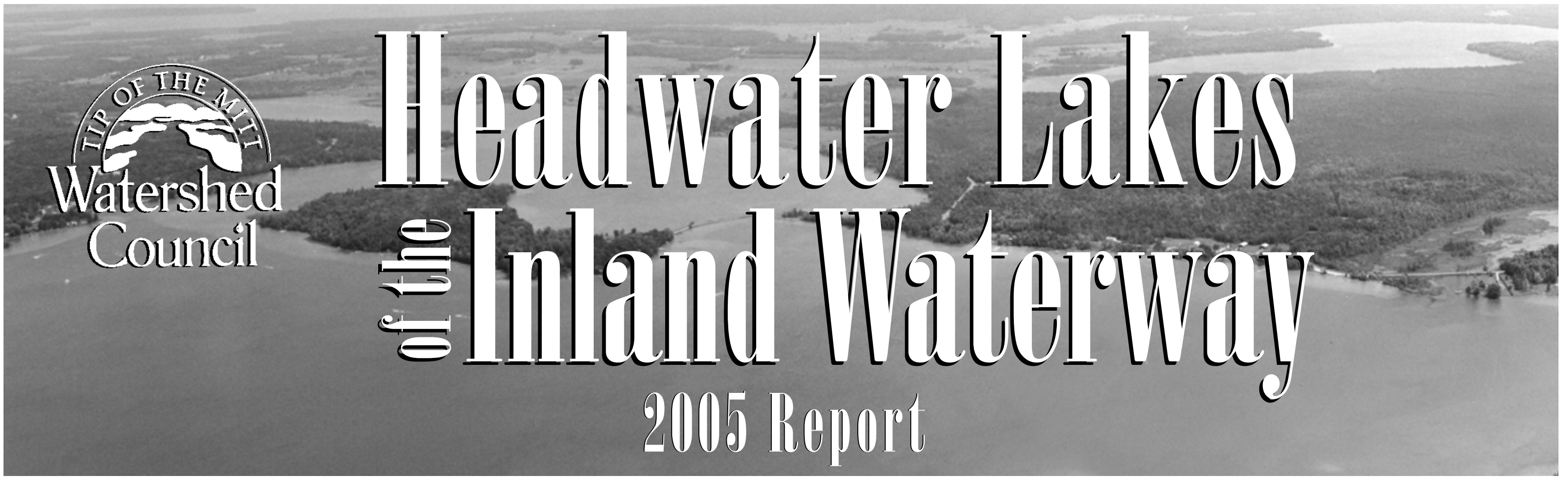
Headwater Lakes of the Inland Waterway
2005 Report

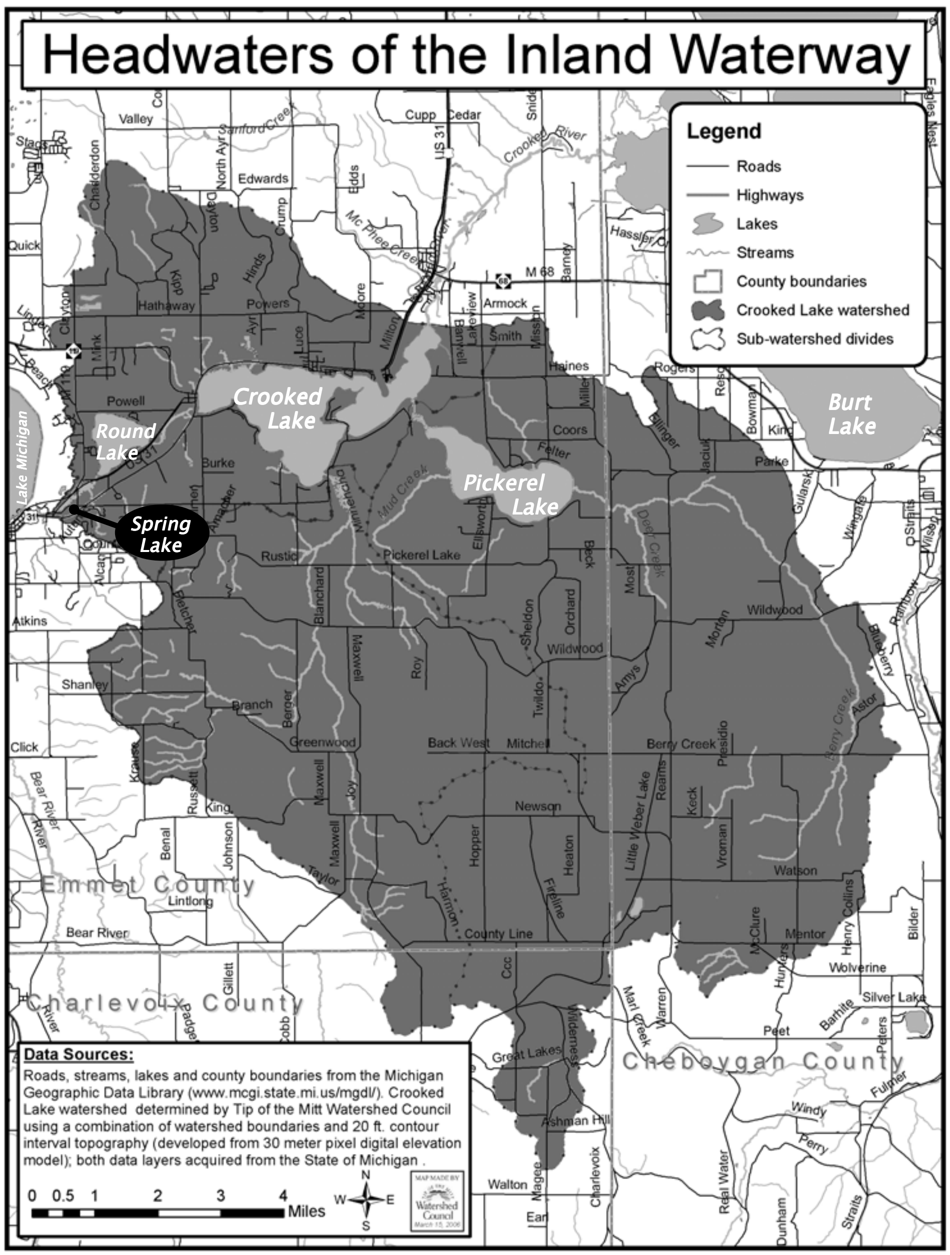


Crooked, Pickerel, Round, and Spring Lakes are at the headwaters of the Inland Waterway, providing abundant clean water that sustains a transportation, recreation, and wildlife corridor that extends across the northern Lower Peninsula. Tip of the Mitt Watershed Council has worked for decades to ensure that it remains a magnificent resource. The information and data contained in this report illustrate the hard work of our staff and volunteers to ensure the high water quality of all Inland Waterway headwater lakes, now and in the future.

You will find in this report data specific for Inland Waterway headwater lakes from two of our cornerstone water quality monitoring programs – Comprehensive Water Quality Monitoring and Volunteer Lake Monitoring. The Comprehensive Water Quality Monitoring program is run by Watershed Council staff who have monitored water quality of Northern Michigan's lakes and streams for the last 17 years. The Volunteer Lake Monitoring program was started in 1984 and relies on dozens of helpful volunteers who collect weekly data on water clarity and algae abundance. These two programs have provided valuable data on the overall health of our waters. Inside are details for the most recent surveys for Crooked, Pickerel, Round, and Spring Lakes.

We hope you enjoy reading about two of our projects on headwater lakes of the Inland Waterway. You'll learn about the Watershed Council's work with shoreline property owners to correct erosion along these four lakes as well as partnership efforts with the Pickerel-Crooked Lakes Association.

We hope you find this report both informative and helpful. If you have any questions, comments, or concerns, please contact the Tip of the Mitt Watershed Council at (231) 347-1181 or visit our website at www.watershedcouncil.org.



Water Quality Trends: 17 years of data

The Comprehensive Water Quality Monitoring (CWQM) program began in 1987 on 10 lakes in the northern Lower Peninsula and has steadily expanded to the present 54 monitoring sites on 47 lakes and rivers. At the headwaters of the Inland Waterway, monitoring is done on Crooked and Pickerel Lakes as well as Round and Spring Lakes (see map on page 1). We now have over 1,300 records in our CWQM database, which are used by Watershed Council staff to characterize lakes and streams, identify specific water quality problems, and view trends or changes in water quality over time. Perhaps the greatest value of the CWQM program is that of an educational and informational tool to generate public interest and promote stewardship of aquatic resources.

By graphing the data collected over the last 17 years, Watershed Council staff have been able to discern a few trends. Total phosphorus concentrations appear to be decreasing on a number of the lakes. Are residents taking more care to prevent phosphorus inputs by reducing or eliminating fertilizers and properly maintaining septic systems? Or could this somehow be linked with the introduction of the invasive zebra mussels to lakes and rivers in our region? Zebra mussels began to appear in the Great Lakes region around 1988, which coincides with the beginning of our monitoring program. While phosphorus levels seem to be decreasing, chloride levels are definitely increasing. Almost all of the lakes monitored for 10+ years show increased chloride concentrations, with a particularly large increase between 2001 and 2004.

Parameters and Results

Every three years, the CWQM program waters are sampled and tested in the spring, as soon after “ice-out” as possible. Testing of physical parameters, including temperature, dissolved oxygen, pH, and conductivity, is done on-site with an electronic instrument called a Hydrolab™. Water samples are collected at the surface, mid-depth, and bottom of the water column with a specialized sample collection device called a Kemmerer bottle. The samples are then sent to a consulting laboratory for analysis of nitrates, total nitrogen, total phosphorous, and chlorides. The following section provides brief descriptions and general findings for parameters that we measure.

pH

pH values provide a measurement of the acidity or alkalinity of water. Measurements above 7 are alkaline, 7 is considered neutral, and levels below 7 are acidic. When pH is outside the range of 5.5 to 8.5, most aquatic organisms become stressed and populations of some species can become depressed or disappear entirely. State law requires that pH be maintained within a range of 6.5 to 9.0 in all waters of the state. Data collected on lakes in the Inland Waterway headwaters has shown that pH levels consistently fall within this range, with a minimum of 7.10 and maximum of 8.48.

Kevin Cronk, our Monitoring and Research Coordinator, uses the Hydrolab to measure water quality.

Dissolved Oxygen

Oxygen is required by almost all organisms, including those that live in the water. Oxygen dissolves into the water from the atmosphere (especially when there is turbulence) and through photosynthesis of aquatic plants and algae. State law requires that a minimum of 5 to 7 parts per million (PPM) be maintained depending on the lake type. Dissolved oxygen levels recorded in headwater lakes of the Inland Waterway have ranged from 3.2 to 13.79 PPM. Levels below 7 PPM have occurred only two times and in deep waters, which is a natural phenomenon in some deep, stratified lakes and thus, still in compliance with state water quality standards.

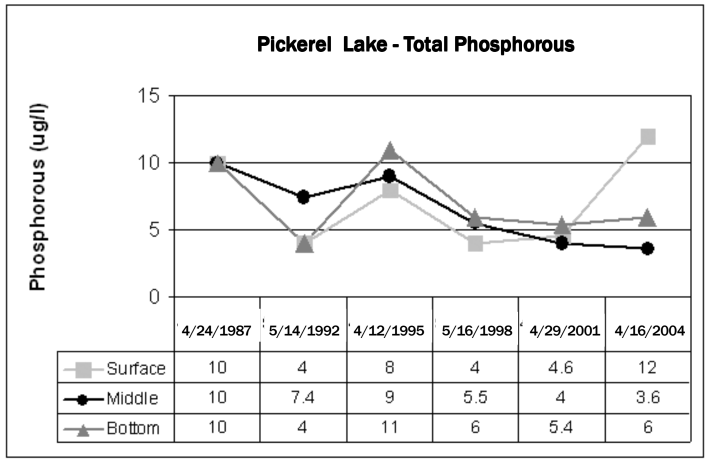
Conductivity

Conductivity is a measure of the ability of water to conduct an electric current, which is dependent upon the concentration of charged particles (ions) dissolved in the water. Readings on lakes monitored by the Watershed Council have ranged from 176 to 656 microSiemens (mS), with an average of 284mS. Conductivity levels in the Inland Waterway headwater lakes have increased steadily in all lakes with the lowest reading of 230mS (Pickerel Lake, 1987) to

the highest of 656mS (Spring Lake, 2004). A steady increase in conductivity levels generally occurs due to greater human activity in the watershed and may indicate that water pollution is occurring. Spring Lake, adjacent to the urban area of Petoskey, is a good example of this, showing levels roughly two times greater than the other lakes.

Chloride

Chloride, a component of salt, is present naturally at low levels in Michigan surface waters due to the marine origin of bedrock in Northern Michigan (typically < 5 PPM). Chloride is a "mobile ion," meaning it is not removed by chemical or biological processes in soil or water. Many products associated with human activities contain chloride (e.g., de-icing salts, water softener salts, and bleach). Although most fish are not affected until chloride concentrations exceed 1,000 PPM, increasing chloride concentrations are indicative of other pollutants associated with human activity (such as automotive fluids from roads or nutrients/bacteria from septic systems) reaching our waterways. Chloride levels have steadily increased in most lakes monitored by the Watershed Council. Within the headwater lakes of the Inland Waterway, chloride levels have ranged from 1 PPM (Crooked Lake, 1987) to 82 PPM (Spring Lake, 2004) and display an interesting, yet expected trend of decreasing concentration moving downstream through the waterway.



Comprehensive Water Quality Monitoring 2004 Data Summary-Dissolved Oxygen and Chloride

Lake	Depth in Water Column	Dissolved Oxygen (mg/l=PPM)	Chloride (mg/l=PPM)
Crooked Lake	Surface	11.86	8.1
	Middle	11.70	7.9
	Bottom	11.72	7.9
Pickerel Lake	Surface	11.18	5.8
	Middle	10.91	5.8
	Bottom	10.49	6.2
Round Lake	Surface	12.14	22.8
	Middle	not available	--
	Bottom	12.25	24.3
Spring Lake	Surface	12.61	82.9
	Middle	not available	--
	Bottom	13.79	82.9

Visit the Watershed Council's website for complete data on all of the lakes monitored through the CWQM Program.
www.watershedcouncil.org

Total Phosphorous

Phosphorous is the most important nutrient for plant productivity in surface waters because it is usually in shortest supply relative to nitrogen and carbon. A water body is considered phosphorous limited if the ratio of nitrogen to phosphorous is greater than 15:1 and, in fact, all lakes monitored by the Watershed Council were found to be phosphorous limited. Although water quality standards have not been set for lakes, the U.S. EPA recommends that total phosphorous concentrations in streams discharging into lakes not exceed 50 parts per billion (PPB). Phosphorous is normally found at concentrations less than 10 PPB in high quality surface waters. In the headwaters of the Inland Waterway, phosphorous levels have ranged from 3.5 PPB (Crooked Lake, 1998) to 30.0 PPB (Crooked Lake, 1987).

Total Nitrogen

Nitrogen is another essential nutrient for plant growth.
It is a very abundant element throughout the earth's surface and is a major component of all plant and animal matter. Although nutrients occur naturally, nutrient pollution is usually the result of human activities (from things such as fertilizer, faulty septic systems, and stormwater runoff). In general, the lowest nutrient levels were found in Lake Michigan and large deep inland lakes, while the highest nutrient levels were found in small shallow lakes. Nitrogen levels on Inland Waterway headwater lakes have ranged from 125 PPB (Pickerel Lake, 1992) to 1,911 PPB (Spring Lake, 2004).

Partnering to Protect Crooked, Pickerel, Round, and Spring Lakes

Keeping the headwater lakes of the Inland Waterway healthy and clean depends on the Tip of the Mitt Watershed Council and the Pickerel-Crooked Lakes Association working together. Whether it's doing water quality monitoring, managing purple loosestrife, educating the public, or commenting on development proposals around the watershed to reduce their impacts, the Pickerel-Crooked Lakes Association's participation has been key to the success of those efforts. With the Watershed Council providing technical assistance and scientific review and the Lake Association providing volunteer time, much has been accomplished on behalf of these important headwaters to the Inland Waterway.

Volunteer Purple Corps

Looks are truly deceiving when it comes to the purple loosestrife plant. Its appearance is beautiful, with tall purple spires, but its presence takes a toll on our wetlands. Due to a lack of predators and diseases, this European plant out-competes native wetland vegetation, easily becoming the dominant plant.

This summer the Watershed Council and Pickerel-Crooked Lakes Association will be conducting a thorough inventory of purple loosestrife in the Pickerel-Crooked Lakes Watershed and developing a strategy to manage this purple plague. The field inventory will use a GPS to record specific locations of purple loosestrife growths. Additional data will be collected about the size of the purple loosestrife beds (e.g., 10 feet by 25 feet); the density (how many other plants are present); proximity to surface water; and other site-specific information. Once the inventory is complete we will produce a map showing the locations and determine the best management methods to use.

Ray McMullen, a resident of Crooked Lake and President of the Pickerel-Crooked Lakes Association, helps to collect Garucella beetles for release to other areas infested with purple loosestrife.

Drop-dead Gorgeous! *Purple loosestrife may be beautiful, but it wreaks havoc whereever it grows. It is so aggressive that it crowds out the native plants that are used by wildlife for food and shelter. Purple loosestrife has almost no wildlife food and shelter value, and so where it invades, valuable wildlife habitat is destroyed. Once established it can destroy wetlands and choke waterways.*

One of the most effective methods for controlling purple loosestrife involves introducing a beetle (*Garucella*) that forages on the plant at different stages during its life cycle. The beetle has been very effective at reducing the growth of purple loosestrife at Spring Lake (near the intersection of M-119 and US 31). The Watershed Council, with volunteer assistance from Bev Osetek, introduced the beetle in the late 1990s to the site. Purple loosestrife was the dominant plant then, but today it occupies only 10% of the wetland adjacent to the lake.

The completed inventory will be used to identify other suitable locations to introduce the beetle. With the help of these little beetles and the Volunteer Purple Corps, we will be able to reduce purple loosestrife dominance and improve the overall health of our wetlands and lake ecosystems.

Restoration Remedies

One day, while enjoying their property on Crooked Lake and reminiscing about the past, Jody and Lewis Hopkins realized their property was changing. “This property has been in our family for more than 80 years. One day, we realized that our shore used to extend much further out, and that we had better do something to prevent future loss,” stated Lewis Hopkins.

In 1995, the Watershed Council installed its first biotechnical erosion control demonstration at the Hopkins’ property on Crooked Lake and two adjoining properties, to restore 180 feet of shoreline. “Although we were unfamiliar with biotechnical erosion control methods, we agreed to participate in a demonstration project using this technique. We are very pleased with the results and appearance of our shoreline, and believe that is has solved our problems,” Hopkins’ added. Since that first project in 1995, the Watershed Council has completed 32 projects on Pickerel and Crooked Lakes alone, and restored a total of 14,000 feet (over 2.5 miles) of shoreline in Northern Michigan.

From phone consultations to comprehensive restoration design, the Watershed Council’s Restoration Remedies program works with shoreline property owners to restore their troubled shorelines and streambanks, enhance their aquatic habitat, and guide their property management. Services available through the program include:

Shoreline and Streambank Erosion Control
Greenbelt Design
Habitat Enhancement
Project Installations
Aquatic Invasive Species Management
Permit Applications
Wetland Delineations

If you would like help with your shoreline property, please contact:

Jennifer Gelb, Restoration Ecologist
(231) 347-1181, ext. 112
jen@watershedcouncil.org

Erosion is a natural process. Accelerated erosion is not. Accelerated erosion occurs most commonly on properties that humans have altered and can have a serious impact on water quality, wildlife habitat, and property value. We applaud the Hopkins and the other shoreline owners on Pickerel, Crooked, and Round Lakes for caring for their shorelines and helping to protect the water quality of their lakes.

If you are concerned about erosion on your shoreline property there are some basic steps to follow to address the problem—1) Assessment of the problem; 2) Prevention of further damage; 3) Restoration, if needed.

Through the Watershed Council’s Restoration Remedies program we offer a fee service for assessment and project design. If you would like to assess the problem on your own, go to our website to look at “Understanding, Living With, and Controlling Shoreline Erosion,” which has detailed information on how to assess your property.

Shorelines are dynamic areas of energy -- restoring accelerated erosion is one thing we can do to minimize our impact and enhance our enjoyment of the shoreline.

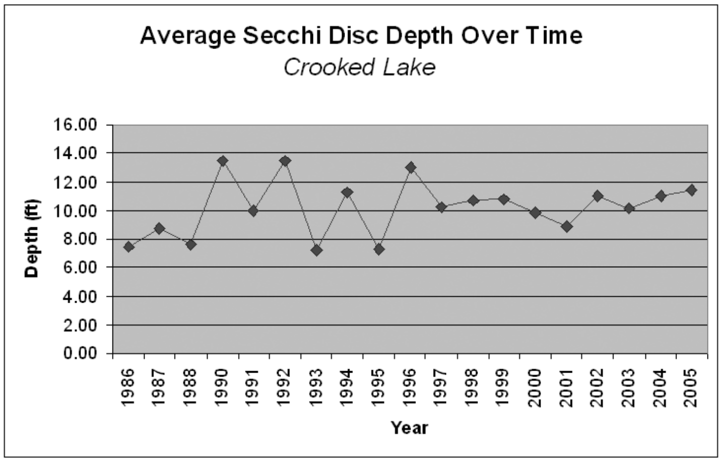
The Hopkins’ Shoreline -- Eight Years Later! *Accelerated erosion along the Hopkins’ property was halted by using biotechnical erosion control methods that included coir bundles and light rock armoring coupled with vegetation plantings. Twenty-two species of trees, shrubs, and herbaceous groundcover were planted in a 12-foot-wide greenbelt that has grown into the beautiful setting pictured above.*

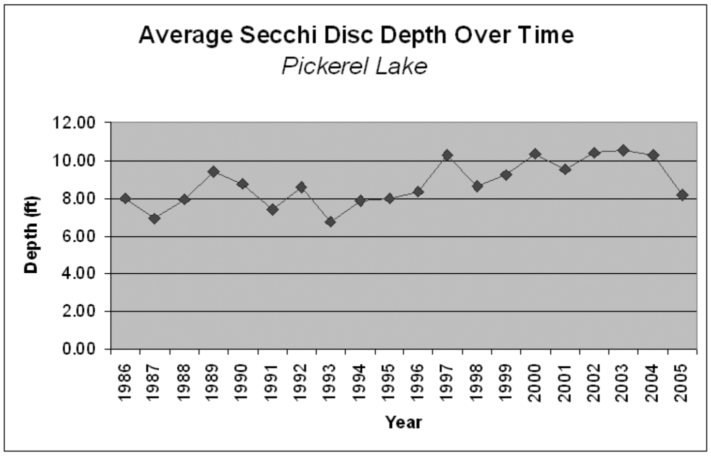
Volunteer Lake Monitoring

Since 1984 the Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM), relying upon dozens of volunteers to monitor the water quality of 35 lakes in the northern Lower Peninsula of Michigan. During the summer of 2005, 45 volunteers monitored water quality at 35 stations on 27 lakes.

A tremendous amount of data has been generated by the VLM program and will be available to the public soon via our web site (www.watershedcouncil.org/volunteerlake.html). This data is essential for discerning short-term changes and long-term trends in the lakes of Northern Michigan. Ultimately, the dedicated effort of volunteers and staff will help improve lake management and protect and enhance the quality of Northern Michigan's waters.

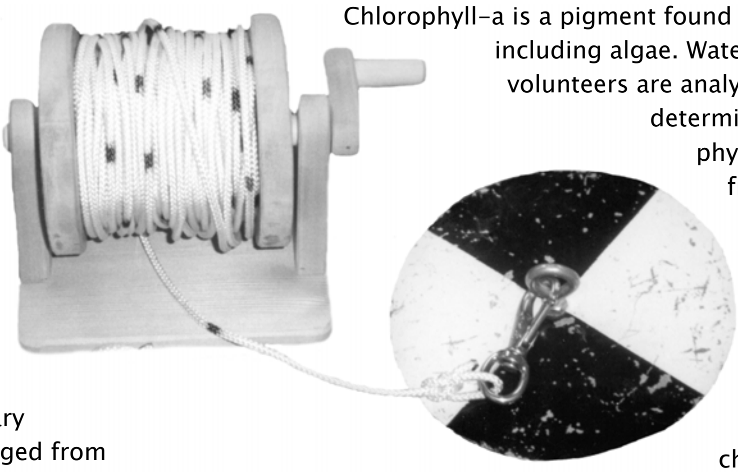
Volunteers have monitored water quality on Crooked and Pickerel Lakes since 1986 and on Round Lake since 1995 (Spring Lake is not monitored). Volunteers measure water clarity on a weekly basis using a Secchi disc. Every other week volunteers collect water samples to be analyzed for chlorophyll-a. Staff at the Watershed Council process the data and determine Trophic Status Index (TSI) scores to classify the lakes and make comparisons. The following section contains detailed explanations and charts showing data from Crooked and Pickerel Lakes as well as others.





Secchi Disc

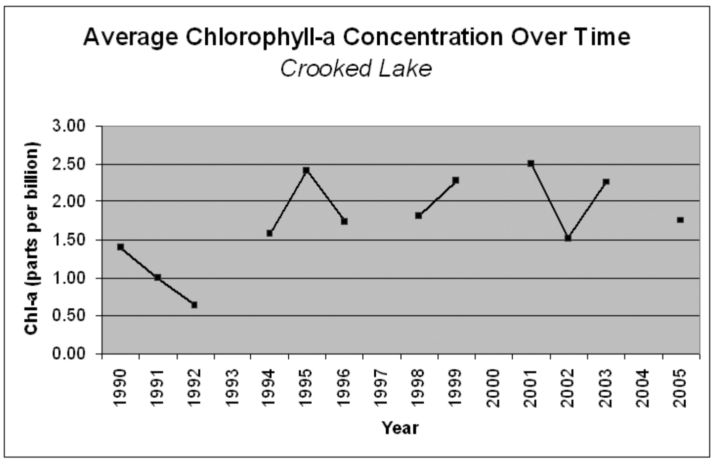
The Secchi disc is a weighted disc (eight inches in diameter, painted black and white in alternating quarters) that is used to measure water clarity. The disc is dropped down through the water column and the depth at which it disappears is noted. Using Secchi disc measurements, we are able to determine the relative clarity of water, which is principally determined by the concentration of algae and/or sediment in the water. The clarity of water is a simple and valuable way to assess water quality. Lakes and rivers that are very clear usually contain lower levels of nutrients and sediments and, in most cases, boast high quality waters. Throughout the summer, different algae bloom at different times, causing clarity to vary greatly. Secchi disc depths have ranged from just a few feet in small inland lakes to 40-50 feet in large inland lakes and Great Lakes' bays.

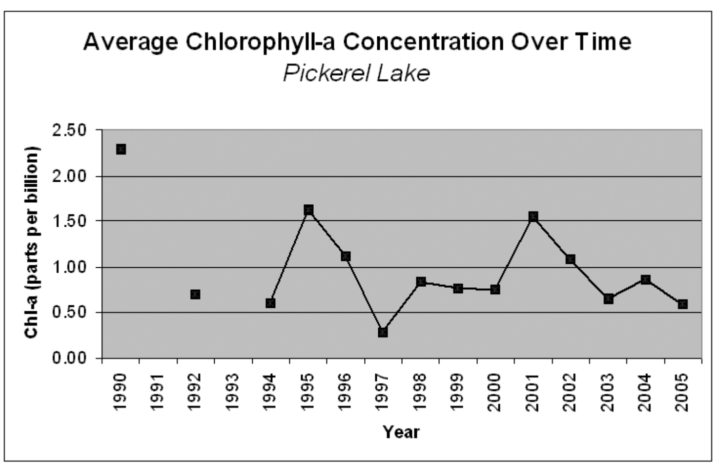


Chlorophyll-a

Chlorophyll-a is a pigment found in all green plants, including algae. Water samples collected by volunteers are analyzed for chlorophyll-a to determine the amount of phytoplankton (minute free-floating algae) in the water column. There is a strong relationship between chlorophyll-a concentrations and Secchi disc depth. Greater amounts of chlorophyll-a indicate

greater phytoplankton densities, which reduces water clarity and thus, the Secchi disc depth as well. So why collect chlorophyll-a data? The chlorophyll-a data provides support for Secchi disc depth data used to determine the productivity of the lake, but it can also help differentiate between turbidity caused by algal blooms versus turbidity caused by other factors such as sedimentation or marl.

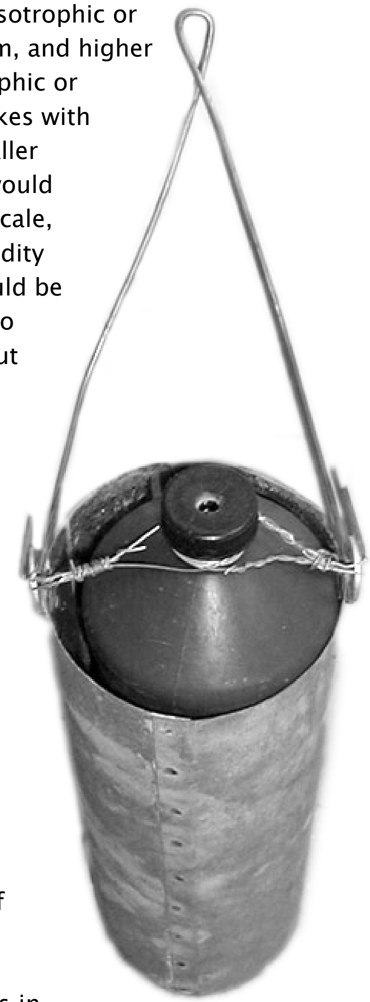




Trophic Status Index

Trophic Status Index (TSI) is a tool developed by Bob Carlson, Ph.D. from Kent State University to determine the biological productivity of a lake. Formulas developed to calculate the TSI value utilize Secchi disc depth and chlorophyll-a measurements collected by our volunteers. TSI values range from 0 to 100. Lower values (0-38) indicate an oligotrophic or low productive system, medium values (39-49) indicate a mesotrophic or moderately productive system, and higher values (50+) indicate a eutrophic or highly productive system. Lakes with greater water clarity and smaller phytoplankton populations would score on the low end of the scale, while lakes with greater turbidity and more phytoplankton would be on the high end. TSI values do not measure water quality, but simply place the lake on a scale of biological productivity. Lakes may be placed in the eutrophic category as a result of algal blooms, which are often a public concern and can be indicative of water pollution problems. On the other hand, low productivity of oligotrophic lakes may result in a lackluster fishery when compared to highly productive eutrophic lakes.

TSI values from 2005 data of 37 on Crooked Lake, 28 on Pickerel Lake, and 34 on Round Lake place these lakes in the oligotrophic category (see chart on the next page). Oligotrophic lakes are characteristically deep, clear, nutrient poor, and with abundant oxygen, whereas eutrophic lakes are shallow, nutrient rich and full of productivity, which when excessive can lead to



Tools of the Trade
Volunteer Lake Monitors use a Secchi disc (page 7, bottom) to measure water clarity and an integrated sampling device (above) to collect water to measure Chlorophyll-a.

Special thanks to our 2005 Volunteer Monitors

Crooked Lake: Dr. G. Michael Pierce
Pickerel Lake: James McKinnon
Round Lake: Lori White

TSI Values *continued*

oxygen depletion. In the 2005 field season none of the lakes surveyed by volunteer lake monitors were classified as eutrophic.

This report would not be possible without the dedicated help of the volunteer lake monitors, so we would like to sincerely thank all who have participated in this program.

Trophic Status Index (TSI) Values for Lakes Monitored in 2005*

Lake	TSI	Lake	TSI	Lake	TSI
Bass Lake	38	Lake Charlevoix, South Arm	33	Silver Lake	28
Black Lake	29	Lake Marion	21	Six Mile Lake	43
Burt Lake, Central Basin	33	Lake Michigan, Bay Harbor	12	Thumb Lake	31
Burt Lake, South	31	Lake Michigan, Little Traverse Bay	24	Twin Lakes	38
Clear Lake	23	Lake Skegemog	35	Walloon Lake, Foot Basin	38
Crooked Lake	37	Mullett Lake, Center	28	Walloon Lake, North	40
Douglas Lake-Cheboygan	38	Mullett Lake, Pigeon Bay	31	Walloon Lake, West Arm	33
Douglas Lake-Otsego	38	Paradise Lake	35	Walloon Lake, Wildwood	34
Elk Lake	28	Pickerel Lake	28	Wilson	40
Lake Charlevoix, Main	23	Round Lake	34		

* *TSI value not available for all lakes monitored due to lack of data needed to calculate the TSI value.*

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