

## MONITORING WATER QUALITY

### **How Do We Measure Water Quality?**

To identify the substances present in a stream or lake, scientists collect samples of the water, living organisms, and suspended and bottom sediments. Then, technicians analyze these samples in a laboratory with specialized instruments and procedures. State-of-the-art analytical instruments can detect down to *one part per trillion* of some substances. This is comparable to tracing one thousandth of a teaspoon of salt dissolved in an Olympic-size swimming pool!

### **Criteria**

The U.S. EPA has developed criteria for the protection of aquatic life and human health. Specific standards may be viewed at: [www.epa.gov/waterscience/criteria](http://www.epa.gov/waterscience/criteria). Water quality standards have been established for 158 pollutants. However, more than 10,000 new chemicals are created annually in the United States and are not regulated.

### **Monitoring**

It is important to establish baseline data for rivers, streams and lakes in order to monitor changes over time. Water quality measurements can include data on the physical, chemical and biological characteristics of a lake or stream.

- Physical characteristics – Size (length, width, shoreline length, surface area, watershed area), maximum or average depth, volume, depth to volume relationship, temperature, clarity, color, suspended solids
- Chemical characteristics – pH, dissolved oxygen, conductivity, chlorides (salts), nutrients, etc.
- Biological characteristics – Fecal coliform, chlorophyll-a, bottom dwelling organisms (benthic macro-invertebrates), and plant and animal species

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## Types of Water Quality Characteristics That Are Measured

### *Physical Characteristics*

<b>Temperature</b>	The temperature of the water is one factor that determines which organisms can live in a lake or stream. Fish species such as lake trout, whitefish, lake herring, burbot, lake sturgeon, sculpins and chub prefer cold water. Brook trout and grayling are found only in cold streams. Other fish species such as bluegill, bass, perch, northern pike, muskellunge and sunfish prefer warmer waters.
<b>Clarity or Turbidity</b>	The more algae, sediment, and microscopic organisms in water, the less clear it is. Muddy waters block sunlight, clog fish gills and smother spawning beds. An eight inch diameter black and white disk (Secchi disk) is used to measure clarity.
<b>Color</b>	Algae, sediments and other suspended or dissolved materials can color water. Algae can give water a green or yellowish color. Soil particles (sediments) suspended in the water can give it a milky brown to dark brown color. Sometimes water color is a result of natural conditions. For example, naturally occurring clay deposits located on the bottom of a stream sometimes cause the water to be a milky, green color. Tea-color staining can be caused by organic compounds in wetlands and swamps. Very clear, deep waters are usually shades of blue, because the blue part of the light spectrum is absorbed least by water and is reflected back to the surface.
<b>Suspended Solids</b>	Suspended solids include silt and clay particles from soil runoff, microscopic plants, sewage, and industrial waste. When water is poured through a filter, suspended solids collect on the filter paper. High concentrations of suspended solids may reduce water clarity, decrease photosynthesis, and increase water temperature. Many dissolved solids bind with toxic compounds and heavy metals, which accumulate in bottom sediments over time.

## Types of Water Quality Characteristics That Are Measured (Cont'd)

### *Chemical Characteristics*

<p><b>pH</b></p>	<p>The pH value of water is a measure of how acidic or basic the water is, measured on a scale from 0-14 (0-7 is acidic; 7 is neutral; and 7-14 is basic). Most aquatic organisms thrive in water within the range of 5.5 to 8.0. For every one unit of change in the scale, there is a ten-fold increase in acidity.</p> <p>Acidity is harmful to immature stages of aquatic insects and immature fish can cause heavy metals, such as copper and aluminum, to dissolve out of the rocks and soil into the water. In the Grand Traverse Region, limestone acts as a buffer and neutralizes some of the effects of acidity in the water.</p>
<p><b>Dissolved Oxygen</b></p>	<p>The amount of dissolved oxygen (DO) in the water also determines which plants and animals can survive. For example, pike and trout require medium to high levels of dissolved oxygen to live. Carp and catfish flourish in waters of low dissolved oxygen. Waters with consistently high levels of dissolved oxygen are usually considered healthy and stable aquatic ecosystems and can support many different kinds of aquatic organisms. The amount of dissolved oxygen in water is determined through the use of the percent saturation value. A 90% or above DO saturation value is considered healthy.</p> <p>Much of the dissolved oxygen in water comes from the atmosphere. And photosynthesis by algae and aquatic plants. Cold water can hold more oxygen than warm water. DO levels also change with the seasons as the lake water 'turns over'. Organic wastes decaying in the water reduce the amount of DO available to aquatic organisms.</p>
<p><b>Conductivity</b></p>	<p>The ability of water to conduct electricity is termed conductivity. The level of conductivity is directly related to the concentration of dissolved substances in the water, but it does not measure the specific substances. Separate tests must be done to determine the amount of dissolved substances such as calcium, nitrogen, phosphorus, iron, sulfur, bicarbonate and other ions found in water.</p> <p>A <u>constant</u> level of these materials is essential for the maintenance of aquatic life. Many of these dissolved ions are the building blocks of molecules necessary for life processes in plants and animals. However, too much of these dissolved substances may upset the balance of the ecosystem.</p>
<p><b>Nutrients</b></p>	<p>Nutrients are elements such as nitrogen, phosphorus, carbon, sulfur, calcium, potassium, and iron that are essential to the growth of living things. In particular, nitrogen and phosphorus are critical nutrients for all types of plants, including aquatic species. Elevated quantities of either of these nutrients can upset the balance in an aquatic ecosystem. Generally, in terms of water quality, nutrients have a negative impact on the system when their concentrations exceed natural background levels. For more information on nutrients see the <i>Nutrients Fact Sheet</i>.</p>

## Types of Water Quality Characteristics That Are Measured (Cont'd)

### *Biological Characteristics*

<p><b>Fecal Coliform</b></p>	<p>Fecal coliform bacteria are found in the feces of humans and other warm-blooded animals. These bacteria can enter water through direct discharge from animals, agricultural runoff, and leaking septic systems.</p> <p>Fecal coliform bacteria by themselves do not cause illness or disease; if fecal coliform counts are high, then there is a greater probability that disease causing organisms are present. There are different water quality standards for fecal coliform levels in water used for drinking, swimming, boating and sewage effluent.</p> <p>For more information on Fecal coliform and other public health issues see the <i>Public Health and Wastewater Fact Sheet</i>.</p>
<p><b>Chlorophyll-a</b></p>	<p>Chlorophyll-a is a pigment found in all green plants, especially algae. Measuring the amount of this pigment provides a measure of the amount of microscopic plants in the water. If nutrient levels are high, then more plants will grow. If a lot of plants are growing, then the clarity of the water is decreasing.</p>
<p><b>Benthic Macroinvertebrates</b></p>	<p>The term “benthic” means bottom dwelling and refers to organisms that live in, crawl upon, or attach themselves to the bottom of a lake or stream. The term, “macroinvertebrate” refers to invertebrates that we can see with the naked eye. Most benthic macroinvertebrates are aquatic insects such as stonefly and mayfly nymphs, caddisfly larvae, and midge larvae. They are important organisms to study for several reasons:</p> <ul style="list-style-type: none"> <li>• Many are sensitive to pollution</li> <li>• They are easily collected</li> <li>• Many live in the water over a year</li> <li>• They provide food for many higher organisms such as fish</li> </ul> <p>Benthic macroinvertebrates are gathered using aquatic nets and sampling a variety of habitats in a stream or lake.</p>

### **Water Quality Standards Information:**

- Criteria for Federal Water Quality Standards: [www.epa.gov/waterscience/criteria](http://www.epa.gov/waterscience/criteria).
- Federal Water Quality Standards: [www.epa.gov/waterscience/standards](http://www.epa.gov/waterscience/standards)
- Federal Drinking Water Standards: [www.epa.gov/safewater/mcl.html](http://www.epa.gov/safewater/mcl.html)
- State Water Quality Standards: [www.michigan.gov/deq](http://www.michigan.gov/deq)