Charles River Watershed Association

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CRWA
Saving the Charles River since 1965

CRWA Water Quality Monitoring Parameters

Tested monthly at all sites:

Escherichia coli, *commonly known as E. coli, is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of E. coli in water is a strong indication of recent sewage or animal waste contamination, however the general strain of E. coli is not harmful to humans. Sewage may contain many types of disease-causing organisms, including both bacteria and viruses. (Reference: US EPA Drinking Water website.) The Charles River is classified as Class B by the Massachusetts Surface Water Quality Standards. According to the standards, the waters of the Charles are designated for both primary (i.e. swimming/fishing) and secondary (i.e. boating) recreational contact. The standards state that the geometric mean of E. coli concentrations of Class B fishable/swimmable waters should have no more than 126 organisms per 100 ml of water sample (or 126cfu/100 ml) and no single sample should have concentrations exceeding 235cfu/100 ml. Waters designated for secondary contact (boating) should not have E. coli concentrations exceeding 630/100 ml and less than 10% of the samples should have concentrations exceeding 1,260/100 ml.*

Tested four times a year at a subset of sites:

Enterococci *are a sub-group of the bacteria class known as fecal streptococci. Enterococci include fecal streptococcus usually found in humans and birds and exclude fecal streptococcus species usually found in the intestines of horses and cows. Enterococci are present in sewage at lower concentrations than fecal coliform. The presence of enterococci indicates the recent contamination of the water. "False positives", or the detection of an analyte not actually present, is common in the analyses of enterococci. In addition, enterococci may be more persistent, or live longer, in the environment than fecal coliform. Thus, levels of enterococci may remain elevated while levels of fecal coliform decrease due to die-off. Some organisms, including birds, cats and dogs, have higher levels of enterococci than humans do. Therefore, in areas heavily populated by birds or other animals, and largely unaffected by human waste, levels of enterococci may be higher than levels of fecal coliform. The U.S. EPA standard for enterococci is 33 organisms per 100 ml.*

Total Kjeldahl Nitrogen *(TKN) is the total of organic and ammonia nitrogen. Organic nitrogen is the form of protein, amino acid, or urea that occurs in water containing organic wastewater. Decomposition of organic nitrogen produces ammonia. Ten river samples collected in 1990 had TKN concentrations ranging from 0.25 to 0.98 mg/L. Organic nitrogen ranges from 8 to 35 mg/L in untreated domestic sewage.*

Total Nitrogen *is the sum of all nitrogenous compounds -- organic nitrogen + ammonia + nitrate + nitrite. It is the measure of all forms of nitrogen. In samples collected from the Charles and tributaries in 2008, total nitrogen ranged from 0.47 to 4.87 mg/L as nitrogen. Where phosphorous is the limiting agent, measures less than 1.0 mg/L are considered acceptable.*

Total Phosphorus *(TP) originates from agricultural runoff and wastewaters containing detergents. Total phosphorous, being the measure of all forms of phosphorous in the system, includes phosphorous already taken up by plants. Although phosphorus occurs in natural waters in smaller amounts than nitrogen, it is an essential plant nutrient. Total phosphorus ranged from 0.015 to 0.104 mg/L in samples collected in 2008. A lake may be considered eutrophic and excessive plant growth may occur at mean annual phosphorus concentrations*

ranging from 0.016 to 0.39 mg/l. Total phosphorus ranges from 4 to 15 mg/L in untreated domestic sewage. Phosphorous is the least abundant macronutrient required by biota and is, therefore, the first element to limit biological productivity.

***Ammonia** (NH3) results from the initial decomposition of organic nitrogen and is always present in untreated sewage. Concentrations of ammonia in Charles river samples collected in 2008 ranged from 0.008 to 0.333 mg/L as nitrogen. Concentrations of ammonia in untreated domestic wastewater range from 12 to 50 mg/L.*

***Nitrates plus Nitrites**. Oxidation of ammonia yields nitrite (NO2), which is quickly converted to nitrate (NO3), the end product of the decomposition of nitrogenous matter. Nitrate is the form of nitrogen that is directly available to algae and other aquatic plants as a nutrient. The major sources for nitrates and nitrites are fertilizers, animal wastes, and atmospheric deposition of automobile emissions and electric powerplant emissions, which then enter rivers and streams either directly or through soils or decomposing plants. In samples collected from the Charles and tributaries in 2008, nitrate plus nitrite ranged from 0.12 to 3.98 mg/L as nitrogen. Nitrates and nitrites are not typically present in untreated domestic wastewater.*

***Orthophosphate** (PO4), the most significant form of inorganic phosphorous, is the amount of soluble phosphorous immediately available for algal use. As plants take up this nutrient from the water, it becomes bound to the plant and is no longer available.*

***Chlorophyll a** (CHLA) is the principle photosynthetic pigment in algae and vascular plants. Chlorophyll a is a good indicator of algae concentrations and over-enrichment of nutrients. Levels higher than 10 mg/l often are indicative of eutrophic conditions. According to Wetzel (1983), eutrophication occurs in lakes with annual mean chlorophyll a concentrations of 3 to 78 mg/l.*

***Phaeophytin** (PHAE) are the end-products of the degradation of chlorophyll a. A high ratio of chlorophyll a to phaeophytin indicates active growth of population and a low ratio indicates aging. Higher ratios signify the occurrence of eutrophication and generally occur in either impoundments or areas of high residential use where nutrient over-enrichment from fertilizers and pesticides is likely to be heaviest.*

***Total Suspended Solids** (TSS) is a combination of organic particles, silt, and sand that either floats on the surface of, or is in suspension in water or wastewater, and is removable by laboratory filtering techniques. TSS clouds the water. Toxic contaminants adhere to solids that eventually settle to the bottom, contaminating bottom sediments and smothering bottom-dwelling organisms. TSS ranged from 1 to 12 mg/l in samples collected from the river and tributaries in 2008.*

Tested on an as needed basis:

***Biochemical Oxygen Demand** (BOD) is a measure of the amount of oxygen required by bacteria to decompose a given amount of organic matter. The five-day BOD test (BOD5) has been accepted as a standard test in water quality analyses. Concentrations of BOD5 range from 100 to 400 mg/L in untreated domestic wastewater; however, in an unpolluted waterbody BOD5 rarely exceeds 2 mg/L. In six samples collected in the Charles and tributaries in 1990 by Mass DEP, concentrations of BOD5 ranged from 0.6 to 2.7 mg/l (Mass DEP 1991).*

***Conductivity/Specific Conductance**. The term conductance refers to the ability of liquids to carry an electric current. Under the influence of an electric field, the flow of current through a liquid is accomplished by movement of positive and negative ions. The conductance of a liquid is defined by the ratio of current to voltage between any two points within the liquid. The conductivity of a solution with a specific electrolyte concentration changes with temperature. Specific conductance is the conductivity measurement corrected to 25oC. Conductivity measurements will be taken by CRWA staff in the field under project-specific conditions.*

Dissolved Oxygen *(DO) is the most important dissolved gas in river water as it is essential to most aquatic organisms, especially fish. It is the amount of oxygen dissolved in water, measured in milligrams of oxygen per liter of water (mg/l). The solubility of oxygen is dependent on water temperature and salinity. The colder the water, the more dissolved oxygen it is capable of holding. The more saline the water, the less dissolved oxygen it can hold. Oxygen is produced whenever green plants are growing (photosynthesis). Oxygen is also used by plants and animals to obtain energy (respiration). Excessive plant growth can utilize more oxygen than it produces, resulting in low dissolved oxygen readings in the water. Dissolved oxygen measurements will be taken by CRWA staff in the field under project-specific conditions.*

Salinity *is a measure of the total dissolved salts in a solution and is used to describe seawater, as well as natural and industrial waters. The units to describe salinity are ppt (parts per thousand). Salt waters, such as oceans, contain 35 parts of salt per 1000 parts of water. Fresh waters have salinity measurements of 0.5 ppt or less. Brackish waters have intermediate salt concentrations. Salinity measurements will be taken by CRWA staff in the field under project-specific conditions.*

Sodium *is derived geologically from leaching of surface and underground deposits of salt and decomposition of various minerals. Human activities contribute excessive amounts through winter de-icing and washing products. (Reference: USGS Water Science website.)*

References

- *1990 Charles River Bacteria Study, by Margo Webber of Massachusetts Department of Environmental Protection, April 1991*
- *The State of Boston Harbor 1995 by the Massachusetts Water Resources Authority*
- *Limnology, 2nd Edition by R. G. Wetzel, 1983*
- *Wastewater Engineering: Treatment, Disposal, Reuse by Metcalf & Eddy, Inc., 1991*
- *The Environment: Issues and Choices for Society by Penelope and Charles ReVelle, 1981.*

For more information about CRWA's methodology for water testing please contact us at charles@crwa.org