Lake Testing Explanation

Background information

In order to get a true picture of lake water quality, it is important to take numerous measurements in a year and continue this practice over many years. Water quality can vary seasonally as well as year to year depending on temperature, rainfall and adjacent land use practices. Secchi depth, phosphorus and chlorophyll-a measurements are very good assessments of water quality, and are fairly easy to implement.

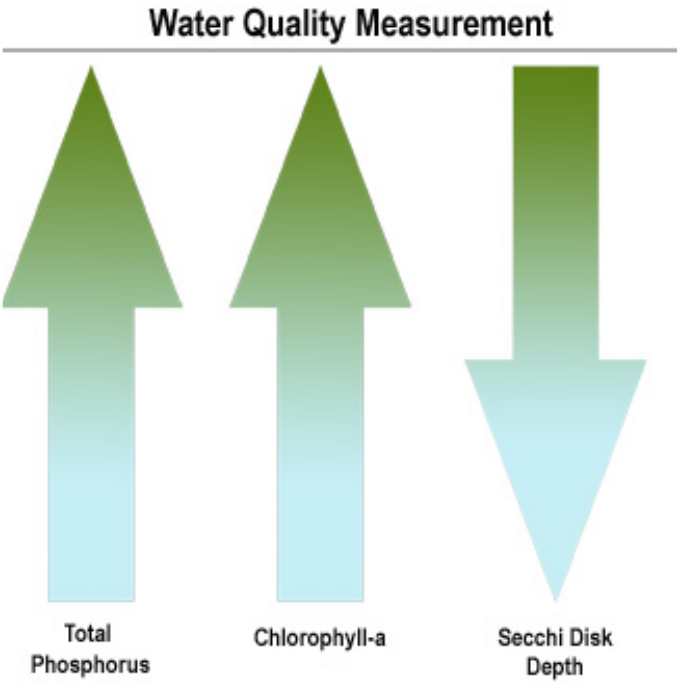
What the tests mean

Overall lake water quality can be summarized well by three measurements, total phosphorus, chlorophyll-a and water transparency (Secchi depth).

Generally, the more phosphorus there is in the lake the lower the water quality for recreation. Phosphorus is food for plants and algae, so the more phosphorus there is in the lake, the more plants and algae can grow. Phosphorus can enter the lake through runoff from agriculture, fertilized lawns, erosion, manure, improperly maintained septic systems, leaf and yard litter, and many other sources.

Chlorophyll-a is the pigment that makes plants and algae green. Chlorophyll-a is measured in lakes to determine how much algae is living there. A high measurement of chlorophyll-a means that there is a large amount of algae in the lake.

Water transparency is how deep sunlight penetrates through the water. Transparency depends on the amount of particles in the water. These particles can be algae or sediment from erosion, the more particles - the less water transparency. In other words, when the water is murky or cloudy, the light cannot penetrate as deeply into the water column. Water transparency is measured with a Secchi disk. Secchi depth can vary throughout the summer, and it is important to get readings at least every other week, if not every week. After large storms and above average rainfall events, the water clarity can temporarily decline due to all the particles that wash into the lake.



These three water quality measurements are related. Total phosphorus is a "cause" parameter, while chlorophyll-a and Secchi depth are "effect" parameters. When phosphorus increases, that means there is more food available for algae, so algae increases. When algae increases, the water becomes less transparent (cloudier) and the Secchi depth decreases.

Trophic State Index Explanation

Phosphorus, Chlorophyll-a (algae concentration) and Secchi depth are related. When phosphorus increases, that means there is more food available for algae, so algal concentrations increase. When algal concentrations increase, the water becomes less transparent and the Secchi depth decreases.

The resulting numbers from these three measurements cover different units and ranges and thus cannot be directly compared to each other or averaged. In order to standardize these three measurements to make them directly comparable, we convert them to a trophic state index using an equation. You can find the equations online at: http://dipin.kent.edu/tsi.htm.

The overall trophic state index (TSI) of a lake is the average of the TSI for phosphorus, the TSI for chlorophyll-a and the TSI for secchi depth; therefore, it can be thought of as the lake condition taking into account phosphorus, chlorophyll-a and secchi depth.

It is important to understand that Trophic States are defined divisions of a continuum in phosphorus and algal concentration. The TSI ranges from 0-100. 0-30 is Oligotrophic, where water is very clear, phosphorus is low, and algae is sparce. 30-50 is an in-between stage where the number of aquatic plants algae increase due to more available phosphorus.

A TSI of over 50 describes a lake that is eutrophic, with a high density of plants and algae that could be unpleasant for swimming at certain times in the summer. Some lakes may be naturally eutrophic, having a TSI of 50 or greater for the last 100 years. Other lakes have gradually increased in TSI as a result of human activities. The Minnesota Pollution Control Agency recommends 8-10 years of quality long term data on a lake for the determination of increasing or decreasing TSI trends.

Trophic State Index is not necessarily interchangeable with water quality. Water quality is subjective and depends on how you intend to use the water body. A lake that is good for duck hunting is not necessarily good for water skiing. In turn, a lake that is great for swimming may not be great for bass fishing.

Explanation of trophic state and a list of possible changes that might be expected in a north temperate lake along the trophic state gradient.

TSI	Chl (ug/L)	SD (ft)	TP (ug/L)	Attributes	Fisheries & Recreation
<30	<0.95	>26.2	<6	**Oligotrophy:** Clear water, oxygen throughout the year at the bottom of the lake, very deep cold water	Trout fisheries dominate
30-40	0.95-2.6	13.1-26.2	6-12	Bottom of shallower lakes may become anoxic (no oxygen)	Trout fisheries in deep lakes only. Walleye, Tullibee present.
40-50	2.6-7.3	6.6-13.1	12-24	**Mesotrophy:** Water moderately clear most of the summer. May be "greener" in late summer.	No oxygen at the bottom of the lake results in loss of trout. Walleye may predominate.
50-60	7.3-20	3.3-6.6	24-48	**Eutrophy:** Algae and aquatic plant problems possible. "Green" water most of the year.	Warm-water fisheries only. Bass may dominate.
60-70	20-56	1.6-3.3	48-96	Blue-green algae dominate, algal scums and aquatic plant problems	Nuisance aquatic plants, algal scums, and low transparency may discourage swimming and boating.
70-80	56-155	0.8-1.6	96-192	**Hypereutrophy:** (light limited productivity). Dense algae and macrophytes	
>80	>155	<0.8	192-384	Algal scums, few aquatic plants	Rough fish (carp) dominate; summer fish kills possible

Source: Carlson, R.E. 1977. A trophic state index for lakes. *Limnology and Oceanography*. 22:361-369.