Walloon Lake Profile

2008 Report

What attracts people to Northern Michigan? In general, people come north to enjoy the natural beauty of the area's pristine ecosystems, but if asked for one specific landscape feature, most would undoubtedly say that "lakes" draw them in. Lakes define the landscape of Northern Michigan and sustain local economies, providing stunning views, abundant fisheries, and tremendous recreational opportunities.

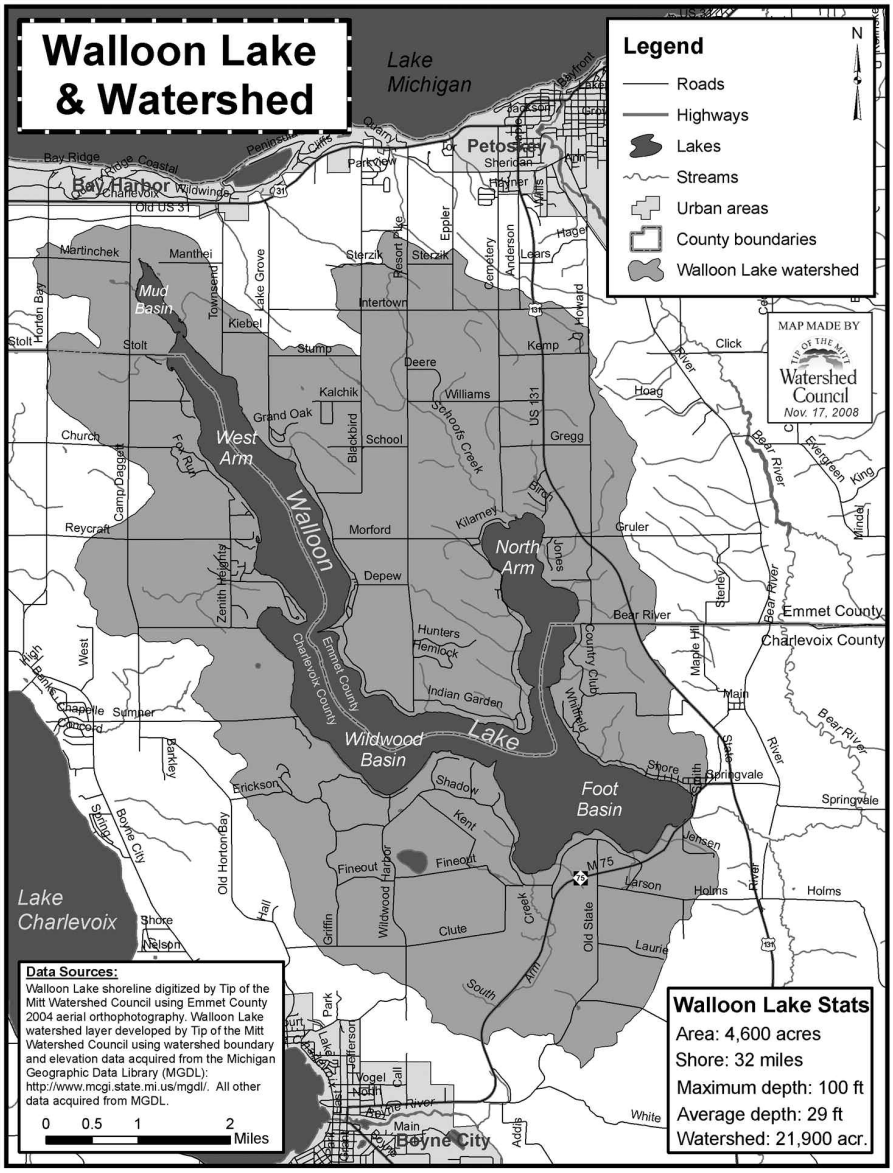
In the Watershed Council service area there are nearly 60 lakes greater than 100 acres in size, and 14 of these are among the State's largest with over 1,000 acres of lake-surface area. The region also boasts some of the State's deepest lakes with five lakes having maximum depths of 100 feet or more. Walloon Lake, on the border of Emmet and Charlevoix Counties, stands among these lake “giants” with 4,600 acres of surface area and a maximum depth of 100 feet!

Over the last few decades, the Watershed Council has put forth great effort to preserve Walloon Lake and ensure it remains a high quality resource for the enjoyment of future generations. Water quality of the region’s lakes, both large and small, has been monitored by staff and volunteers alike, providing valuable data on the overall health of our waters. Our cornerstone water quality monitoring programs include 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 20 years. The Volunteer Lake Monitoring program was started in 1984 and has relied on hundreds of dedicated volunteers who monitor water clarity, algae abundance, phosphorus levels and more.

In addition to monitoring, the Watershed Council has worked with lake shoreline owners and lake organizations on a variety of projects to protect the lakes scattered throughout Northern Michigan. Projects carried out on these lakes have ranged from comprehensive aquatic plant surveys to shoreline restoration projects. Details about recent monitoring activities and lake projects on Walloon Lake are included in this report.

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



Comprehensive Water Quality Monitoring

Water Quality Trends: 20 years of data

In May of 2007, Tip of the Mitt Watershed Council completed its 20th year of comprehensive monitoring. Starting on just 10 lakes in 1987, the Watershed Council's Comprehensive Water Quality Monitoring Program has expanded to include over 50 lakes and rivers throughout Northern Michigan. An incredible amount of data has been generated from this program and utilized by the Watershed Council, lake and stream associations, local governments and regulatory agencies in an effort to protect and improve the water resources that are so important to the region.

Every three years, Watershed Council staff head into the field as soon as ice is out to monitor lakes and rivers spread across the tip of the mitt. Over 60% of the region's lakes greater than 100 acres in size and all major rivers are included in the program. In each of these water bodies, the Watershed Council collects a variety of data, including parameters such as dissolved oxygen, pH, chloride, phosphorus and nitrogen.

Information gathered in the Comprehensive Water Quality Monitoring Program has proven to be very useful. The data are used by the Watershed Council and others to characterize water bodies, identify specific problems and examine trends over time. One obvious trend found by analyzing data from this program is that chloride (a component of salt) levels have increased significantly in many water bodies during the last 20 years. Why? We need not look any farther than ourselves to find the answer as we use salt in everything from de-icing to cooking.

The following pages contain descriptions of the types of data collected in the program as well as select data from Walloon Lake. We have also included charts to provide a graphic display of trends occurring in the lakes. For additional information about the Comprehensive Water Quality Monitoring Program please visit our web site at www.watershedcouncil.org.

Parameters and Results

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 Walloon Lake has shown that pH levels consistently fall within this range, with a minimum of 7.5 (Foot Basin, 1998) and maximum of 8.4 (Mud Basin, 2001).

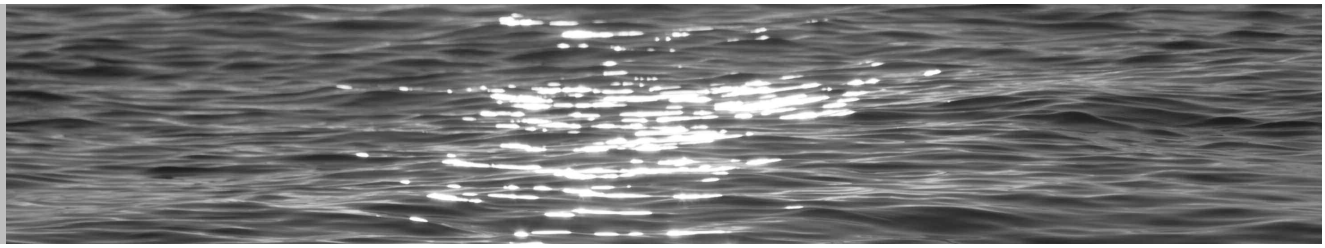
Kevin Cronk, our Monitoring and Research Coordinator, uses the Hydrolab™ to measure water quality.

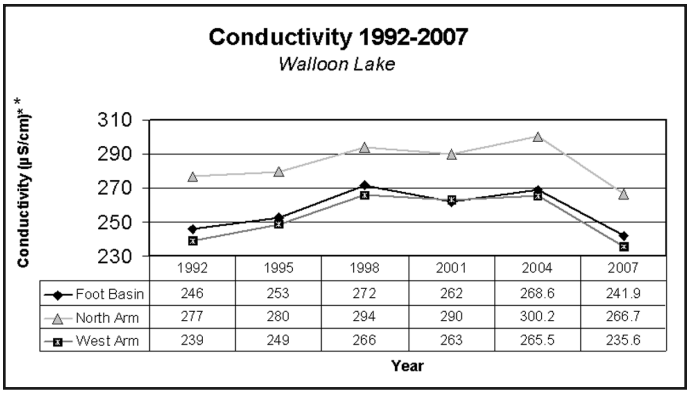
Dissolved Oxygen

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 Walloon Lake have consistently exceeded State minimums, ranging from 7.7 PPM (North Arm, 1998) to 13.2 PPM (West Arm, 2007).

Conductivity

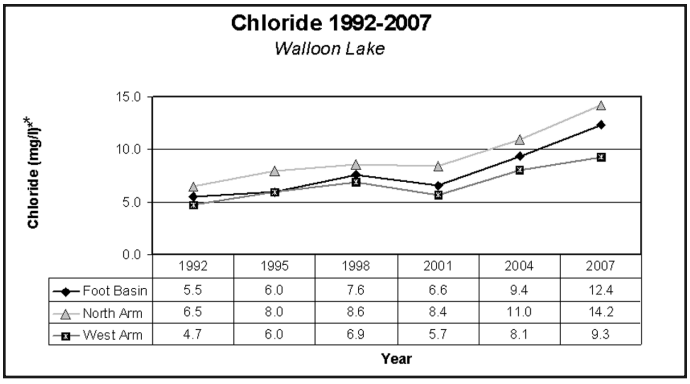
Conductivity is a measure of the ability of water to conduct an electric current, which is dependent upon the concentration of charged particles (ions) dissolved in the water. A steady increase in conductivity levels generally occurs due to greater human activity in the watershed and may indicate that water pollution is occurring. Readings on lakes monitored by the Watershed Council have ranged from 175 to 656 microSiemens (µS). Conductivity levels in Walloon Lake have varied throughout time, rising and falling, with a low of 234 µS (West Arm, 2007) and a high of 311 µS (Mud Basin, 2004).





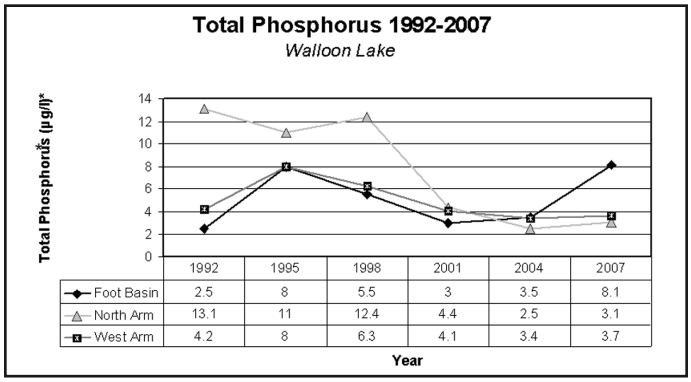
Chloride

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). Chloride concentrations in all basins of Walloon Lake have steadily increased from a low of 4.7 PPM in 1992 (West Arm) to a high of 16.8 PPM in 2004 (Mud Basin). Although most aquatic organisms 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.



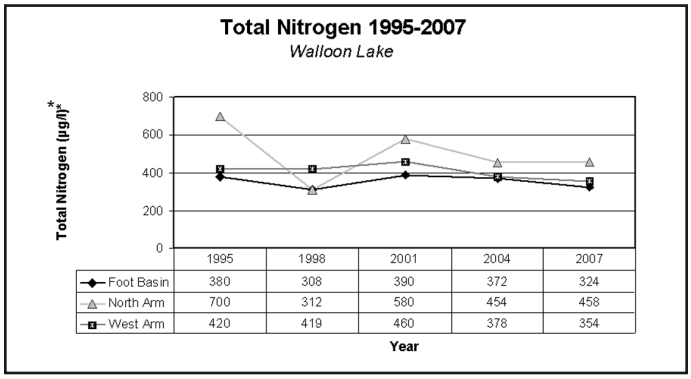
Total Phosphorus

Phosphorus 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 phosphorus limited if the ratio of nitrogen to phosphorus is greater than 15:1. In fact, most lakes monitored by the Watershed Council are found to be phosphorus limited. Although water quality standards have not been set for lakes, the U.S. EPA recommends that total phosphorus concentrations in streams discharging into lakes not exceed 50 parts per billion (PPB). Phosphorus is normally found at concentrations less than 10 PPB in high quality surface waters. In Walloon Lake, total phosphorus levels have ranged from 1.9 PPB (Foot Basin, 2007) to 18.3 PPB (Mud Basin, 2001). Data from the last 15 years show an initial increase in phosphorus in Walloon Lake, followed by a gradual decline.



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. Total nitrogen levels in water bodies monitored by the Watershed Council have ranged from 125 PPB to 1911 PPB, whereas values in Walloon Lake have ranged from 195 PPB (Foot Basin, 1998) to 700 PPB (North Arm, 1995). Nitrogen data from Walloon Lake show no clear trends.



*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

Comprehensive Water Quality Monitoring Program
How Does Walloon Lake Compare?

Water quality data from the surface of all water bodies monitored in 2007

Water Body	Date	Dissolved Oxygen (mg/l)	pH (units)	Specific Conductivity (µS)	Chloride (mg/l)	Nitrate-Nitrogen (µg/l)	Total Nitrogen (µg/l)	Total Phosphorus (µg/l)
Bass Lake	4/19/2007	12.33	8.41	309.6	38.1	17.0	504.0	7.9
Bear River	5/24/2007	8.78	8.26	338.0	12.3	103.5	305.0	8.6
Bellaire Lake	4/19/2007	12.43	8.36	294.9	8.5	428.1	469.0	4.6
Benway Lake	4/16/2007	11.37	8.08	311.7	8.5	419.4	556.0	1.6
Birch Lake	4/19/2007	12.48	8.30	257.0	15.6	42.5	279.0	3.7
Black Lake	5/4/2007	11.74	8.16	262.5	6.0	54.5	269.0	3.5
Black River	4/9/2007	13.14	8.17	260.7	2.9	62.4	250.0	3.1
Boyne River	4/2/2007	10.29	8.32	366.4	6.1	368.2	475.0	3.2
Burt Lake	5/8/2007	11.9	8.29	273.6	10.4	120.3	254.0	3.0
Charlevoix, Main Basin	5/2/2007	13.00	8.19	271.9	10.2	300.0	498.0	2.2
Charlevoix, South Arm	5/2/2007	12.28	8.30	285.3	9.1	570.6	508.0	2.4
Cheboygan River	4/9/2007	14.18	8.34	282.9	6.1	68.4	338.0	4.8
Clam Lake	4/17/2007	12.10	8.24	300.5	8.8	421.4	471.0	2.6
Crooked Lake	4/25/2007	11.62	8.31	275.1	7.8	267.9	404.0	2.8
Crooked River	3/28/2007	11.97	8.36	290.3	8.9	224.8	373.0	4.9
Deer Lake	4/24/2007	11.41	8.32	239.9	6.7	49.1	308.0	2.6
Douglas Lake	4/20/2007	12.24	8.22	194.9	6.8	46.9	455.0	9.4
Elk Lake	4/17/2007	13.24	8.31	249.4	9.3	262.3	338.0	2.9
Elk River	4/2/2007	11.64	8.47	267.1	8.0	245.0	305.0	1.0
Ellsworth Lake	4/16/2007	11.90	8.12	310.3	9.6	349.3	409.0	3.5
Hanley Lake	4/19/2007	11.79	8.26	316.5	9.4	443.7	547.0	3.3
Huffman Lake	4/30/2007	10.43	8.41	277.2	4.7	38.0	179.0	6.9
Huron, Duncan Bay	5/8/2007	12.11	8.27	215.5	8.2	170.5	311.0	3.9
Indian River	5/22/2007	10.13	8.25	284.7	10.4	105.2	316.5	3.9
Intermediate Lake	4/19/2007	12.11	8.33	315.9	11.3	442.6	608.0	3.4
Jordan River	4/2/2007	10.04	8.30	322.0	6.0	981.5	1021.0	5.6
Lancaster Lake	4/20/2007	10.08	8.25	201.1	7.9	53.8	444.0	13.5
Larks Lake	5/3/2007	10.88	8.50	189.6	4.2	66.0	453.0	7.6
Little Sturgeon River	5/21/2007	9.82	8.30	293.3	13.2	57.5	202.0	8.1
Long Lake	5/4/2007	11.40	8.21	191.3	8.9	45.3	346.0	4.4
Maple River	4/9/2007	14.41	8.17	222.3	3.3	270.3	472.0	3.0
Michigan, Bay Harbor	5/30/2007	10.87	8.13	262.2	13.4	279.0	391.0	2.5
Michigan, Grand Traverse Bay	4/17/2007	13.34	8.29	232.6	6.3	257.3	331.0	2.0
Michigan, Little Traverse Bay	5/17/2007	13.40	8.29	228.0	11.6	259.0	397.0	2.5
Mullett Lake	5/8/2007	11.54	8.28	276.2	12.9	73.0	211.0	3.1
Munro Lake	5/8/2007	11.88	8.35	187.8	4.0	79.6	948.0	9.5
Nowland Lake	5/10/2007	10.40	8.49	184.2	6.5	10.2	567.0	8.1
Paradise Lake	4/20/2007	12.58	8.29	180.7	10.9	35.5	569.0	8.3
Pickerel Lake	4/25/2007	11.07	8.31	267.5	6.3	209.1	361.0	2.7
Pigeon River	5/21/2007	9.75	8.37	316.0	6.8	28.0	247.0	7.8
Pine River	4/2/2007	13.54	8.47	277.7	7.7	322.2	418.0	4.6
Rainy River	4/9/2007	13.14	8.09	248.8	4.5	32.7	411.0	8.3
Round Lake (Emmet Cty)	5/1/2007	10.44	8.54	262.9	26.9	16.7	350.0	6.3
Silver Lake (Wolverine)	4/30/2007	11.15	8.30	190.0	4.2	35.2	1203.0	2.8
Six-mile Lake	4/24/2007	11.38	8.21	260.6	6.9	224.9	433.0	4.2
Skegemog Lake	4/17/2007	12.75	8.36	257.7	8.3	300.0	311.0	1.8
Spring Lake	5/1/2007	11.07	8.25	571.5	88.2	857.7	1292.0	7.3
St. Clair Lake	4/16/2007	11.97	8.13	293.6	6.1	283.8	385.0	3.2
Sturgeon River	4/9/2007	14.41	8.26	340.5	12.2	280.5	280.0	2.3
Susan Lake	4/24/2007	10.83	8.28	251.4	9.5	29.1	333.0	3.6
Tannery Creek	3/28/2007	12.22	8.22	428.1	37.1	705.2	902.0	5.7
Thumb Lake	4/30/2007	11.66	8.33	177.8	4.4	37.0	293.0	2.8
Torch Lake	4/17/2007	13.07	8.34	245.9	6.2	364.6	377.0	2.2
Twin Lakes	5/1/2007	11.27	8.40	239.5	2.3	10.3	275.0	7.7
Walloon, Foot	5/7/2007	11.77	8.18	243.6	12.4	91.2	279.0	1.9
Walloon, Mud Basin	5/9/2007	10.92	8.32	277.7	15.2	9.6	424.0	10.2
Walloon, North Arm	5/7/2007	10.91	8.24	267.1	14.2	268.5	458.0	4.1
Walloon, West Arm	5/9/2007	12.27	8.27	238.4	9.3	157.7	385.0	3.0
Walloon, Wildwood Basin	5/7/2007	11.79	8.24	238.8	12.5	82.9	255.0	2.7
Wildwood Lake	4/30/2007	10.13	8.42	247.0	13.2	>1	379.0	6.2
Wilson Lake	4/16/2007	11.75	8.11	317.6	9.7	405.2	595.0	1.9

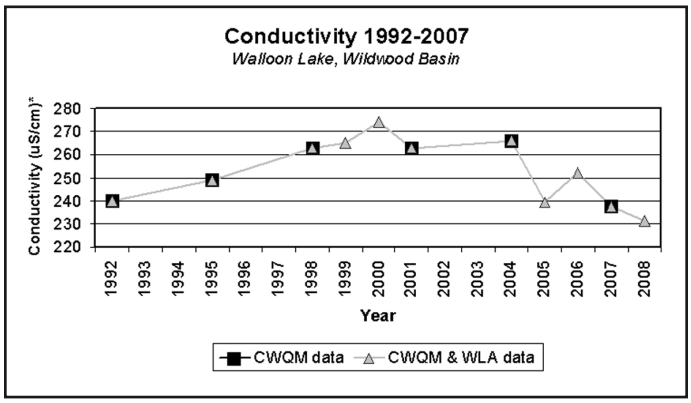
*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

Partnering to Protect *Walloon Lake*

Walloon Lake Association Fills the Gap: Spring Phosphorus Monitoring

Providing a constant supply of volunteer lake monitors and sponsoring shoreline surveys every few years are just a few ways that the Walloon Lake Association (WLA) teams up with Tip of the Mitt Watershed Council to monitor and protect the water quality of Walloon Lake. Beginning in 1996, WLA has contracted with the Watershed Council every year to conduct springtime water quality monitoring of all basins on Walloon Lake. Walloon Lake is monitored as part of the Watershed Council's Comprehensive Water Quality Monitoring Program (CWQM), but monitoring in this program is limited to one monitoring event every three years. By gathering water quality data in off-years, the additional monitoring sponsored by WLA fills data gaps in the Watershed Council's program.

With the additional data we are able to see year-to-year changes, which is particularly important when there is a big change in water quality during the three years between sampling events in the CWQM program. For example, conductivity levels in Walloon Lake rose from 1992 to 1998, leveled off until 2004 and suddenly dropped again in 2007. (See chart.) The large drop from 2004 to 2007 was not expected and initially thought to be an anomaly. Using the additional data gathered as part of the WLA-sponsored springtime monitoring project, we took a closer look and saw that it was not an anomaly at all, but rather a drop that started in 2005 and has continued since then.



WLA has been a regional leader among lake associations, spearheading and sponsoring projects for decades to protect and improve the water quality of Walloon Lake. Although low-cost, the annual springtime monitoring project has produced very valuable data. This data fills gaps that will ultimately improve collaborative efforts between WLA and the Watershed Council to maintain and enhance the water quality of Walloon Lake.

Volunteer Lake Monitoring

Local Volunteers Monitor & Protect Our Lakes

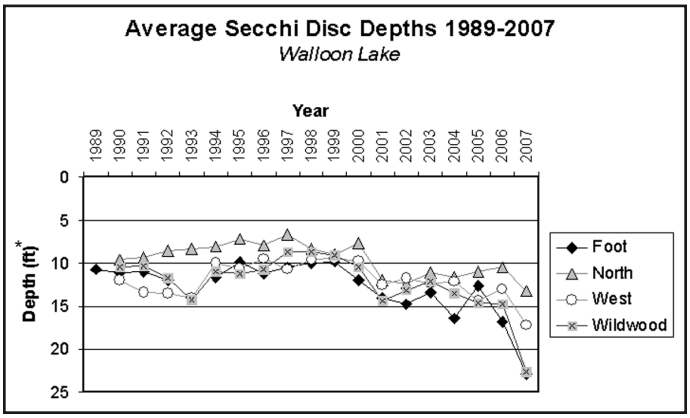
Since 1984, Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM), relying upon hundreds of volunteers to monitor the water quality in dozens of lakes in the northern Lower Peninsula of Michigan. During the summer of 2007, 40 volunteers monitored water quality at 32 stations on 25 lakes.

A tremendous amount of data has been generated by the VLM program and is available to the public via our web site www.watershedcouncil.org. 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 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 summarizes the results.

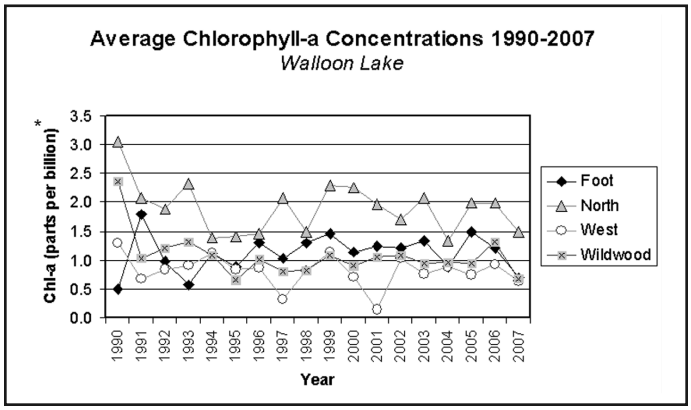
Secchi Disc

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

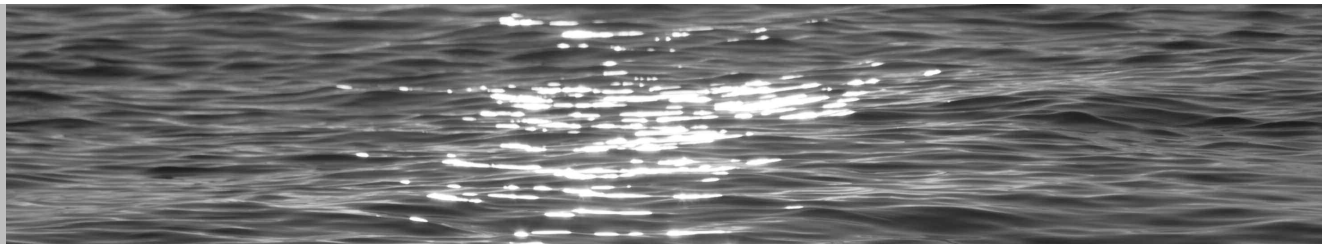
Chlorophyll-a is a pigment found in all green plants, including algae. Water samples collected by volunteers are analyzed for chlorophyll-a to determine the amount of phytoplankton (minute free-floating algae) in the water column. There is a strong relationship between chlorophyll-a concentrations and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

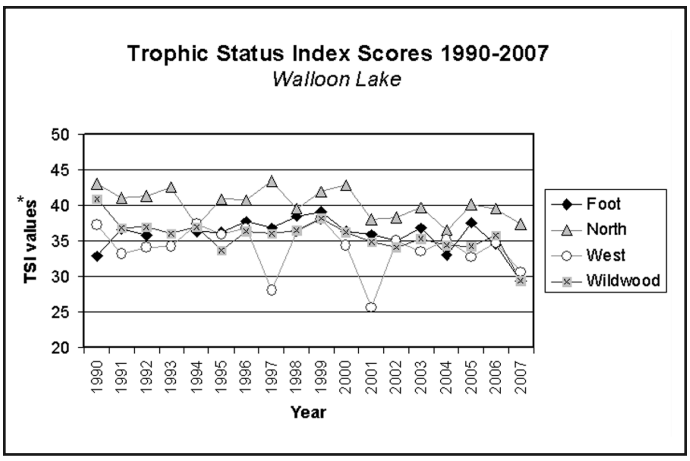


Trophic Status Index

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 population would score on the low end of the scale, while

*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

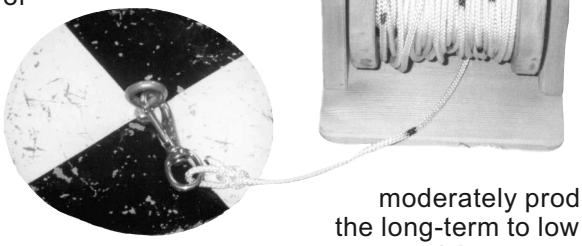




lakes with greater turbidity and more phytoplankton would be on the high end.

TSI values do not measure water quality, but simply place the lake on a scale of biological productivity. Oligotrophic lakes are characteristically deep, clear, nutrient poor, and with abundant oxygen. On the other end of the spectrum, eutrophic lakes are shallow, nutrient rich and full of productivity, which when excessive can lead to oxygen depletion. Mesotrophic lakes lie somewhere in between and are moderately productive. 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.

(2007 TSI Values for all lakes on back page.)



Results from Walloon Lake

Volunteers have monitored water quality on the four major basins of Walloon Lake for nearly 20 years. All four basins on Walloon Lake have fairly consistent data going back to 1990 for both Secchi disc depth and chlorophyll-a concentrations. These long-term Secchi disc and chlorophyll-a data allow Watershed Council staff to characterize water bodies, assess water quality, and examine changes over time.

Averaged yearly Secchi disc depths in Walloon Lake decreased somewhat through the 1990s, but have increased to some extent since 2000. At the same time, averaged yearly chlorophyll-a concentrations decreased in the first few years and have since gone up and down with no clear pattern. In many lakes monitored by volunteers that have zebra mussels in them, Secchi disc depths have increased dramatically and chlorophyll-a concentrations have dropped sharply. Although changes in Walloon Lake have not been dramatic, there is some evidence that the lake is becoming less productive since zebra mussels were introduced.

The non-native zebra mussel is a voracious filter-feeder that feeds upon algae and essentially cleans the water column. Unfortunately, zebra mussels are not cleaning the water, but rather removing the algae that are the base of the food chain and thus, causing ecosystem disruptions. Their feeding habits make them a very likely culprit for the changes we are seeing in the lakes. If quagga mussels (another invasive in the Great Lakes) get into Walloon Lake, the ecosystem would be more heavily impacted as quaggas cluster more densely and live at greater depths than zebra mussels.

Except for the North Arm, Trophic Status Index (TSI) scores for Walloon Lake basins have almost uniformly placed it in the oligotrophic (low productivity) category. TSI scores for the North Arm were usually in the mesotrophic range (moderately productive lake) until 2000 when scores dropped into the oligotrophic category and has remained ever since. Since 2000, TSI scores for the other basins have steadily dropped as well, with a particularly steep drop in 2007. The decreasing TSI scores are most likely related to zebra mussel impacts. It does appear that North Arm, a once moderately productive basin, may have changed for the long-term to low productive: clear, nutrient-poor, but oxygen-rich.

Overall, data show that Walloon Lake has exceptionally high quality waters. Without dedicated volunteers, we would have less data, so we would like to send out a big “thank you” to all those that have helped with the program. We would also like to encourage others to become involved with our volunteer program to help us monitor and protect the hidden treasures of northern Michigan. We are fortunate to have volunteers monitoring at four locations on Walloon Lake, but there is always a need for alternates and replacements.

If you would like to get involved, please contact the program coordinator, Kevin Cronk, at ext. 109 or at kevin@watershedcouncil.org.

*Unit descriptions: mg/l = parts per million, µg/l = parts per billion, µS = microSiemens per centimeter

Trophic Status Index (TSI) Values for Lakes Monitored in 2007

Lake	TSI*	Lake	TSI*	Lake	TSI*
Bass Lake	39	Huffman Lake	34	Six Mile Lake	46
Black Lake	30	Lake Marion	29	Thumb Lake	34
Burt Lake, Central Basin	33	Lake Michigan, Bay Harbor	22	Twin Lake	36
Burt Lake, North	29	Lake Skegemog	37	Walloon Lake, Foot Basin	29
Burt Lake, South	34	Long Lake, Cheboygan County	30	Walloon Lake, North	37
Douglas Lake - Cheboygan	38	Mullett Lake, Center	29	Walloon Lake, West Arm	31
Douglas Lake - Otsego	40	Mullet Lake, Pigeon Bay	33	Walloon Lake, Wildwood	29
Elk Lake	26	Munro Lake	44		
Lake Charlevoix, Main	25	Paradise Lake	40		
Lake Charlevoix, South Arm	30	Pickerel Lake	34		

* 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.

Watershed Council
TIP OF THE MITT
426 Bay Street
Petoskey, MI 49770

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