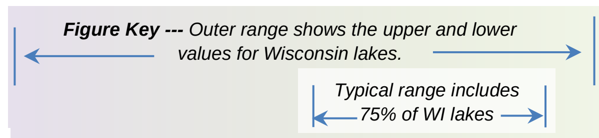
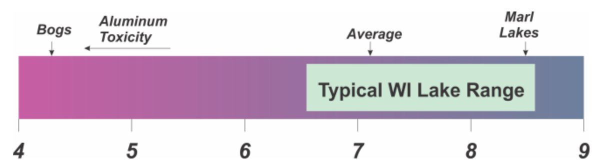
Interpreting Your Wisconsin Lake Chemistry

Lake Chemistry is used to understand the importance of geology and water sources, likely summer algal growth, and the impact of land management. We encourage you to explore these in more detail using the UW-Extension publication ***Understanding Lake Data*** and the **references listed on our website**. **Sample Type** can be important to interpreting the results. **Lake Overturn Samples** are collected in the spring or fall when the lake water temperature is uniform from top to bottom. The lake is likely well mixed and the results are the average concentrations in the lake. **Growing Season Samples** are collected from the surface of a lake during the summer. They may show how the settling or release of phosphorus from the sediment or storms can influence algal growth.

Major Chemistry — Geology / Landuse / Lake Type

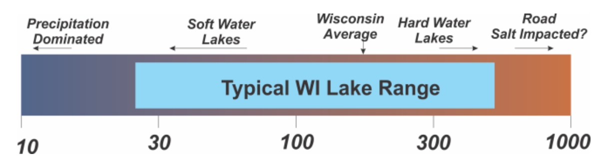


The pH of the lake is an important control over the solubility and toxicity of other compounds. It is controlled by the source of water and biological activity in the lake. A pH of 7 is often called "neutral," above 7 is basic ("alkaline"), and below 7 is acidic. Higher pH is found where carbonate minerals are in the watershed. Lower pH is found in watersheds with granitic bedrock. Both very low and very high pH can be a problem. At very low pH, the metals that can be toxic to fish are more soluble and the formation of shells can be reduced. With increasing pH, ammonia is more toxic and phosphorus can be released from the sediment.

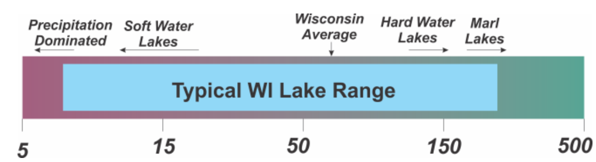


While most Wisconsin lakes are resistant to pH reductions from acid rain or small amounts of acids (see alkalinity below), some soft water lakes are vulnerable to decreasing pH. Higher pH can occur during the day when photosynthesizing algae are removing carbon dioxide from the water. In very eutrophic lakes, this can lead to pH near 9.

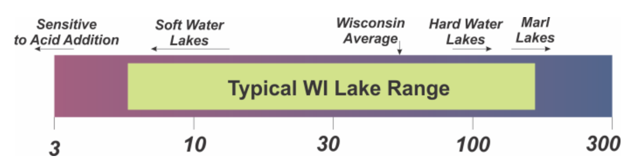
Specific Conductance (μmho or μS/cm) is how well the water conducts electricity. Also called "conductivity," It reflects the concentration of dissolved minerals (ions) in the water and generally is controlled by the type of geology near the lake. For example, precipitation dominated lakes are on the low end for this measurement because rain has little dissolved minerals. When the watershed contains easily dissolved carbonate rocks such as limestone and dolomite, lakes have higher conductivity. Watershed with slow-to-dissolve rocks such as granite, have lakes with lower specific conductance. In Wisconsin, very high conductivity (> 1000) or conductivity that is much more than double the hardness usually indicates more saline waters or contamination from deicing or other salts.



Total Hardness (mg/l as $CaCO_3$) is affected by the minerals in the watershed soil and bedrock, and by how much the lake water contacts them. High levels of hardness and alkalinity can cause marl (calcium carbonate or $CaCO_3$) to precipitate out of the water. Hard water lakes tend to produce more fish and aquatic plants than soft water lakes. Soft water lakes are found in areas with granitic bedrock or where lake water has had little contact with soils and bedrock.

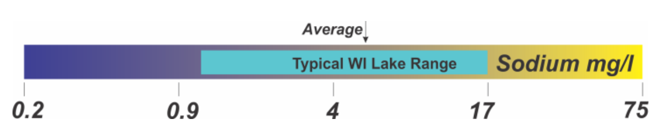


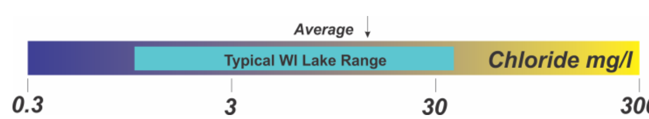
Alkalinity (mg/l as $CaCO_3$) is a measure of how resistant the lake is to pH change. Higher alkalinity lakes are more resistant to change. Lower alkalinity lakes can be sensitive to acid addition. Alkalinity in Wisconsin lakes results primarily from the slow dissolution of rocks as water moves through the watershed to the lake. Lakes in areas with more carbonate rock or carbonate containing glacial deposits, such as limestone, dolomite or glacial outwash from those rocks (e.g., eastern or central Wisconsin), tend to have higher alkalinity. Lakes in areas with granitic bedrock (northern Wisconsin) or lakes where the source of water is mostly precipitation (bogs) tend to have lower alkalinity.

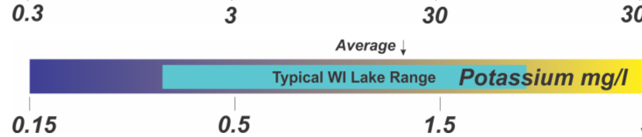


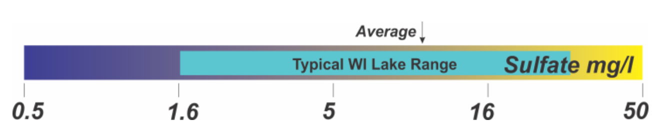
Sodium and Chloride sources include common table salt, water softening salt and deicing road salt. Both are usually found at low concentrations except in lakes with significant road salt use.
Potassium occurs naturally in rocks and vegetation. Higher concentrations may reflect potassium chloride fertilizer, decomposing organic matter and breakdown of animal waste. **Sulfate** is also usually found at low concentrations except in a few areas such as near Lake Winnebago and Lake Michigan where the bedrock can contain naturally high levels. It is also found in soil amendments that contain gypsum.

Increasing concentrations of any of these compounds can point to impacts from the lake's watershed and tracking their concentrations over time can be useful to understanding how the watershed is impacting lake chemistry.



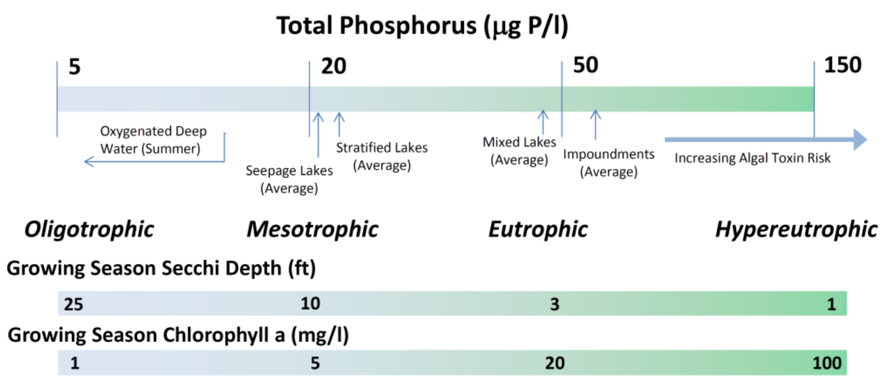


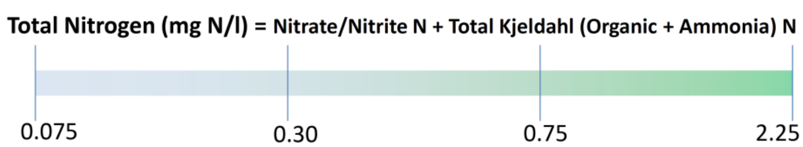




Limiting Nutrients – Important to Lake Biology

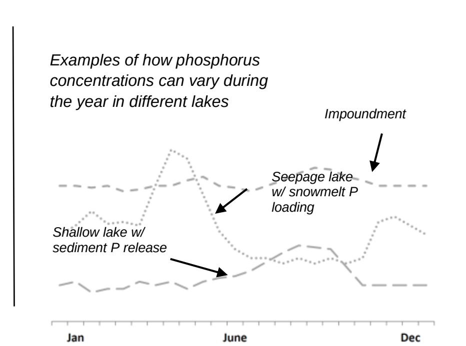
The critical, limiting nutrients **Phosphorus** and **Nitrogen** can determine the amount of biological activity in a lake. In Wisconsin lakes, phosphorus is usually the element in shortest supply. As a result, increases in phosphorus concentration will lead to an increase in algae. Higher levels of algae reduce water clarity, provide food for populations of larger organisms and result in lower oxygen levels when this organic matter ultimately decomposes. Nitrogen is also an essential element for algae and plants, and together with phosphorus can influence the mix of algal and plant species.





Total Phosphorus is often a key driver of biological productivity in a lake. Phosphorus concentrations are shown here with measures of algal concentrations (Secchi depth and Chlorophyll) based on research that relates all of these to a lake's trophic condition. If they are much different than expected, other factors may also be influencing lake biology.

Lake total phosphorus concentrations can vary over time—from year-to-year and within years. In deep lakes, the overturn sample can provide often project summer conditions. Shallow that do not stratify in the spring often have higher phosphorus concentrations during the summer. The Figure below shows examples of how phosphorus concentration varies during the year.

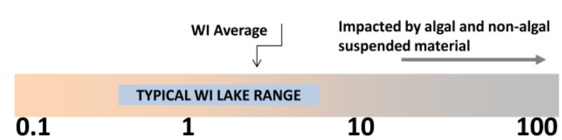


Total Nitrogen concentrations are shown here corresponding to an **N/P** ratio of 15 in a typical Wisconsin lake. If the nitrogen concentrations are very low relative to the phosphorus, nitrogen may be a more important contributor to lake productivity. Total nitrogen is composed of different forms of nitrogen including **Nitrate, Ammonia and Organic Nitrogen**. Their concentrations reflect the sources of water, water residence time, and time of the year.

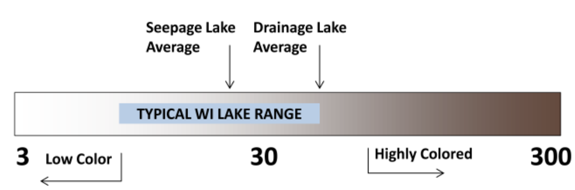
Water Clarity— Turbidity and Color

An important water quality measure to lake observers is the water clarity or the ability of light to pass through the water. Low water clarity can be attributed to algal particles (*algal turbidity*), sediment such as silt and clay (*non-algal turbidity*) or the color of dissolved substances (*true color*).

Turbidity (Turbidity Units) measures small, suspended particles that lead to a cloudy appearance to the water. These particles can be from both sediment (either washed into the lake or suspended from the bottom) or from algae. The turbidity is measured by the light reflected by the sample and is expressed in turbidity units (NT)..



Color (Standard Units) in lakes can appear blue, green, red, or brown. These colors reflect the light that is not absorbed in the water. For example, algae absorbs red and blue light leading to a green color. Sediments usually make the water appear brown. Water often appears blue or blue-green because the other colors are absorbed by the water or particles. Color or "true color" of the water is measured on a filtered sample to prevent the reflection off of particles. The color is expressed in standard color units (SU). This measurement often reflects the amount of dissolved organic matter in the water. Highly colored waters are often those with substantial wetlands draining to the lake



This is a publication of the Water & Environmental Analysis Laboratory at the University of Wisconsin- Stevens Point.
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