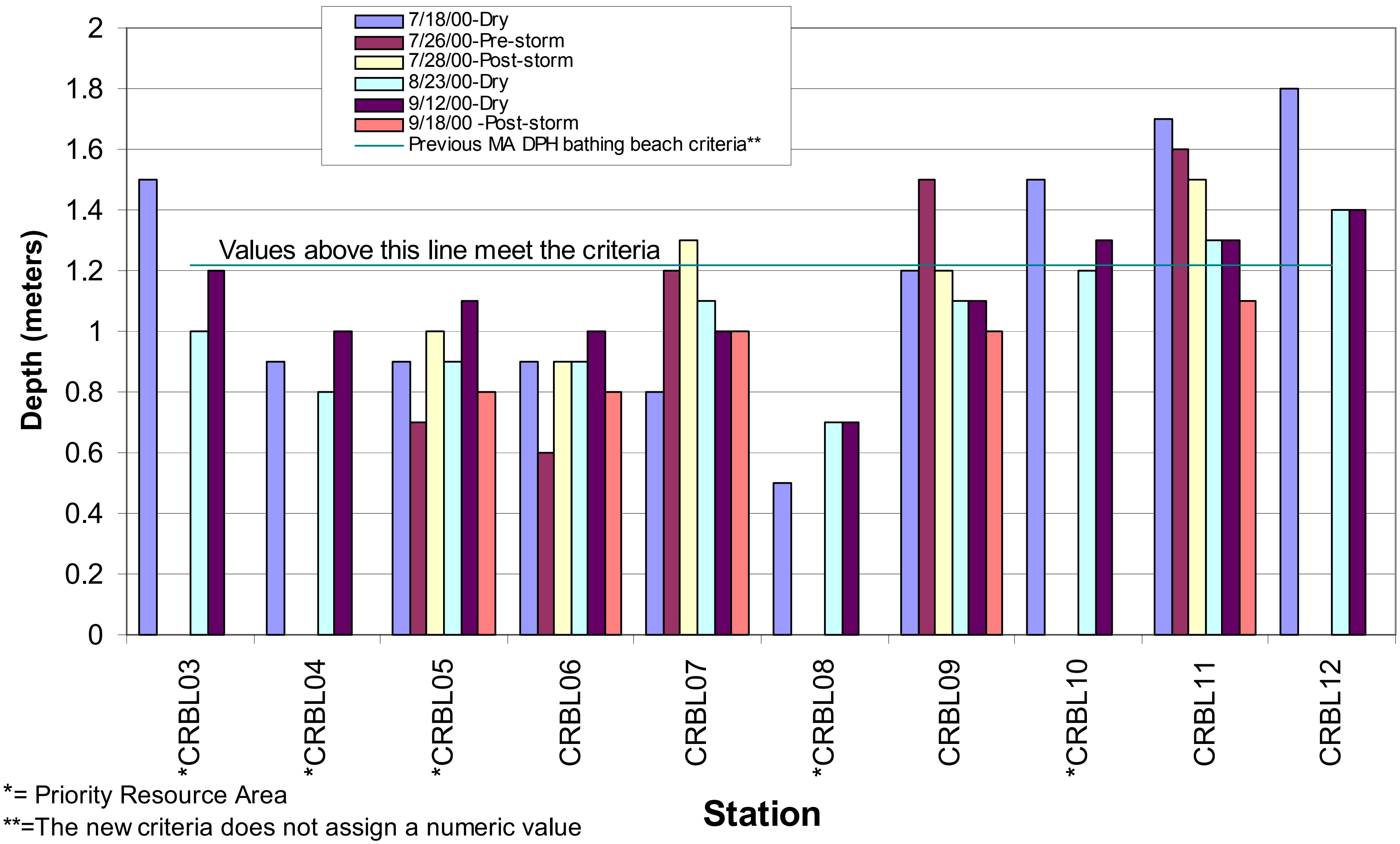
A transmissometer will be used to measure in-situ clarity during dry weather, pre-storm and post-storm sampling. Transmissivity readings will be compared to Secchi disk readings to assess water clarity.

E. Coli will replace *Enterococcus* bacteria. Enterococcus was measured in 1999 and 2000. During this time the draft Massachusetts DPH Bathing Beach Criteria referenced only *Enterococcus*. The new published regulations allow for the use of E. coli and *Enterococcus* in freshwater. Generally, E. Coli is a better indicator in freshwater. Therefore, EPA will measure E.coli and fecal coliform in 2001.

Two wet weather sampling events are planned for 2001. Typically, the program has targeted three storm events. In the last two years we have fully monitored five storm events and partially monitored others. Monitoring two storms should adequately define the wet weather changes in the river.

Targeted pipe monitoring will be conducted at identified hot spots in the basin for fecal coliform and possible other sewage indicators. Sampling will be conducted during dry and wet weather conditions starting in July.

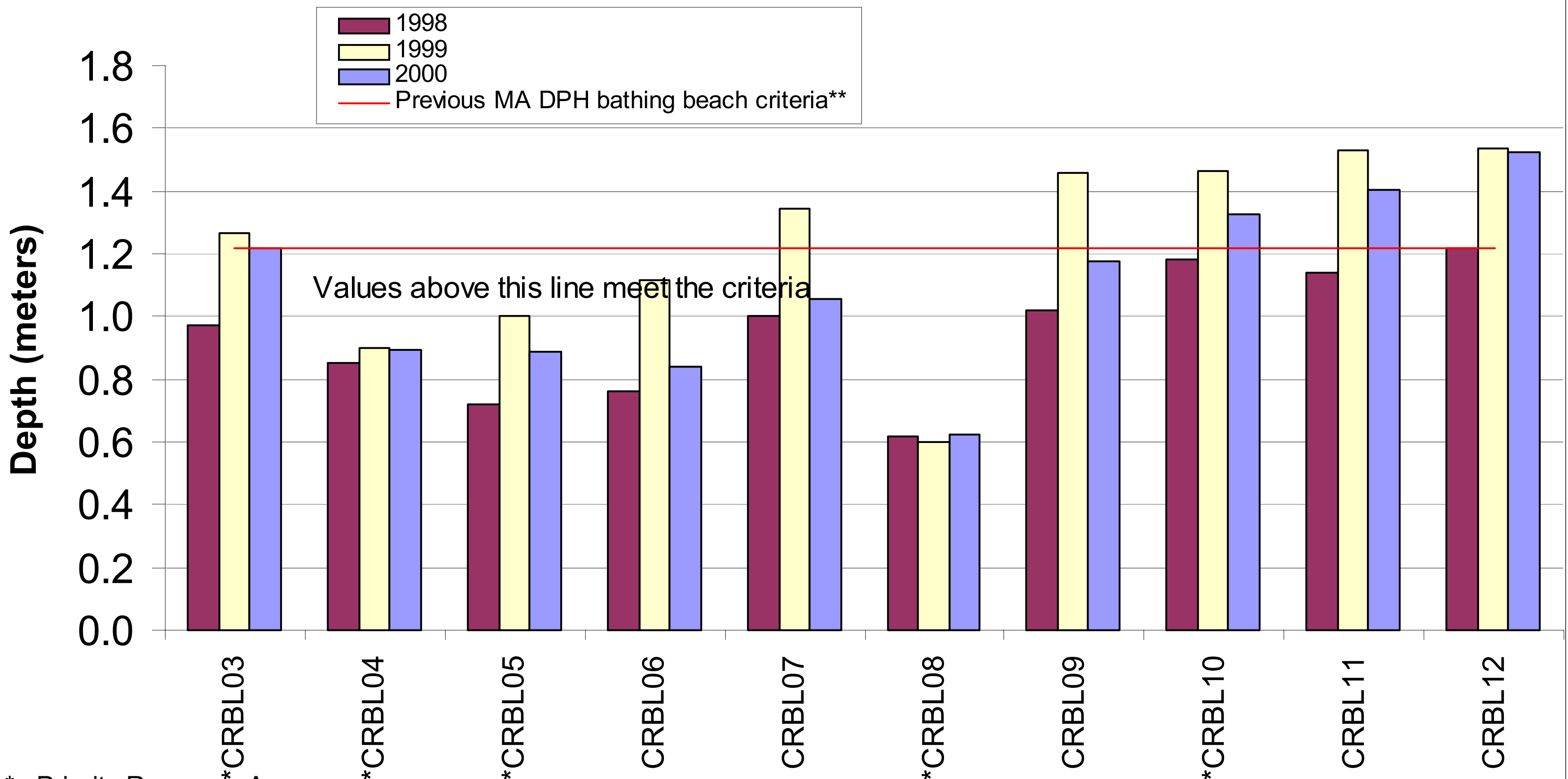
Figure 2: Clarity - Secchi Disk Measurments at Stations CRBL03 - CRBL12



*= Priority Resource Area

**=The new criteria does not assign a numeric value

Figure 3: 1998-2000 Mean Secchi Disk Measurements at Station CRBL03 - CRBL12

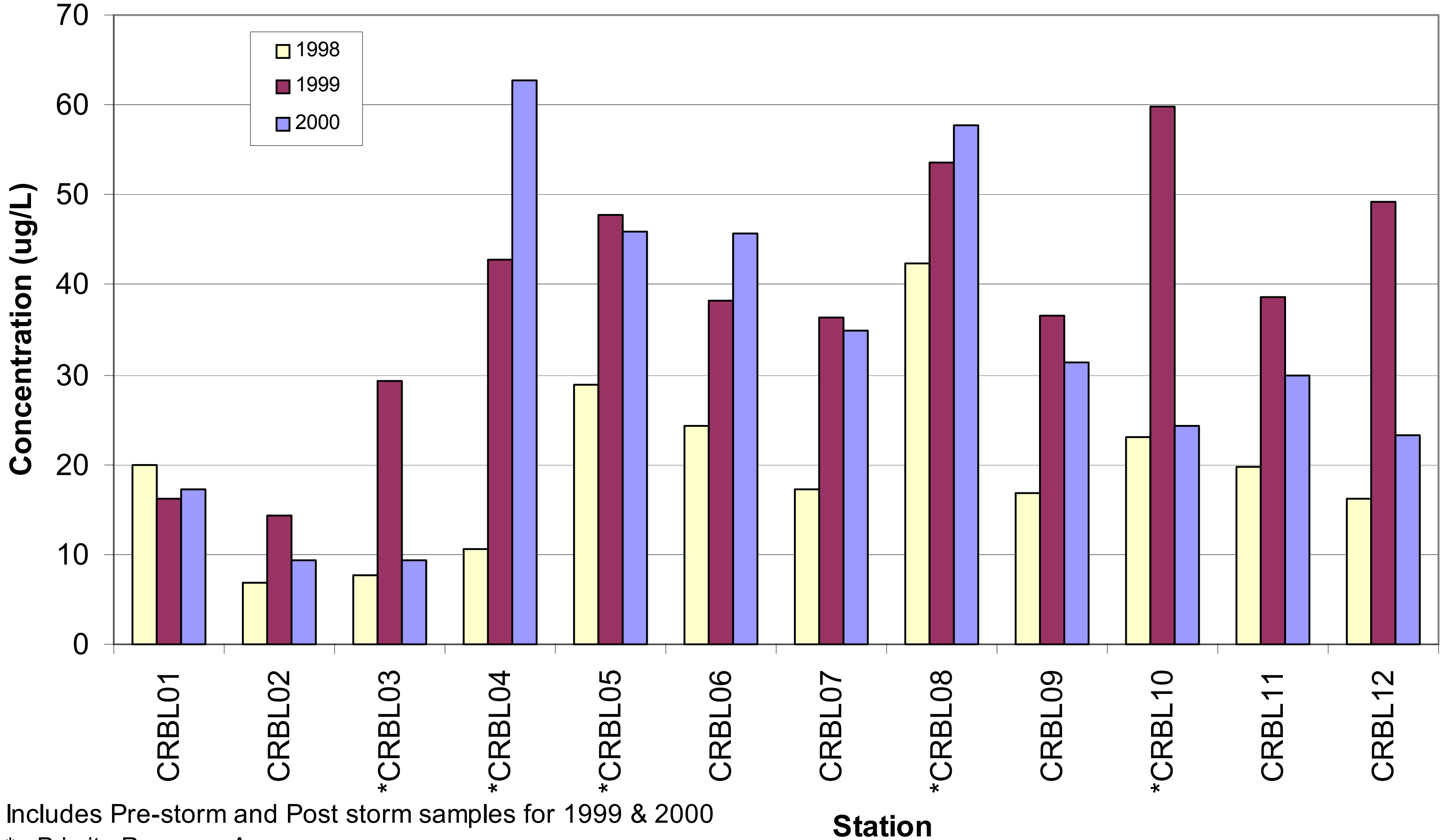


*= Priority Resource Area

1999 and 2000 means include Pre-storm and Post-storm measurements

**=The new criteria does not assign a numeric value

Figure 4: 1998-2000 Chlorophyll a Means



Includes Pre-storm and Post storm samples for 1999 & 2000
*= Priority Resource Area

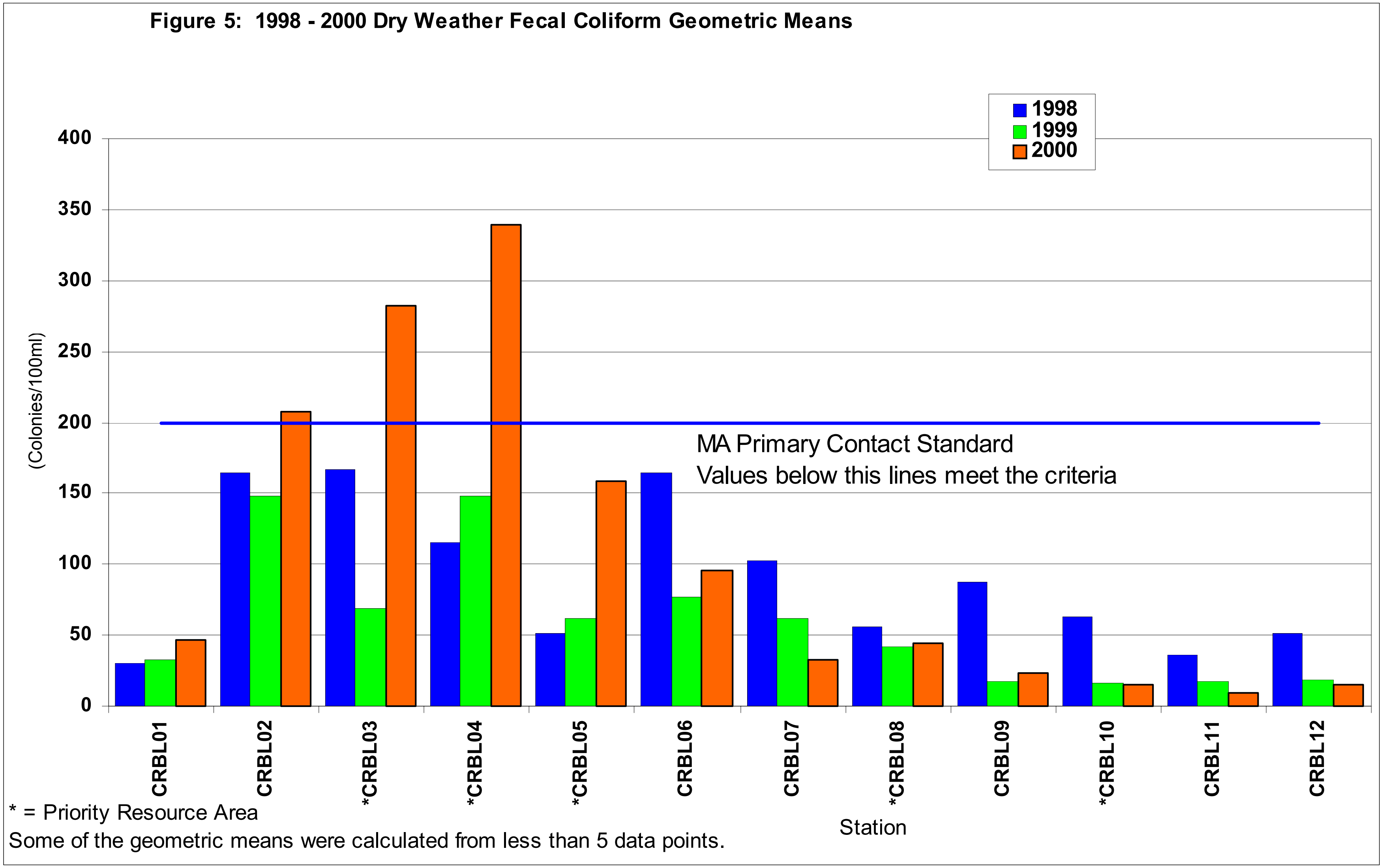
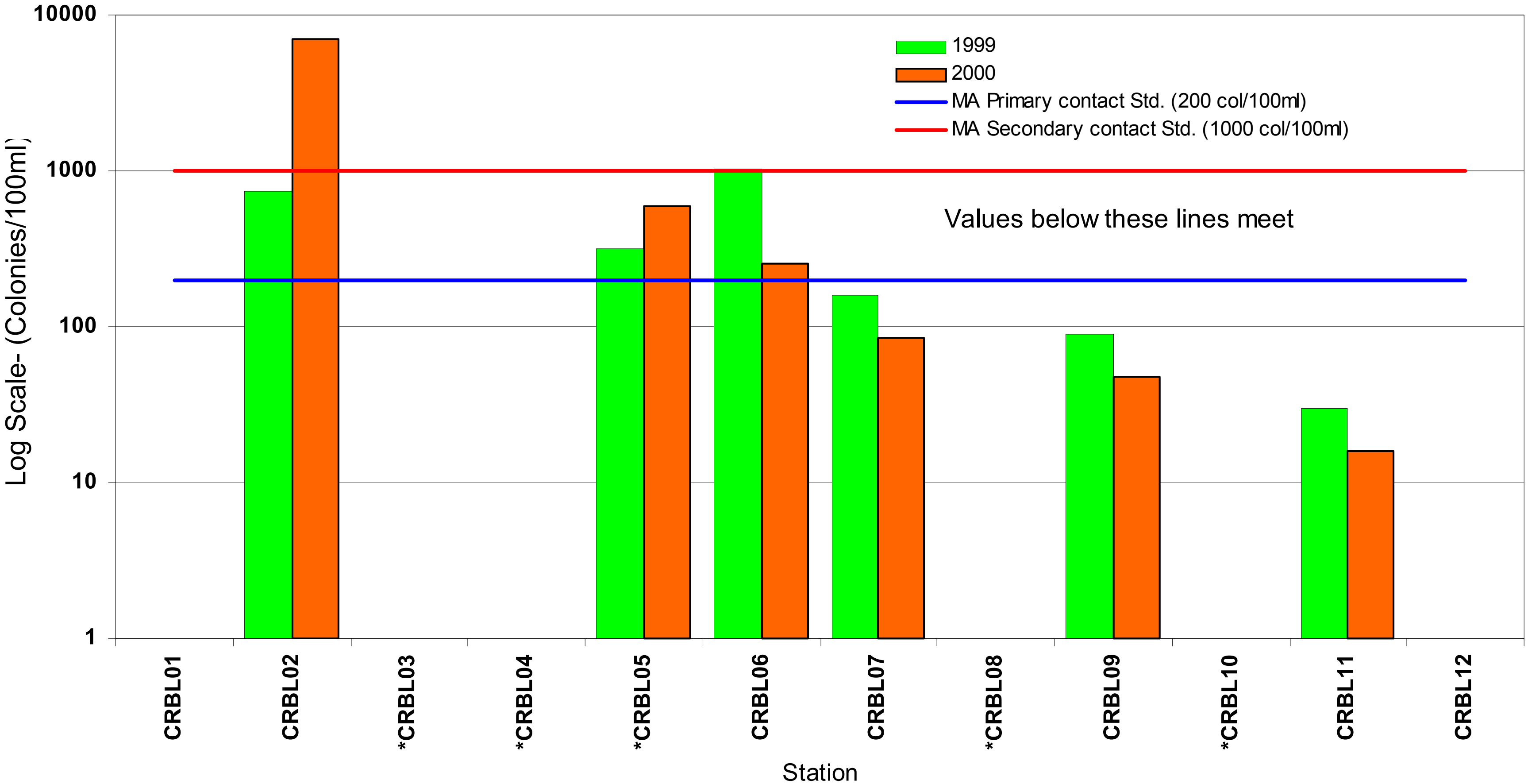


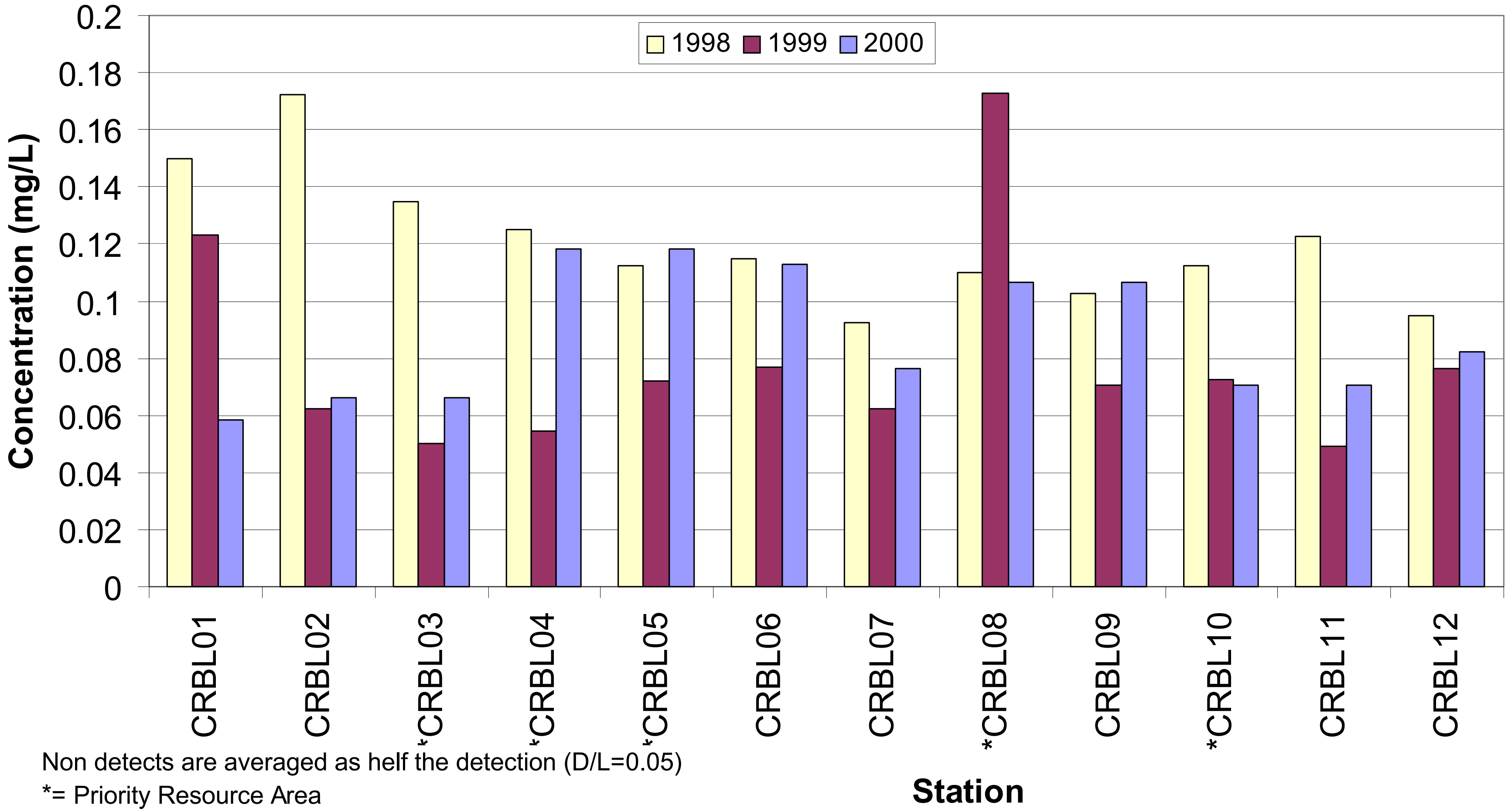
Figure 5: 1998 - 2000 Dry Weather Fecal Coliform Geometric Means
1998
1999
2000
(Colonies/100ml)
400
350
300
250
200
150
100
50
0
MA Primary Contact Standard
Values below this lines meet the criteria
CRBL01
CRBL02
*CRBL03
*CRBL04
*CRBL05
CRBL06
CRBL07
*CRBL08
CRBL09
*CRBL10
CRBL11
CRBL12
Station
* = Priority Resource Area
Some of the geometric means were calculated from less than 5 data points.

Figure 6: 1999 and 2000 Wet Weather Fecal Coliform Geometric Means



* = Priority Resource Area

Figure 7: 1998-2000 Total Phosphorus Dry Weather Means



Non detects are averaged as helf the detection (D/L=0.05)

*= Priority Resource Area

Table 5: Priority Pollutant Metals Dry Weather Concentrations and the Ambient Water Quality Criteria (AWQC)

STATION	Arsenic Conc. (ug/L)	Arsenic AWQC Acute (ug/L)	Arsenic AWQC Chronic (ug/L)	Cadmium Conc. (ug/L)	Cadmium AWQC Acute (ug/L)	Cadmium AWQC Chronic (ug/L)	Chromium Conc. (ug/L)	Chromium AWQC Acute (ug/L)	Chromium AWQC Chronic (ug/L)	Copper Conc. (ug/L)	Copper AWQC Acute (ug/L)	Copper AWQC Chronic (ug/L)	Lead Conc. (ug/L)	Lead AWQC Acute (ug/L)	Lead AWQC Chronic (ug/L)
Sampling was conducted on 7/18/00 (dry weather)															
CRBL01	ND(0.5)	340	150	ND(0.20)	2.2	1.4	0.6	342	44	2.0	7	5	0.50	32.6	1.3
CRBL02	0.8	340	150	ND(0.20)	2.7	1.6	ND(0.50)	406	53	4.4	9	6	1.80	41	1.6
CRBL03	0.7	340	150	ND(0.20)	2.8	1.7	0.6	412	54	3.8	9	6	1.90	41.9	1.6
CRBL04	0.8	340	150	ND(0.20)	2.6	1.6	ND(0.50)	396	51	3.8	9	6	2.40	39.6	1.5
CRBL05	0.9	340	150	ND(0.20)	2.7	1.6	0.6	406	53	4.9	9	6	3.30	41.1	1.6
CRBL06	0.9	340	150	ND(0.20)	2.7	1.6	ND(0.50)	403	52	4.3	9	6	3.20	40.6	1.6
CRBL07	1.0	340	150	ND(0.20)	3.0	1.8	0.6	438	57	4.7	10	7	4.80	45.5	1.8
CRBL08	1	340	150	ND(0.20)	3.0	1.8	~0.7	436	57	~8	10	7	8.60	45.2	1.8
CRBL09	1.0	340	150	ND(0.20)	3.7	2.0	0.7	510	66	5.4	12	8	5.5	55.7	2.2
CRBL10	1.2	340	150	ND(0.20)	4	2.1	0.7	538	70	7.2	13	8	5.5	59.9	2.3
CRBL11	1.2	340	150	ND(0.20)	4.4	2.3	0.8	585	76	7.6	14	9	5.10	66.9	2.6
CRBL12	1.5	340	150	ND(0.20)	5.8	2.8	0.8	721	94	7.2	18	11	4.20	88.1	3.4
Sampling was conducted on 7/26/00 (prestorm)															
CRBL02	0.6	340	150	ND(0.20)	2.7	1.6	2.2	402	52	2.4	9	6	0.51	40.4	1.6
CRBL05	0.7	340	150	ND(0.20)	2.4	1.5	1.5	366	48	3.3	8	6	1.20	35.7	1.4
CRBL06	0.8	340	150	ND(0.20)	2.7	1.6	2.0	404	52	3.1	9	6	1.80	40.7	1.6
CRBL07	1.0	340	150	ND(0.20)	3.8	2.1	2.1	521	68	4.4	12	8	2.10	57.4	2.2
CRBL09	1.0	340	150	ND(0.20)	4.0	2.1	2.1	541	70	5.1	13	8	2.00	60.3	2.4
CRBL11	1.0	340	150	ND(0.20)	4.3	2.2	1.8	569	74	6.2	13	9	2.00	64.4	2.5
Sampling was conducted on 8/23/00 (dry weather)															
CRBL01	ND(5.0)	340	150	ND(0.05)	2.2	1.4	ND(0.50)	345	45	ND(5.0)	8	5	0.67	32.9	1.3
CRBL02	ND(5.0)	340	150	ND(0.05)	2.5	1.6	ND(0.50)	385	50	ND(5.0)	9	6	3.00	38.2	1.5
CRBL03	ND(5.0)	340	150	ND(0.05)	2.6	1.6	ND(0.50)	389	51	ND(5.0)	9	6	1.10	38.8	1.5
CRBL04	ND(5.0)	340	150	ND(0.05)	2.9	1.7	ND(0.50)	422	55	ND(5.0)	10	7	1.20	43.2	1.7
CRBL05	ND(5.0)	340	150	ND(0.05)	2.8	1.7	ND(0.50)	414	54	ND(5.0)	9	6	0.59	42.2	1.6
CRBL06	ND(5.0)	340	150	ND(0.05)	3.1	1.8	ND(0.50)	442	58	ND(5.0)	10	7	0.47	46.1	1.8
CRBL07	ND(5.0)	340	150	ND(0.05)	3.5	1.9	ND(0.50)	486	63	ND(5.0)	11	8	0.41	52.2	2.0
CRBL08	ND(5.0)	340	150	ND(0.05)	3.5	1.9	ND(0.50)	488	63	ND(5.0)	11	8	1.20	52.5	2.0
CRBL09	ND(5.0)	340	150	ND(0.05)	3.6	2.0	ND(0.50)	497	65	ND(5.0)	11	8	0.36	53.9	2.1
CRBL10	ND(5.0)	340	150	ND(0.05)	4.0	2.1	ND(0.50)	541	70	ND(5.0)	13	8	0.32	60.3	2.3
CRBL11	ND(5.0)	340	150	ND(0.05)	4.0	2.1	ND(0.50)	542	71	5.4	13	9	0.43	60.5	2.4
CRBL12	ND(5.0)	340	150	ND(0.05)	4.6	2.4	ND(0.50)	604	79	5.3	14	10	0.32	69.7	2.7
Sampling was conducted on 9/12/00 (dry weather)															
CRBL01	ND(2.0)	340	150	ND(0.20)	2.4	1.5	8.0	372	48	2.4	8	6	ND(0.20)	36.4	1.4
CRBL02	ND(2.0)	340	150	ND(0.20)	2.8	1.7	0.9	420	55	2.6	9	7	0.40	42.9	1.7
CRBL03	ND(2.0)	340	150	ND(0.20)	3.0	1.8	2.4	438	57	3.3	10	7	0.78	45.4	1.8
CRBL04	ND(2.0)	340	150	ND(0.20)	3.1	1.8	1.2	450	59	3.0	10	7	0.35	47.2	1.8
CRBL05	ND(2.0)	340	150	ND(0.20)	3.1	1.8	1.0	452	59	2.9	10	7	ND(0.20)	47.4	1.8
CRBL06	ND(2.0)	340	150	ND(0.20)	3.5	1.9	0.9	486	63	3.1	11	8	ND(0.20)	52.2	2
CRBL07	ND(2.0)	340	150	ND(0.20)	4.1	2.2	0.9	555	72	3.7	13	9	0.20	62.4	2.4
CRBL08	ND(2.0)	340	150	ND(0.20)	4.3	2.3	1.1	574	75	3.7	14	9	1.20	65.2	2.5
CRBL09	ND(2.0)	340	150	ND(0.20)	4.5	2.3	1.1	591	77	4.5	14	9	ND(0.20)	67.8	2.6
CRBL10	ND(2.0)	340	150	ND(0.20)	5.1	2.5	0.8	651	85	5.3	16	10	ND(0.20)	77.0	3.0
CRBL11	ND(2.0)	340	150	ND(0.20)	5.0	2.5	0.7	645	84	5.1	15	10	ND(0.20)	76.1	3.0
CRBL12	ND(2.0)	340	150	ND(0.20)	5.5	2.7	0.8	691	90	6.0	17	11	ND(0.20)	83.4	3.3
Sampling was conducted on 9/15/00 (pre-storm)															
CRBL02	0.6	340	150	ND(0.20)	3.2	1.9	ND(0.50)	462	60	4.6	11	7	0.34	48.8	1.9
CRBL05	0.9	340	150	ND(0.20)	3.9	2.1	ND(0.50)	531	69	4.4	12	8	0.35	58.8	2.3
CRBL06	1.0	340	150	ND(0.20)	4.4	2.3	ND(0.50)	578	75	4.7	14	9	0.16	65.9	2.6
CRBL07	1.2	340	150	ND(0.20)	4.9	2.5	ND(0.50)	635	83	5.5	15	10	0.17	74.6	2.9
CRBL09	1.2	340	150	ND(0.20)	5.2	2.6	ND(0.50)	662	86	5.8	16	10	0.26	78.8	3.1
CRBL11	1.3	340	150	ND(0.20)	5.4	2.6	ND(0.50)	683	89	6.3	17	11	0.21	82.2	3.2

Note:

~ =Estimated data

ND = Not detected above the associated detection limit

Chronic '= Exceeds Chronic Criteria

Acute '= Exceeds Acute Criteria

Table 5: Priority Pollutant Metals Dry Weather Concentrations and the Ambient Water Quality Criteria (AWQC) Cont.

STATION	Mercury Conc. (ug/L)	Mercury AWQC Acute (ug/L)	Mercury AWQC Chronic (ug/L)	Nickel Conc. (ug/L)	Nickel AWQC Acute (ug/L)	Nickel AWQC Chronic (ug/L)	Selenium Conc. (ug/L)	Selenium AWQC Chronic (ug/L)	Silver Conc. (ug/L)	Silver AWQC Acute (ug/L)	Zinc Conc. (ug/L)	Zinc AWQC Acute (ug/L)	Zinc AWQC Chronic (ug/L)
Sampling was conducted on 7/18/00 (dry weather)													
CRBL01	0.004	1.6	0.91	1.3	276	31	ND((2.5)	5	ND(0.20)	1.2	2.7	69	70
CRBL02	0.004	1.6	0.91	1.5	330	37	ND((2.5)	5	ND(0.20)	1.7	4.7	82	83
CRBL03	0.004	1.6	0.91	1.5	335	37	ND((2.5)	5	ND(0.20)	1.7	4.4	84	84
CRBL04	0.006	1.6	0.91	1.6	321	36	ND((2.5)	5	ND(0.20)	1.6	3.8	80	81
CRBL05	0.006	1.6	0.91	1.7	330	37	ND((2.5)	5	ND(0.20)	1.7	4.2	83	83
CRBL06	0.008	1.6	0.91	1.6	327	36	ND((2.5)	5	ND(0.20)	1.7	4.5	82	83
CRBL07	0.007	1.6	0.91	1.7	357	40	ND((2.5)	5	ND(0.20)	2.0	4.5	89	90
CRBL08	0.017	1.6	0.91	1.7	355	39	ND((2.5)	5	ND(0.20)	2.0	~3	89	90
CRBL09	0.007	1.6	0.91	1.8	418	46	ND((2.5)	5	ND(0.20)	2.7	5.2	104	105
CRBL10	0.006	1.6	0.91	1.8	442	49	ND((2.5)	5	ND(0.20)	3.1	6.7	111	111
CRBL11	0.005	1.6	0.91	1.8	481	53	ND((2.5)	5	ND(0.20)	3.6	6.0	120	121
CRBL12	0.005	1.6	0.91	1.9	597	66	ND((2.5)	5	ND(0.20)	5.6	7.7	149	151
Sampling was conducted on 7/26/00 (pre-storm)													
CRBL02	0.002	1.6	0.91	1.5	326	36	ND(2.5)	5	ND(0.20)	1.7	3.6	82	82
CRBL05	0.01	1.6	0.91	1.4	296	33	ND(2.5)	5	ND(0.20)	1.4	2.7	74	75
CRBL06	0.017	1.6	0.91	1.5	328	36	ND(2.5)	5	ND(0.20)	1.7	ND(2.0)	82	83
CRBL07	0.006	1.6	0.91	1.7	427	47	ND(2.5)	5	ND(0.20)	2.9	3.1	107	108
CRBL09	0.004	1.6	0.91	1.7	444	49	ND(2.5)	5	ND(0.20)	3.1	3.8	111	112
CRBL11	0.004	1.6	0.91	1.7	467	52	ND(2.5)	5	ND(0.20)	3.4	3.8	117	118
Sampling was conducted on 8/23/00 (dry weather)													
CRBL01	0.0031	1.6	0.91	1.5	279	31	ND(2.5)	5	ND(0.20)	1.2	10.8	70	70
CRBL02	0.0046	1.6	0.91	1.7	312	35	ND(2.5)	5	ND(0.20)	1.5	11.5	78	79
CRBL03	0.0032	1.6	0.91	1.6	316	35	ND(2.5)	5	ND(0.20)	1.6	ND(10.0)	79	80
CRBL04	0.0076	1.6	0.91	1.6	343	38	ND(2.5)	5	ND(0.20)	1.8	ND(10.0)	86	87
CRBL05	0.0076	1.6	0.91	1.8	337	37	ND(2.5)	5	ND(0.20)	1.8	ND(10.0)	84	85
CRBL06	0.0072	1.6	0.91	1.8	361	40	ND(2.5)	5	ND(0.20)	2.0	ND(10.0)	90	91
CRBL07	0.0077	1.6	0.91	1.8	397	44	ND(2.5)	5	ND(0.20)	2.5	ND(10.0)	99	100
CRBL08	0.0111	1.6	0.91	1.9	399	44	ND(2.5)	5	ND(0.20)	2.5	ND(10.0)	100	101
CRBL09	0.0051	1.6	0.91	1.9	407	45	ND(2.5)	5	ND(0.20)	2.6	ND(10.0)	102	103
CRBL10	0.0036	1.6	0.91	1.9	444	49	ND(2.5)	5	ND(0.20)	3.1	ND(10.0)	111	112
CRBL11	0.0034	1.6	0.91	1.9	445	49	ND(2.5)	5	ND(0.20)	3.1	ND(10.0)	111	112
CRBL12	0.0029	1.6	0.91	2.0	497	55	ND(2.5)	5	ND(0.20)	3.9	ND(10.0)	124	125
Sampling was conducted on 9/12/00 (dry weather)													
CRBL01	0.0017	1.6	0.91	1.7	301	33	ND(2.5)	5	ND(0.50)	1.4	ND(5.0)	75	76
CRBL02	0.0018	1.6	0.91	1.7	341	38	ND(2.5)	5	ND(0.50)	1.8	ND(5.0)	85	86
CRBL03	0.0053	1.6	0.91	1.9	357	40	ND(2.5)	5	ND(0.50)	2.0	ND(5.0)	89	90
CRBL04	0.0044	1.6	0.91	1.7	367	41	ND(2.5)	5	ND(0.50)	2.1	ND(5.0)	92	93
CRBL05	0.0054	1.6	0.91	1.7	369	41	ND(2.5)	5	ND(0.50)	2.1	ND(5.0)	92	93
CRBL06	0.0034	1.6	0.91	1.7	397	44	ND(2.5)	5	ND(0.50)	2.5	ND(5.0)	99	100
CRBL07	0.003	1.6	0.91	1.7	456	51	ND(2.5)	5	ND(0.50)	3.3	ND(5.0)	114	115
CRBL08	0.0111	1.6	0.91	1.7	472	52	0.7	5	ND(0.50)	3.5	ND(5.0)	118	119
CRBL09	0.0045	1.6	0.91	1.8	486	54	ND(2.5)	5	ND(0.50)	3.7	ND(5.0)	122	123
CRBL10	0.0034	1.6	0.91	1.8	537	60	2.8	5	ND(0.50)	4.6	ND(5.0)	134	136
CRBL11	0.003	1.6	0.91	1.9	532	59	2.6	5	ND(0.50)	4.5	ND(5.0)	133	134
CRBL12	0.0024	1.6	0.91	1.8	572	64	3.2	5	ND(0.50)	5.2	ND(5.0)	143	144
Sampling was conducted on 9/15/00 (pre-storm)													
CRBL02	0.0017	1.6	0.91	2.0	377	42	ND(2.5)	5	ND(0.20)	2.2	2.7	94	95
CRBL05	0.0082	1.6	0.91	2.0	435	48	ND(2.5)	5	ND(0.20)	3.0	2.2	109	110
CRBL06	0.0108	1.6	0.91	2.0	476	53	ND(2.5)	5	ND(0.20)	3.6	1.6	119	120
CRBL07	0.0052	1.6	0.91	1.8	524	58	ND(2.5)	5	ND(0.20)	4.3	1.1	131	132
CRBL09	0.0058	1.6	0.91	2.0	547	61	2.8	5	ND(0.20)	4.7	1.1	137	138
CRBL11	0.0037	1.6	0.91	2.0	565	63	2.8	5	ND(0.20)	5.1	1.3	141	143

Note:

Except for Mercury, which is reported as Total Mercury, all metals concentrations and AWQC criteria are reported as dissolved metals.

~ =Estimated data

ND = Not detected above the associated detection limit

Chronic '= Exceeds Chronic Criteria

Acute '= Exceeds Acute Criteria

Table 6: Priority Pollutant Metals Wet Weather Concentrations and the Ambient Water Quality Criteria (AWQC)

STATION	Arsenic Conc. (ug/L)	Arsenic AWQC Acute (ug/L)	Arsenic AWQC Chronic (ug/L)	Cadmium Conc. (ug/L)	Cadmium AWQC Acute (ug/L)	Cadmium AWQC Chronic (ug/L)	Chromium Conc. (ug/L)	Chromium AWQC Acute (ug/L)	Chromium AWQC Chronic (ug/L)	Copper Conc. (ug/L)	Copper AWQC Acute (ug/L)	Copper AWQC Chronic (ug/L)	Lead Conc. (ug/L)	Lead AWQC Acute (ug/L)	Lead AWQC Chronic (ug/L)
Sampling was conducted on 7/26/00 (first flush)															
CRBL02	0.6	340	150	ND(0.20)	2.6	1.6	2.1	392	51	3.2	9	6	0.95	39.1	1.5
CRBL05	0.6	340	150	ND(0.20)	2.3	1.5	1.8	363	47	3.5	8	6	1.20	35.2	1.4
CRBL06	0.6	340	150	ND(0.20)	2.5	1.6	2.0	383	50	3.4	8	6	1.50	37.9	1.5
CRBL07	0.9	340	150	ND(0.20)	3.5	1.9	2.0	486	63	3.7	11	8	2.00	52.2	2.0
CRBL09	1.0	340	150	ND(0.20)	4.1	2.2	2.1	557	72	4.7	13	9	2.10	62.7	2.4
CRBL11	0.9	340	150	ND(0.20)	4.2	2.2	1.8	562	73	5.4	13	9	2.00	63.4	2.5
Sampling was conducted on 7/27/00 (peak flow)															
CRBL02	0.7	340	150	ND(0.20)	1.3	1.0	0.9	230	30	3.1	5	3	1.20	19.0	0.7
CRBL05	0.6	340	150	ND(0.20)	2.1	1.4	0.6	337	44	3.6	7	5	1.40	31.9	1.2
CRBL06	0.7	340	150	ND(0.20)	2.0	1.3	0.5	323	42	4.2	7	5	1.50	30.2	1.2
CRBL07	0.9	340	150	ND(0.20)	3.7	2.0	ND(0.50)	509	66	4.5	12	8	2.20	55.5	2.2
CRBL09	1.0	340	150	ND(0.20)	3.3	1.9	ND(0.50)	473	62	4.3	11	7	2.30	50.4	2.0
CRBL11	1.0	340	150	ND(0.20)	4.1	2.2	ND(0.50)	558	73	4.9	13	9	2.00	62.8	2.4
Sampling was conducted on 7/28/00 (post-storm)															
CRBL02	~0.6	340	150	ND(0.2)	2.4	1.5	1.0	372	48	2.2	8	6	0.90	36.5	1.4
CRBL05	0.8	340	150	ND(0.2)	2.4	1.5	1.1	370	48	3.3	8	6	1.90	36.2	1.4
CRBL06	0.7	340	150	ND(0.2)	2.4	1.5	1.1	372	48	3.3	8	6	1.60	36.5	1.4
CRBL07	0.9	340	150	ND(0.2)	3.3	1.9	1.2	474	62	4.0	11	7	1.90	50.5	2.0
CRBL09	0.8	340	150	ND(0.2)	3.0	1.8	1.2	435	57	4.2	10	7	1.70	45.1	1.8
CRBL11	1.0	340	150	ND(0.2)	3.7	2.0	0.9	509	66	4.3	12	8	1.80	55.6	2.2
Sampling was conducted on 9/15/00 (first flush)															
CRBL02	0.7	340	150	ND(0.20)	3.1	1.8	ND(0.5)	444	58	~3.0	10	7	0.37	46.3	1.8
CRBL05	0.8	340	150	ND(0.20)	3.6	2.0	ND(0.5)	499	65	4.0	12	8	0.25	54.1	2.1
CRBL06	0.9	340	150	ND(0.20)	3.7	2.0	ND(0.5)	511	67	4.0	12	8	0.22	55.9	2.2
CRBL07	1.2	340	150	ND(0.20)	4.9	2.5	ND(0.5)	632	82	4.8	15	10	0.20	74.1	2.9
CRBL09	1.3	340	150	ND(0.20)	5.5	2.7	ND(0.5)	689	90	6.0	17	11	0.26	83.1	3.2
CRBL11	1.3	340	150	ND(0.20)	5.4	2.6	ND(0.5)	682	89	6.1	17	11	0.22	82.0	3.2
Sampling was conducted on 9/15/00 (peak flow)															
CRBL02	1.0	340	150	ND(0.20)	1.4	1.1	1.4	247	32	5.3	5	4	1.40	20.9	0.8
CRBL05	0.8	340	150	ND(0.20)	3.1	1.8	0.7	444	58	4.8	10	7	0.59	46.3	1.8
CRBL06	1.1	340	150	ND(0.20)	3.3	1.9	0.7	475	62	9.0	11	7	0.68	50.6	2.0
CRBL07	1.2	340	150	ND(0.20)	4.9	2.5	ND(0.50)	633	82	4.7	15	10	0.21	74.3	2.9
CRBL09	1.4	340	150	ND(0.20)	5.2	2.5	ND(0.50)	657	85	5.4	16	10	0.21	78.0	3.0
CRBL11	1.3	340	150	ND(0.20)	5.3	2.6	ND(0.50)	672	87	5.9	16	11	0.28	80.4	3.1
Sampling was conducted on 9/18/00 (post-flow)															
CRBL02	~0.6	340	150	ND(0.20)	3.2	1.8	~0.6	457	59	~3.5	10	7	0.57	48.1	1.9
CRBL05	~0.6	340	150	ND(0.20)	3.0	1.8	ND(0.50)	438	57	4.2	10	7	0.46	45.5	1.8
CRBL06	~0.7	340	150	ND(0.20)	3.4	1.9	ND(0.50)	476	62	4.6	11	7	0.38	50.8	2.0
CRBL07	~1.0	340	150	ND(0.20)	4.5	2.3	ND(0.50)	596	78	4.8	14	9	0.31	68.6	2.7
CRBL09	~1.2	340	150	ND(0.20)	5.1	2.5	ND(0.50)	655	85	5.5	16	10	0.28	77.8	3.0
CRBL11	~1.4	340	150	ND(0.20)	5.6	2.7	ND(0.50)	700	91	6.3	17	11	0.39	84.7	3.3

Note:

Except for Mercury, which is reported as Total Mercury, all metals concentrations and AWQC criteria are reported as dissolved metals.

~ =Estimated data

ND = Not detected above the associated detection limit

Chronic '= Exceeds Chronic Criteria

Acute '= Exceeds Acute Criteria

Table 6: Priority Pollutant Metals Wet Weather Concentrations and the Ambient Water Quality Criteria (AWQC) cont

STATION	Mercury Conc. (ug/L)	Mercury AWQC Acute (ug/L)	Mercury AWQC Chronic (ug/L)	Nickel Conc. (ug/L)	Nickel AWQC Acute (ug/L)	Nickel AWQC Chronic (ug/L)	Selenium Conc. (ug/L)	Selenium AWQC Chronic (ug/L)	Silver Conc. (ug/L)	Silver AWQC Acute (ug/L)	Zinc Conc. (ug/L)	Zinc AWQC Acute (ug/L)	Zinc AWQC Chronic (ug/L)
Sampling was conducted on 7/26/00 (firstfFlush)													
CRBL02	0.004	1.6	0.91	1.5	318	35	ND(2.5)	5	ND(0.20)	1.6	~6.0	80	80
CRBL05	0.0080	1.6	0.91	1.4	294	33	ND(2.5)	5	ND(0.20)	1.3	~2.6	73	74
CRBL06	0.015	1.6	0.91	1.4	310	34	ND(2.5)	5	ND(0.20)	1.5	~9.8	78	78
CRBL07	0.006	1.6	0.91	1.6	397	44	ND(2.5)	5	ND(0.20)	2.5	~3.2	99	100
CRBL09	0.004	1.6	0.91	1.7	458	51	ND(2.5)	5	ND(0.20)	3.3	~3.8	115	115
CRBL11	0.003	1.6	0.91	1.7	462	51	ND(2.5)	5	ND(0.20)	3.4	~4.5	115	116
Sampling was conducted on 7/27/00(peak flow)													
CRBL02	0.012	1.6	0.91	1.2	184	20	ND(2.5)	5	ND(0.20)	0.5	6.9	46	46
CRBL05	0.008	1.6	0.91	1.7	272	30	ND(2.5)	5	ND(0.20)	1.1	7.9	68	69
CRBL06	0.015	1.6	0.91	1.6	261	29	ND(2.5)	5	ND(0.20)	1.0	5.4	65	66
CRBL07	0.008	1.6	0.91	1.8	416	46	ND(2.5)	5	ND(0.20)	2.7	2.8	104	105
CRBL09	0.008	1.6	0.91	1.8	387	43	ND(2.5)	5	ND(0.20)	2.3	4.2	97	97
CRBL11	0.004	1.6	0.91	2.0	458	51	ND(2.5)	5	ND(0.20)	3.3	3.2	115	116
Sampling was conducted on 7/28/00 (post-storm)													
CRBL02	0.005	1.6	0.91	1.6	302	34	ND(2.5)	5	ND(0.2)	1.4	4.0	75	76
CRBL05	0.006	1.6	0.91	1.6	300	33	ND(2.5)	5	ND(0.2)	1.4	3.5	75	76
CRBL06	0.009	1.6	0.91	1.7	301	33	ND(2.5)	5	ND(0.2)	1.4	2.9	75	76
CRBL07	0.006	1.6	0.91	1.7	387	43	ND(2.5)	5	ND(0.2)	2.3	3.9	97	98
CRBL09	0.007	1.6	0.91	1.7	355	39	ND(2.5)	5	ND(0.2)	2.0	4.5	89	89
CRBL11	0.004	1.6	0.91	1.8	417	46	ND(2.5)	5	ND(0.2)	2.7	3.7	104	105
Sampling was conducted on 9/15/00 (first flush)													
CRBL02	0.003	1.6	0.91	2.0	362	40	ND(2.5)	5	ND(0.20)	2.0	3.3	90	91
CRBL05	0.0138	1.6	0.91	2.1	408	45	ND(2.5)	5	ND(0.20)	2.6	3.5	102	103
CRBL06	0.0111	1.6	0.91	2.1	419	47	ND(2.5)	5	ND(0.20)	2.8	2.6	105	106
CRBL07	0.005	1.6	0.91	2.0	521	58	ND(2.5)	5	ND(0.20)	4.3	1.3	130	131
CRBL09	0.006	1.6	0.91	2.1	570	63	2.8	5	ND(0.20)	5.1	1.4	143	144
CRBL11	0.004	1.6	0.91	2.1	564	63	2.8	5	ND(0.20)	5.0	1.5	141	142
Sampling was conducted on 9/15/00 (peak flow)													
CRBL02	0.0394	1.6	0.91	1.5	197	22	ND(2.5)	5	ND(2.5)	0.6	10.7	49	50
CRBL05	0.0129	1.6	0.91	2.0	362	40	ND(2.5)	5	ND(2.5)	2.0	6.0	91	91
CRBL06	0.0187	1.6	0.91	2.3	388	43	ND(2.5)	5	ND(2.5)	2.4	11.0	97	98
CRBL07	0.004	1.6	0.91	1.8	522	58	ND(2.5)	5	ND(2.5)	4.3	1.0	131	132
CRBL09	0.009	1.6	0.91	1.9	543	60	2.8	5	2.8	4.7	1.2	136	137
CRBL11	0.003	1.6	0.91	2.0	555	62	2.9	5	2.9	4.9	2.0	139	140
Sampling was conducted on 9/18/00 (post-flow)													
CRBL02	0.004	1.6	0.91	2.0	373	41	ND(2.5)	5	ND(0.20)	2.2	3.0	93	94
CRBL05	0.008	1.6	0.91	2.0	357	40	ND(2.5)	5	ND(0.20)	2.0	2.4	89	90
CRBL06	0.009	1.6	0.91	1.9	389	43	ND(2.5)	5	ND(0.20)	2.4	2.8	97	98
CRBL07	0.006	1.6	0.91	2.1	491	55	ND(2.5)	5	ND(0.20)	3.8	2.0	123	124
CRBL09	0.008	1.6	0.91	2.1	541	60	ND(2.5)	5	ND(0.20)	4.6	1.8	135	137
CRBL11	0.005	1.6	0.91	2.0	579	64	3.1	5	ND(0.20)	5.3	1.3	145	146

Note:

Except for Mercury, which is reported as Total Mercury, all metals concentrations and AWQC criteria are reported as dissolved metals.

~ =Estimated data

ND = Not detected above the associated detection limit

Chronic '= Exceeds Chronic Criteria

Acute '= Exceeds Acute Criteria

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APPENDIX

Charles River 2000 Core Monitoring Data Report