Tip of the Mitt Watershed Council

2010 Report

Elk River Chain of Lakes

Bellaire Lake • Ben-way Lake • Clam Lake • Elk Lake • Elk River • Ellsworth Lake • Hanley Lake Intermediate Lake • Sixmile Lake • Skegemog Lake • St. Claire Lake • Torch Lake • Wilson Lake

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 our "lakes". Lakes define the landscape of Northern Michigan and sustain local economies, providing stunning views, abundant fisheries, and tremendous recreational opportunities.

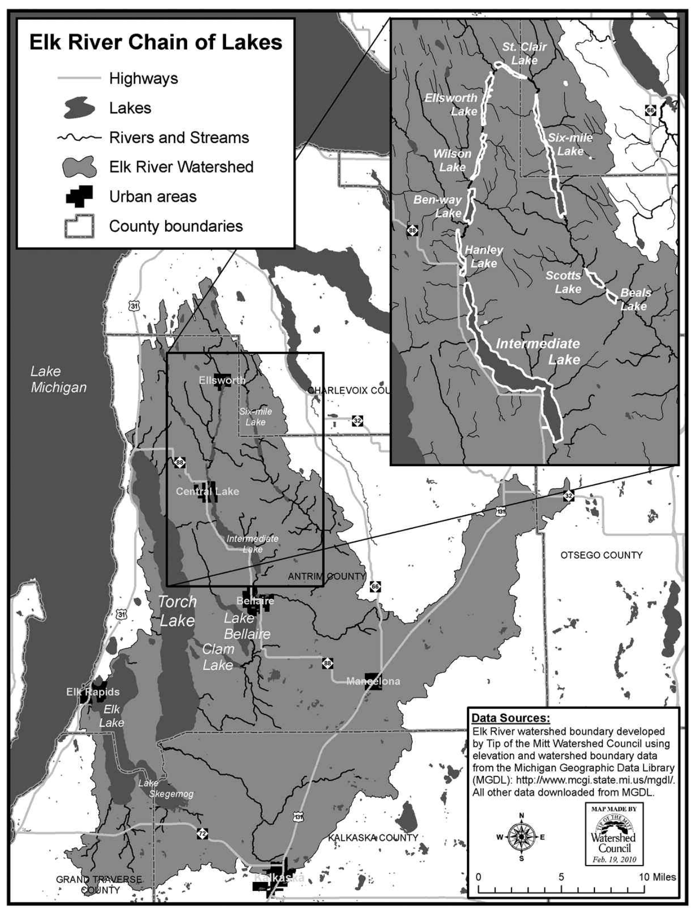
In the Tip of the Mitt Watershed Council service area there are nearly 60 lakes greater than 100 acres in size, and 14 of these are among the State's largest with over 1,000 acres of lake-surface area. The region also boasts some of the State's deepest lakes with five lakes having maximum depths of 100 feet or more. A few of these "giants" are found within the Elk River Chain of Lakes, including Torch Lake with over 18,000 acres of surface area and 300 feet of depth and Elk Lake with over 8,000 acres and 200 feet deep. In fact, all 14 lakes in the chain have qualities that allure and captivate residents and visitors fortunate enough to experience the enchanting natural beauty of these aquatic treasures first hand.

The Elk River Chain of Lakes drains a 321,000-acre watershed, beginning at its serene headwaters near East Jordan and emptying into the majestic deep blue waters of East Grand Traverse Bay at Elk Rapids. The sinuous chain first flows north from Beals to Scotts, through Sixmile and on to St. Clair Lake. Near the town of Ellsworth, the chain turns 180 degrees and heads south through Ellsworth, Wilson, Ben-way, Hanley and Intermediate Lakes. South of the town of Bellaire, the chain begins to open up, jogging south, west, south and west again through typically larger lakes, from Lake Bellaire to Clam and Torch Lakes, then to Lake Skegemog and Elk Lake before emptying into Lake Michigan. The combined surface area of all fourteen lakes is 34,420 acres – a veritable wealth of water resources!

Over the last few decades, the Watershed Council has put forth great effort to preserve the Elk River Chain of Lakes 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 over 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. We are pleased to cooperate with many lake associations in the area that have monitoring programs as well. 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 water resource management initiatives in the Elk River Chain of Lakes 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
in the Elk River Chain of Lakes

Tip of the Mitt Watershed Council has consistently monitored water quality throughout the Elk River Chain of Lakes since 1992. 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 22 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 the Elk River Chain of Lakes. We have also included charts to provide a graphic display of trends occurring in the lake. For additional information about the Comprehensive Water Quality Monitoring Program please visit our web site at www.watershedcouncil.org/protect

Parameters and Results

pH

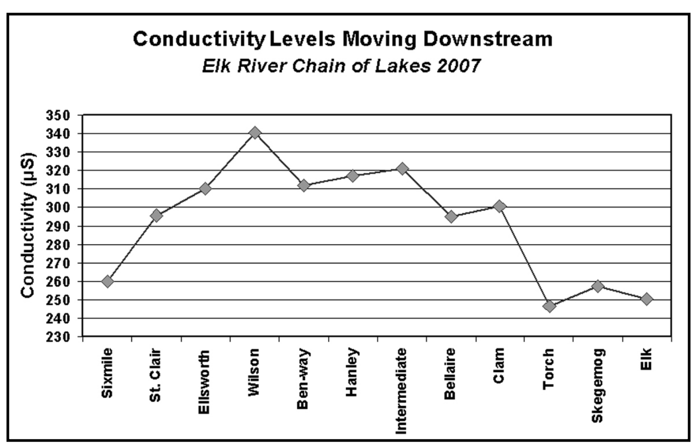
pH values provide a measurement of the acidity or alkalinity of water. Measurements above 7 are alkaline, 7 is considered neutral, and levels below 7 are acidic. When pH is outside the range of 5.5 to 8.5, most aquatic organisms become stressed and populations of some species can become depressed or 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 from the Elk River Chain of Lakes show that pH levels consistently fall within this range, with a minimum of 6.76 (Ellsworth, 1992) and a maximum of 8.56 (Ben-way, 2001).

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 at mid-depth and at the surface in the Elk River Chain of Lakes have consistently exceeded State minimums, ranging from 5.1 PPM (Ben-way, 1998) to 13.6 PPM (Elk, 2007). On several occasions, dissolved oxygen levels near the bottom of the smaller lakes have been below 5 PPM. Oxygen depletion at the bottom is typical for many lakes, though it can be an indicator of water quality impairment.

Conductivity

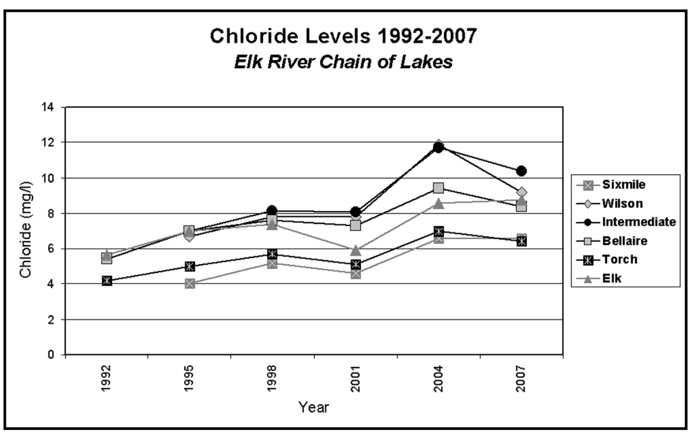
Conductivity is a measure of the ability of water to conduct an electric current, which is dependent upon the concentration of charged particles (ions) dissolved in the water. Research shows that conductivity is a good indicator of human impacts on aquatic ecosystems because levels usually increase as population and human activity in the watershed increase. Readings on lakes monitored by the Watershed Council have ranged from 175 to 656 microSiemens (µS), and in the Elk River Chain of Lakes, ranging from a low of 246 µS (Torch, 2007) to a high of 536 µS (St. Clair, 1998). Conductivity levels increase throughout the Upper Chain and then drop considerably downstream of Bellaire. This phenomenon may be the result of heavy groundwater inputs in the Upper Chain because groundwater in this area tends to have relatively high conductivity as compared to surface water.



Kevin Cronk, Monitoring & Research Coordinator for Tip of the Mitt Watershed Counci,l collecting data in the Chain of Lakes area.

Chloride

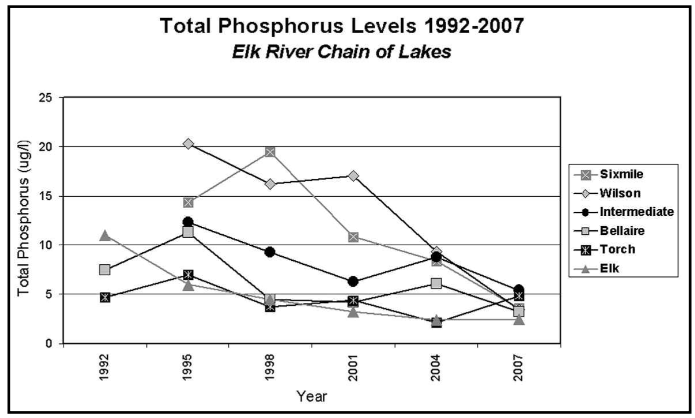
Chloride, a component of salt, is present naturally at low levels in Northern Michigan surface waters due to the marine origin of bedrock (typically < 5 PPM). Chloride is a "mobile ion," meaning it is not removed by chemical or biological processes in soil or water. Many products associated with human activities contain chloride (e.g., de-icing salts, water softener salts, and bleach). Although most 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. Chloride concentrations gradually increased throughout the Elk River Chain of Lakes from 4 to 7 PPM in the early 1990s to as high as 12 PPM in 2004, but then saw a modest decrease in 2007.



Total Phosphorus

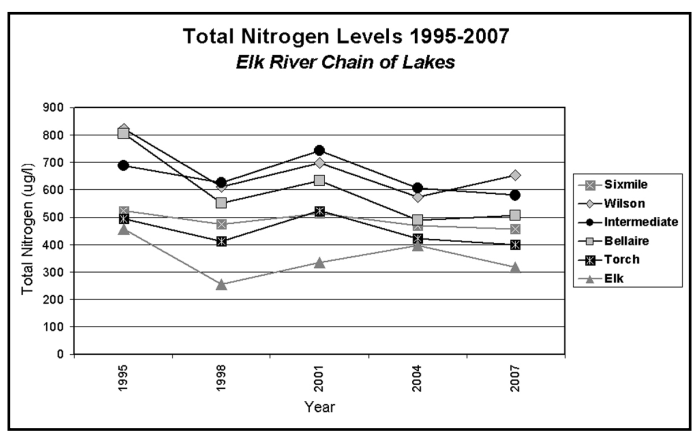
Phosphorus is the most important nutrient for plant productivity in surface waters because it is usually in shortest supply relative to nitrogen and carbon. A water body is considered phosphorus limited if the ratio of nitrogen to phosphorus is greater than 15:1. In fact, most lakes monitored by the 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 of less than 10 PPB in high quality surface waters.

In the Elk River Chain of Lakes, total phosphorus concentrations have nearly uniformly decreased over time. For example, total phosphorus levels in Wilson Lake have dropped dramatically from an average of over 20 PPB in 1995 to less than 5 PPB in 2007. This drop may be partially due to greater awareness on the part of watershed residents regarding impacts of nutrient pollution and a consequent decrease in inputs. However, invasive zebra mussels have now colonized all water bodies in the Chain from Sixmile Lake downstream and are known to disrupt the natural nutrient cycling process, which often leads to decreased phosphorus concentrations in open water.



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 (e.g. fertilizers, faulty septic systems, and storm water 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 the Elk River Chain of Lakes have ranged from 230 PPB (Elk, 1998) to 1010 PPB (Ellsworth, 2001). Total nitrogen has gone up and down in the Chain of Lakes, with a gradual decrease over time.



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

Comprehensive Water Quality Monitoring Program 2007 Data*

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	11.19	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

*2010 data will be available in early 2011.

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

LOCAL ORDINANCE GAPS ANALYSIS

Local government is the first line of defense for our environment. However, most local governments also recognize the challenges of doing so. Even though they often appreciate the important economic, ecological and aesthetic benefits of wise resource management, it is not always easy to accomplish.

Many issues arise at the local level to threaten the health of our precious water resources. At Tip of the Mitt Watershed Council, we see time and again how the lack of local ordinances, or weak ordinances, leaves citizens without the necessary tools to protect their lake, river, or ground water source. We often hear from local residents when these threats arise, and the common question is, “Why can’t we do anything about this?”

Interestingly, the question is often asked by folks who believe local zoning should be kept to a minimum. But when they see the consequences of no zoning, many of them become leading advocates for ordinances that protect water resources.

Ideological stances that insist upon “no zoning” are often coupled with challenges that arise when attempting to protect a water body surrounded by multiple jurisdictions. These are key reasons for us to address this issue, and we have determined that:

1. No one in this region has documented the “big picture” of what currently exists in local water protection zoning and how that overlaps or competes with adjacent jurisdictions; and

2. There is a lack of direction and no plan for improving weak ordinances and enacting missing ordinances.

The need is serious because the water resources of the region are a crucial economic driver. High water quality in our lakes and rivers translates into solid property values and a high quality of life. But every year, numerous pressures bring more stress to these same water resources and we need to have a balanced approach for managing them. If the situation is left untreated, our communities will move forward with less direction, wasting money, time and effort while our water remains vulnerable to various threats.

These situations inspired the Watershed Council to get creative and search for ways to help local officials and ultimately, local citizens. We have solutions, and one of them is our *Local Ordinance Gaps Analysis* project.

The goal of this project is to evaluate all existing water-related ordinances in our 4-county service area of Cheboygan, Emmet, Charlevoix, and Antrim. The analysis is being done at the county, city, and township levels to determine if existing water-related zoning is strong, adequate, weak or missing. There are two powerful outcomes for this project:

- ✔ Convenient collection of relevant ordinances for easy reference.

- ✔ A formal report detailing results of the evaluation. This will include recommendations for improving weak ordinances, as well as suggestions for how to enact new ordinances to fill in the gaps that exist in current protections.

This project benefits many local communities in our region, providing well-documented, thoughtful approaches for them to consider that will have a long-term, lasting impact. It gives local decision makers a valuable tool they can use to make a positive difference and ensure protection of Northern Michigan’s environment and economy.

Upon completion, we will do extensive follow-up with the local governments, including distribution of the report, presentations to review how to use the report, and work sessions to support them as they implement the report recommendations. An evaluation form will be developed for local government officials to complete after they read the report.

In the process of gathering the necessary information to do this work, it has become obvious that this Gaps Analysis is something that will be extremely beneficial to local governments and citizens. It is a huge undertaking that requires a lot of research and work, but the final product will be useful to numerous local government entities for literally years to come.

Volunteer Lake Monitoring

Local Volunteers Monitor & Protect Our Lakes

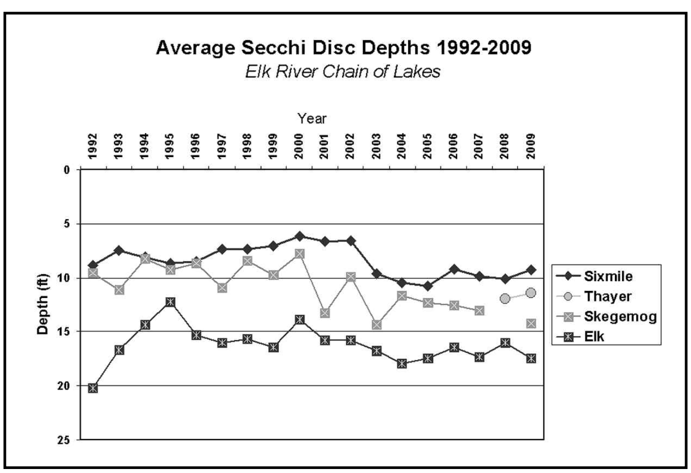
Since 1984, Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM), relying upon hundreds of volunteers to monitor the water quality of dozens of lakes in the northern Lower Peninsula of Michigan. During the summer of 2009, 38 volunteers monitored water quality at 31 stations on 23 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/protect). 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. Volunteers have monitored water quality in several of the Elk River Chain of Lakes over the past few decades. The following section summarizes the parameters monitored and results.

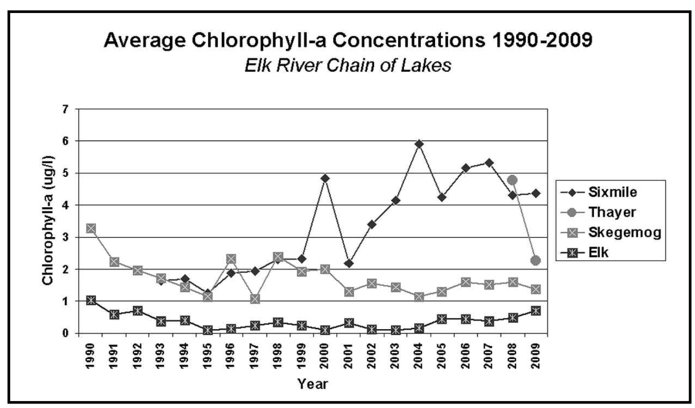
Secchi Disc

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

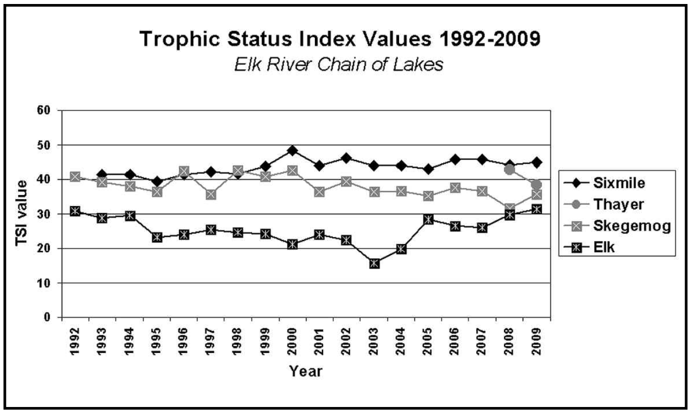
Chlorophyll-a is a pigment found in all green plants, including algae. Water samples collected by volunteers are analyzed for chlorophyll-a to determine the amount of phytoplankton (minute free-floating algae) in the water column. There is a strong relationship between chlorophyll-a concentrations and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



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

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

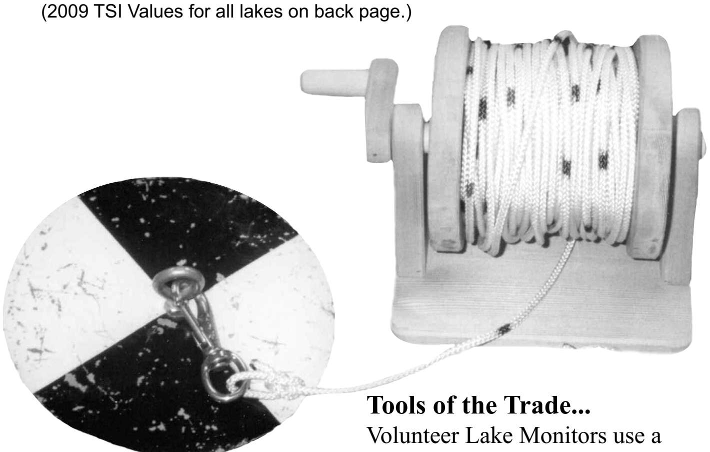


system, and higher values (50+) indicate a eutrophic or highly productive system. Lakes with greater water clarity and smaller phytoplankton populations would score on the low end of the scale, while lakes with greater turbidity and more phytoplankton would be on the high end.

TSI values do not measure water quality, but simply place the lake on a scale of biological productivity. 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.

(2009 TSI Values for all lakes on back page.)



Tools of the Trade...
Volunteer Lake Monitors use a Secchi disc to measure water clarity.

Results from the Elk River Chain of Lakes

Volunteer monitors have collected water quality on the Elk River Chain of Lakes for 20 years! Elk and Skegemog Lakes have been monitored since 1990 and Sixmile Lake since 1992. Most other lakes in the chain have been monitored at some point as part of our program or the statewide program, including Bellaire, Ben-way, Clam, Ellsworth, Hanley, Intermediate, Torch, and Wilson. The long-term Secchi disc and chlorophyll-a data from these lakes allow Watershed Council staff to assess water quality and examine changes over time.

Average Secchi disc depths in Elk, Skegemog, and Sixmile Lakes have gone up and down, though all three lakes have seen a steady increase in clarity since the late 1990s. Average chlorophyll-a concentrations have also gone up and down on Elk and Skegemog Lakes, showing no definitive pattern. Sixmile Lake, however, has shown a marked increase in chlorophyll-a since the mid 1990s.

Zebra mussels are now known to occur in lakes in the chain from Sixmile Lake downstream to Elk Lake. Zebra mussels are voracious filter-feeders that feed upon algae and essentially clear 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 ultimately, causing ecosystem disruptions. Their feeding habits are probably at least partially responsible for the increased water clarity in the lakes consistently monitored. Interestingly, chlorophyll-a concentrations have not decreased accordingly as would be expected. In fact, it is puzzling that chlorophyll-a levels have actually increased in Sixmile Lake even though zebra mussels are present. It would appear that either zebra mussels in Sixmile Lake are not found in sufficient densities to impact algal populations or that nutrient inputs into the lake are high enough to sustain phytoplanktonic algae despite impacts from filter-feeding zebras.

In those lakes currently monitored in the Elk River Chain of Lakes, the trophic status varies from mesotrophy (moderately productive) to oligotrophy (low productivity). Data show Sixmile Lake to be firmly mesotrophic as its trophic status index scores have consistently been above 40. Lake Skegemog wavered between mesotrophy and oligotrophy until the year 2000, after which it has generally fallen into the oligotrophic category. Elk Lake has consistently and expectedly scored in the oligotrophic category. Extensive water quality data, collected by Watershed Council staff during the last 10 years as part of a special monitoring project sponsored by the Elk-Skegemog Lake Association, support this oligotrophic categorization. In addition to being a very large and deep lake, the special project data have shown Elk Lake to be nutrient-poor, but with abundant oxygen throughout its depths at all times of year.

Overall, data show that The Elk River Chain of Lakes 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 aquatic treasures of Northern Michigan. If you would like to get involved, please contact the program coordinator, Kevin Cronk, at (231) 347-1181 ext. 109 or by e-mailing kevin@watershedcouncil.org.

* 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.

Trophic Status Index* (TSI) Values for Lakes Monitored in 2009

Lake	TSI	Lake	TSI	Lake	TSI
Bass Lake	43	Huffman Lake	50	Pickerel Lake	44
Black Lake	39	Lake Marion	41	Six Mile Lake	45
Burt Lake, Central Basin	36	Lake Michigan, Bay Harbor	25	Thayer Lake	42
Burt Lake, North	39	Lake Michigan, Little Traverse Bay	28	Thumb Lake	32
Crooked Lake	42	Long Lake, Cheboygan County	35	Twin Lake	39
Douglas Lake - Cheboygan	39	Mullett Lake, Center	38	Walloon Lake, Foot Basin	34
Douglas Lake - Otsego	42	Mullett Lake, Pigeon Bay	36	Walloon Lake, North	39
Elk Lake	36	Munro Lake	43	Walloon Lake, West Arm	35
Lake Charlevoix, Main	32	Paradise Lake	45	Walloon Lake, Wildwood	32
Lake Charlevoix, South Arm	35				

*TSI values range are based on secchi disc data and 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.

Special Thanks to Our Volunteer Lake Monitors

Joe Nerone - *Sixmile Lake* ~ Dale Claudepierre - *Lake Skegemog*
Thom Yokum - *Elk Lake* ~ Don Venburg & Jim Schneider - *Thayer Lake*