Lake Charlevoix

2012 Lake Profile

Tip of the Mitt Watershed Council

What would Michigan be without water? One might as well ask what the Sahara would be without sand or the Himalayas without mountains. Michigan is defined by water and, in fact, the definition of Michigan in some Native American languages literally means water, "big lake" to be precise.

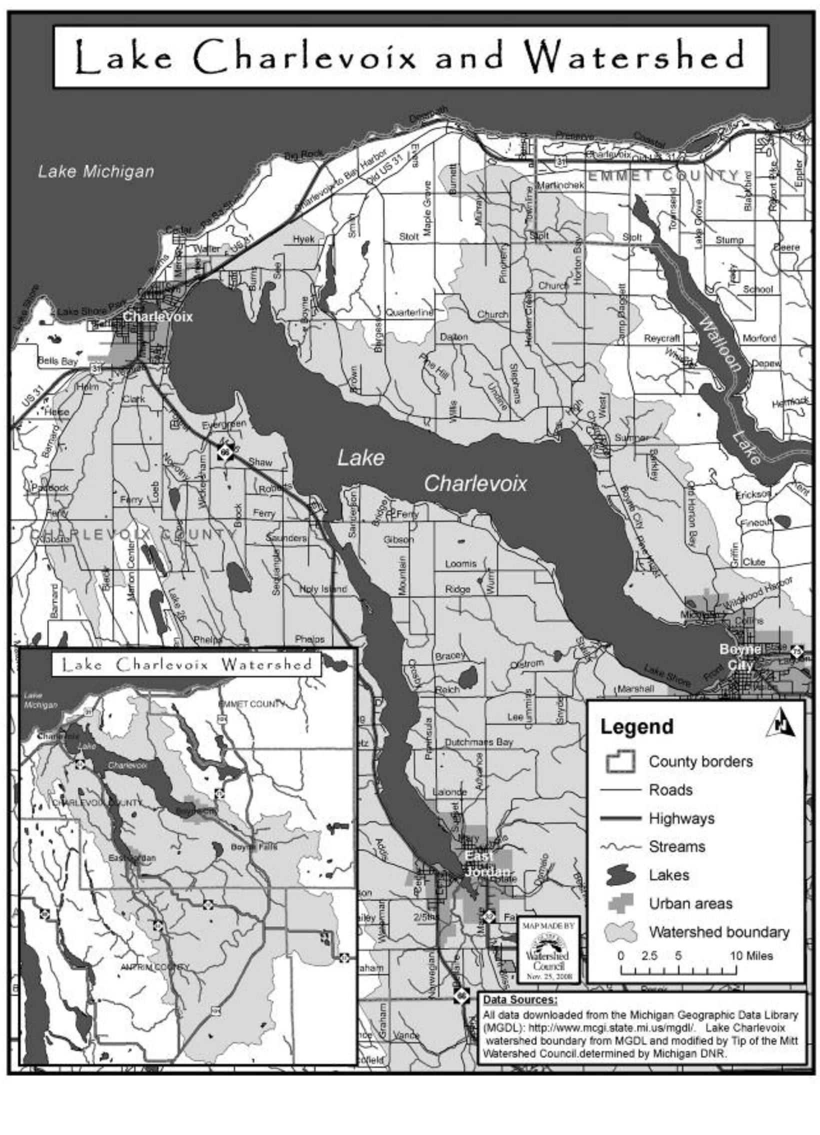
Water formed Michigan, frozen water that is, thousands of feet thick. A series of glaciers advanced and retreated across Michigan over the course of millions of years, creating the present-day landscape of rolling hills and broad plains; dotted with lakes, crisscrossed with rivers, and surrounded by freshwater seas. Glacial scouring and huge ice chunks that were left behind formed thousands of lakes across the landscape, lakes of all shapes and sizes, each unique: each beautiful and special in its own way.

Many people live in or travel through Northern Michigan because of these lakes and the character they lend to the region. Lake Charlevoix is among the largest and most breath-taking lakes in Michigan, a true aquatic treasure that is experienced and enjoyed by thousands upon thousands of people annually; year after year and generation after generation. The Watershed Council has long recognized the value of Lake Charlevoix and worked diligently for decades to protect the water quality and preserve the ecosystem integrity of this incredible lake.

Lakes throughout Northern Michigan, whether large or small, are monitored by Watershed Council staff and volunteers alike who gather valuable data to keep tabs on the health of our waters. Over 50 lakes and streams in the region are monitored in early spring on an every three year basis through our Comprehensive Water Quality Monitoring Program. Volunteers supplement the comprehensive program and fill in data gaps by collecting weekly water quality data throughout summer months as part of our Volunteer Lake Monitoring Program.

In addition to monitoring, the Watershed Council works with property owners, associations, local governments, and others on a variety of projects to protect lakes throughout Northern Michigan. Projects carried out on these lakes have ranged from lake-wide aquatic plant surveys to individual shoreline property restoration projects. Details about recent projects involving Lake Charlevoix are included in this report.

We hope you find the information presented in this report both interesting and insightful. 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

Restoration Ecologist, Jennifer Gelb, uses a Kemmerer bottle to collect water samples.

Water Quality Trends in Lake Charlevoix

Tip of the Mitt Watershed Council has been consistently monitoring the water quality of Northern Michigan lakes for decades as part of the Comprehensive Water Quality Monitoring Program. When the program was launched in 1987, Watershed Council staff monitored a total of 10 lakes. Since then, the program has burgeoned and now, remarkably, includes more than 50 lakes and rivers throughout the tip of the mitt. Over the course of 20+ years of monitoring, we have managed to build an impressively large water quality dataset. This unique, historical dataset is, simply put: invaluable. Data from the program are regularly used by the Watershed Council, lake and stream associations, local governments, regulatory agencies, and others in efforts to protect and improve the water resources that are so important to the region.

Every three years, Watershed Council staff head into the field in early spring, as soon as ice is out, to monitor lakes and rivers spread across the tip of the mitt. All lakes over 1000 acres and the majority of lakes greater than 100 acres in size, as well as all major rivers, are included in the program. In each of these water bodies, the Watershed Council collects a variety of physical and chemical data, including parameters such as dissolved oxygen, pH, chloride, phosphorus and nitrogen.

Water quality data collected in the field are compiled and used by Watershed Council staff 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 23 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 Lake Charlevoix. 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

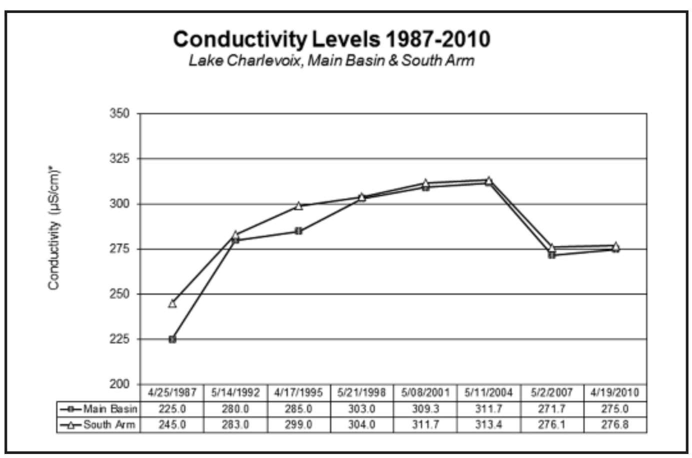
pH values provide a measurement of the acidity or alkalinity of water. Measurements above 7 are alkaline, 7 is considered neutral, and levels below 7 are acidic. When pH is outside the range of 5.5 to 8.5, most aquatic organisms become stressed and populations of some species can become depressed or 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 Lake Charlevoix show that pH levels consistently fall within this range, with a low of 7.55 (South Arm, 1998) and a high of 8.41 (Main Basin, 2010).

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. Springtime dissolved oxygen levels have always been far above 7 parts per million in Lake Charlevoix, ranging from 10.0 PPM (Main Basin, 1998) to 14.0 PPM (South Arm, 2010).

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 from lakes monitored by the Watershed Council have ranged from 175 to 656 microSiemens (μS). Conductivity levels in Lake Charlevoix rose gradually from 1987 to 2004, followed by a large decrease in 2007 that has persisted through 2010. Measurements have ranged from a low of 225 μS (Main Basin, 1987) to a high of 321 μS (South Arm, 2004).

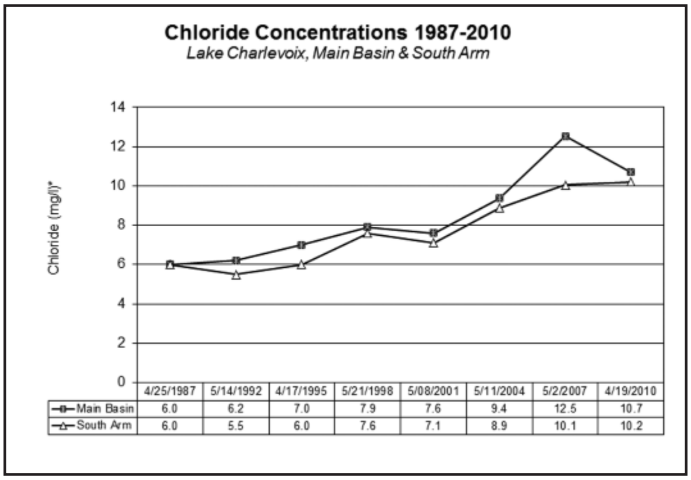


	4/25/1987	5/14/1992	4/17/1995	5/21/1998	5/08/2001	5/11/2004	5/2/2007	4/19/2010
Main Basin	225.0	280.0	285.0	303.0	309.3	311.7	271.7	275.0
South Arm	245.0	283.0	299.0	304.0	311.7	313.4	276.1	276.8

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

Chloride

Chloride, a component of salt, is present naturally at low levels in Northern Michigan surface waters due to the marine origin of the underlying 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, fertilizers, and bleach). Although most aquatic organisms are not affected until chloride concentrations exceed 1,000 PPM, increases 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 in Lake Charlevoix have gradually increased from approximately 5 PPM in 1987 to over 10 PPM in 2010.



	4/25/1987	5/14/1992	4/17/1995	5/21/1998	5/08/2001	5/11/2004	5/2/2007	4/19/2010
Main Basin	6.0	6.2	7.0	7.9	7.6	9.4	12.5	10.7
South Arm	6.0	5.5	6.0	7.6	7.1	8.9	10.1	10.2

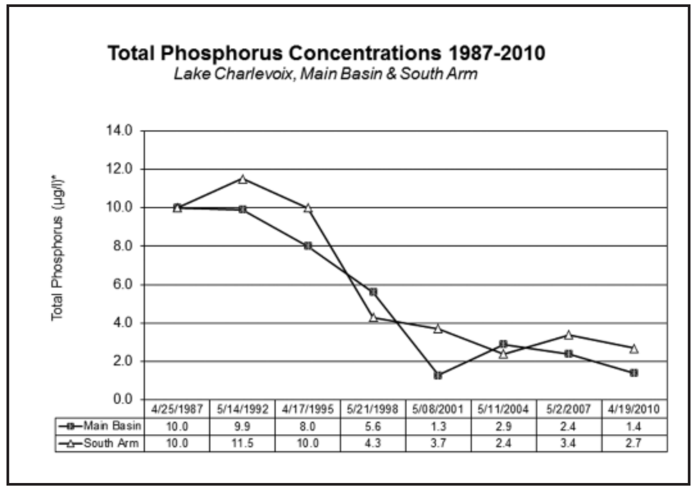
Nutrients

Nutrients are needed by organisms to live, grow, and reproduce; occurring naturally in soils, water, air, plants, and animals. Phosphorus and nitrogen are essential nutrients for plant growth and important for maintaining healthy, vibrant aquatic ecosystems. However, excess nutrients from sources such as fertilizers, faulty septic systems, and stormwater runoff lead to nutrient pollution, which can have negative impacts on our surface waters. In general, nutrient concentrations are highest in small, shallow lakes and lowest in large, deep lakes.

Total Phosphorus

Phosphorus is the most important nutrient for plant productivity in our lakes 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.

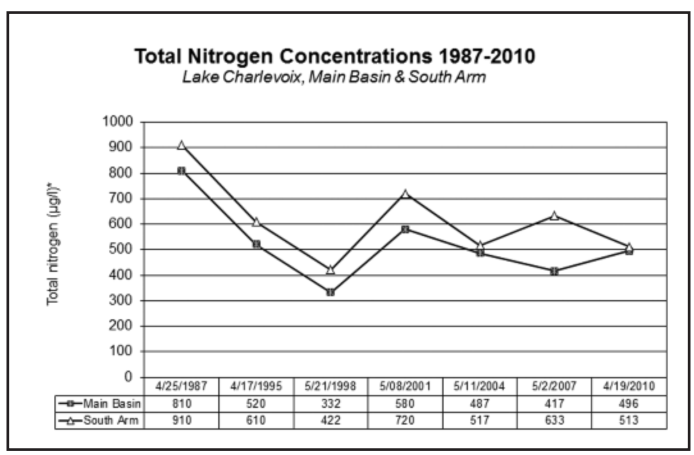
Because of the negative impacts that phosphorus can have on surface waters, legislation has been passed in Michigan to ban phosphorus in soaps, detergents, and fertilizers. Water quality standards for nutrients in surface waters have not been established, but total phosphorus concentrations are usually less than 10 parts per billion (PPB) in the high quality lakes of Northern Michigan. Total phosphorus concentrations in Lake Charlevoix have steadily decreased from highs of 10+ PPB in 1987 to lows less than 3 PPB in 2010. This decrease is probably, at least in part, due to the introduction of zebra and quagga mussels, which have filtered much of the algae out of the water column and disrupted the natural nutrient cycle in the lake.



	4/25/1987	5/14/1992	4/17/1995	5/21/1998	5/08/2001	5/11/2004	5/2/2007	4/19/2010
Main Basin	10.0	9.9	8.0	5.6	1.3	2.9	2.4	1.4
South Arm	10.0	11.5	10.0	4.3	3.7	2.4	3.4	2.7

Total Nitrogen

Nitrogen is a very abundant element throughout the earth's surface and is a major component of all plant and animal matter. Nitrogen is also generally abundant in our lakes and streams and needed for plant and algae growth. Interestingly, algae have adapted to a wide variety of nitrogen situations in the aquatic environment, some fixating nitrogen directly from the atmosphere to compete in low-nitrogen environments (blue-green algae), while others tend to thrive in nitrogen-rich environments (diatoms). Total nitrogen levels in Lake Charlevoix have ranged from 332 PPB (Main Basin, 1998) to 910 PPB (South Arm, 1987). Nitrogen concentrations experienced an initial decrease from 1987 to 1995, which may reflect changes in analytical procedures, and from 1995 to 2010, levels have gone up and down with no clear trend.



	4/25/1987	4/17/1995	5/21/1998	5/08/2001	5/11/2004	5/2/2007	4/19/2010
Main Basin	810	520	332	580	487	417	496
South Arm	910	610	422	720	517	633	513

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

Comprehensive Water Quality Monitoring Program
How Does Lake Charlevoix Compare?

Water quality data from the surface of all water bodies monitored in 2010

Water Body	Date	Dissolved Oxygen (mg/l)*	Specific Conductivity (µS)*	pH (units)*	Nitrate-Nitrogen (µg/l)*	Total Nitrogen (µg/l)*	Total Phosphorus (µg/l)*	Chloride (mg/l)*
Bass Lake	4/14/10	11.21	335.3	8.53	11	584	8.8	42.9
Bear River	3/24/10	13.05	283.1	8.30	192	433	16.2	14.3
Bellaire Lake	4/23/10	11.19	315.9	8.29	347	452	3.7	10.7
Ben-way Lake	4/6/10	11.06	358.0	11.32	406	567	6.4	10.8
Birch Lake	4/14/10	11.36	271.6	8.43	3	273	5.7	20.5
Black Lake	4/28/10	10.87	289.3	8.34	27	265	6.8	6.0
Black River	4/15/10	10.54	254.1	8.16	20	308	4.0	4.3
Boyne River	3/26/10	12.71	359.0	8.45	390	626	7.0	11.4
Burt Lake	4/28/10	10.68	297.2	8.32	94	240	3.7	11.5
Charlevoix, Main Basin	**4/19/10**	**12.52**	**272.7**	**8.38**	**343**	**474**	**1.4**	**11.1**
Charlevoix, South Arm	**4/19/10**	**11.80**	**280.8**	**8.34**	**427**	**574**	**1.4**	**9.9**
Cheboygan River	4/15/10	9.41	285.0	8.35	34	269	2.9	8.5
Clam Lake	4/23/10	10.76	317.6	8.25	322	423	2.7	10.0
Crooked Lake	3/24/10	11.72	252.8	8.51	269	443	8.7	8.7
Crooked River	4/21/10	10.76	293.9	8.50	137	296	4.5	9.4
Deer Lake	3/26/10	11.63	265.4	8.45	53	411	4.6	15.2
Douglas Lake	3/30/10	11.27	214.8	8.25	55	544	7.8	7.3
Elk Lake	4/19/10	12.80	246.7	8.35	193	411	9.6	9.8
Elk River	4/14/10	12.49	261.3	8.51	205	313	2.0	10.0
Ellsworth Lake	3/29/10	10.39	374.8	8.09	404	696	7.0	11.6
Hanley Lake	4/5/10	10.53	367.3	8.27	451	725	3.0	10.9
Huffman Lake	3/26/10	10.66	287.2	8.36	84	248	2.3	4.5
Huron, Duncan Bay	4/22/10	10.85	278.6	8.36	77	322	3.6	9.7
Indian River	4/21/10	11.32	301.4	8.48	75	226	1.6	12.4
Intermediate Lake	4/23/10	10.63	344.8	8.25	363	458	3.2	11.8
Jordan River	3/29/10	10.22	340.5	8.22	1122	1567	8.3	7.1
Lancaster Lake	4/1/10	8.49	276.0	7.72	75	596	6.9	9.1
Larks Lake	3/30/10	11.62	213.0	8.51	76	706	4.8	4.3
Little Sturgeon River	4/21/10	11.36	320.1	8.35	54	228	2.9	14.5
Long Lake	4/15/10	11.17	206.2	8.19	57	355	6.3	9.0
Maple River	4/22/10	10.30	275.9	8.16	308	544	4.5	6.4
Marion Lake	5/10/10	no data	no data	no data	<1	482	9.0	22.2
Michigan, Bay Harbor	5/3/10	11.31	277.0	8.16	284	493	2.2	14.8
Michigan, Grand Traverse Bay	4/28/10	12.40	241.1	8.26	251	360	1.4	11.8
Michigan, Little Traverse Bay	5/10/10	12.03	244.5	8.29	268	373	2.2	12.8
Mullett Lake	4/22/10	11.63	298.0	8.37	56	287	2.7	11.7
Munro Lake	4/1/10	11.55	215.4	8.41	36	1022	13.3	4.9
Nowland Lake	4/14/10	11.09	190.1	8.47	7	583	5.4	6.2
Paradise Lake	4/22/10	10.52	207.2	8.30	8	325	5.0	11.2
Pickerel Lake	3/24/10	11.26	261.6	8.26	183	453	3.1	7.3
Pigeon River	4/21/10	10.09	341.5	8.37	35	233	3.8	6.5
Pine River, Charlevoix	4/14/10	12.42	268.2	8.36	273	349	0.5	11.2
Round Lake (Emmet Cty)	3/30/10	11.95	306.3	8.52	49	739	2.9	25.9
Silver Lake (Wolverine)	4/20/10	10.65	194.4	8.35	26	247	3.3	4.9
Six-mile Lake	3/29/10	10.52	333.5	8.14	279	541	4.4	7.2
Skegemog Lake	4/19/10	10.87	255.8	8.45	186	292	1.4	9.6
Spring Lake	3/24/10	12.46	529.9	8.21	1397	1457	5.3	90.0
St. Clair Lake	3/29/10	10.49	351.0	8.14	260	560	5.4	8.8
Sturgeon River	4/22/10	11.03	374.0	8.33	194	273	1.0	13.9
Susan Lake	3/26/10	12.04	282.7	8.36	111	685	8.0	10.5
Thumb Lake	4/1/10	10.99	200.7	8.22	38	301	10.0	5.1
Torch Lake	4/23/10	12.39	260.3	8.31	270	371	0.7	8.0
Twin Lakes	4/23/10	11.49	259.6	8.32	27	393	9.7	2.2
Walloon, Foot	4/28/10	10.31	265.5	8.29	75	316	3.2	12.8
Walloon, Mud Basin	4/28/10	9.14	296.8	8.30	25	371	9.3	16.4
Walloon, North Arm	4/28/10	9.53	298.0	8.32	194	539	5.3	14.5
Walloon, West Arm	4/28/10	10.66	259.8	8.29	134	377	3.0	11.1
Walloon, Wildwood Basin	4/28/10	10.29	260.6	8.32	68	274	3.4	12.3
Wildwood Lake	4/20/10	10.35	295.0	8.38	<1	332	11.9	16.0
Wilson Lake	4/7/10	10.50	358.7	8.28	433	800	5.3	10.7

*Unit descriptions: mg/l = milligrams/liter (parts per million), µg/l = micrograms/liter (parts per billion), µS = microSiemens per centimeter

Collaboration: Hard at Work on a Plan to Protect the *Lake Charlevoix Watershed*

Even in Northern Michigan, where the vast majority of land cover in a watershed is natural, water quality and aquatic ecosystems are threatened by pollution sources and other stressors. To effectively address all existing or potential problems, a plan is needed – a comprehensive, all-inclusive plan that involves local community partners and residents in the watershed.

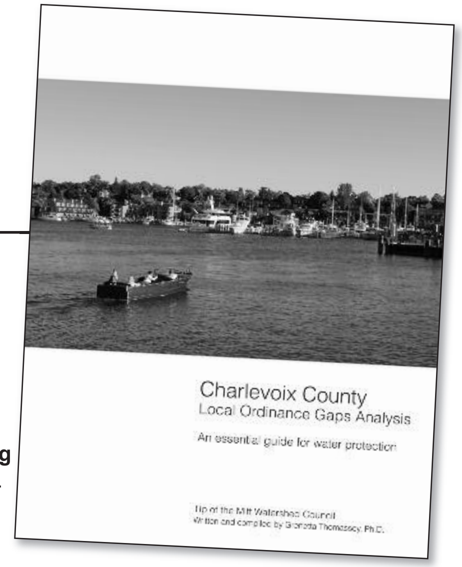
To that end, a partnership of organizations, agencies, local governments, and individuals was formed to develop a watershed-wide plan for water protection. An Advisory Committee was created, and after years of work and coordination, the writing of the Lake Charlevoix Watershed Management Plan was completed in 2001. This was a great step toward protecting all waters important to the health of Lake Charlevoix.

From that point forward, a variety of plan recommendations were implemented. This was due, in large part, to the work of that Advisory Committee, which remains very active to this day. Early accomplishments included invasive species control efforts, shoreline surveys to reduce nutrient pollution, and monitoring of stormwater runoff. In spite of those important successes, it eventually became apparent that the plan needed updates to stay relevant, address emerging threats, and comply with regulatory standards.

In 2009, the Watershed Council received funding through the Michigan Department of Environmental Quality (MDEQ) to update the plan and implement a project called “Lake Charlevoix Watershed: Local Government Solutions.” The update project included four components and four partners: Michigan State University Extension (MSUE), Antrim Conservation District (ACD), Northwest Michigan Council of Governments (NWMCOG), and Tip of the Mitt Watershed Council (TOMWC).

The outcomes produced by this project were:

1. **Local Zoning Ordinance Gaps Analysis.** This comprehensive analysis of local water protection ordinances in the Lake Charlevoix Watershed was conducted by the Watershed Council. The research involved produced a comprehensive written report, with chapters devoted to every jurisdiction in the county, and a chapter devoted to the county, itself. NWMCOG also conducted workshops for local government officials to familiarize them with this valuable tool.



The ***Charlevoix County Local Ordinance Gaps Analysis, An essential guide for water protection*** book is available online at **www.watershedcouncil.org** under the “Publications” tab.

2. **Social Indicators Survey.** MSUE was responsible for this part of the project, which included formal mail surveys conducted at the beginning and end of the project to gauge attitudes and behaviors of watershed residents as a whole, as well as targeted local officials, riparian landowners, and seasonal residents.

3. **Rural Site BMP Demonstration.** The ACD took the lead on this part of the project and installed something called a French Mattress at a difficult dirt/gravel rural road site that had erosion problems. This is a new Stormwater Best Management Practice (BMP), and once it was successfully installed and monitored, the ACD held a workshop for road commissions and others on how to use the new technique.

4. **Update the Lake Charlevoix Watershed Management Plan.** The Watershed Council completed this update to include required criteria and obtain formal approval from the MDEQ and the US Environmental Protection Agency (EPA). Many sections from the 2001 plan were expanded to include broader material, and new information was added (e.g. shoreline survey data). The Watershed Council also relied upon Advisory Committee meetings and personal contact with members to obtain their insight regarding the plan update.

The grant to update the watershed plan and finish various urban and rural local government projects will be completed in 2012. However, the Advisory Committee will continue to meet quarterly and project partners pursue funds to implement the recommended tasks and actions of the Management Plan. Step by step, the important work of water resources protection continues in the Lake Charlevoix Watershed.

Volunteer Lake Monitoring

Local Volunteers Monitor & Protect Our Lakes

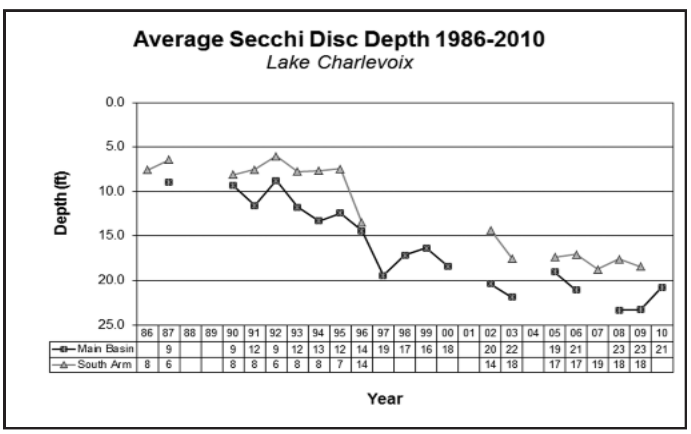
Since 1984, Tip of the Mitt Watershed Council has coordinated the Volunteer Lake Monitoring program (VLM), relying upon hundreds of volunteers to monitor the water quality of dozens of lakes in the northern Lower Peninsula of Michigan. During the most recent summer for which data are available (2010), 51 volunteers monitored water quality at 32 stations on 25 lakes.

A remarkable 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 Lake Charlevoix over the past few decades. The following section summarizes the parameters monitored and results.

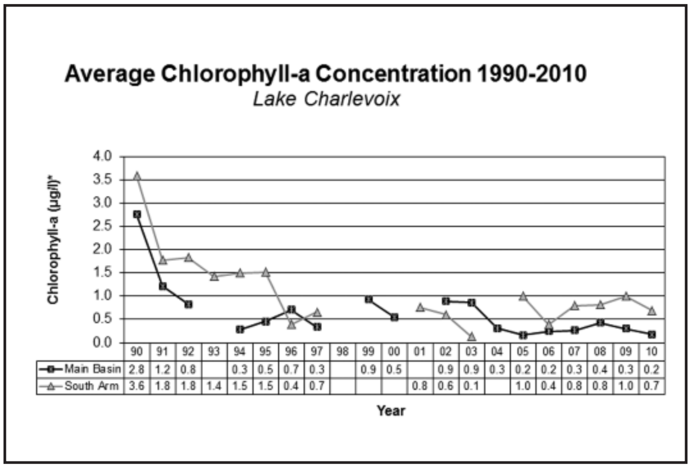
Secchi Disc

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 types bloom at different times, causing clarity to vary greatly. Secchi disc depths have ranged from just a few feet in small inland lakes to over 80 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 estimate 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

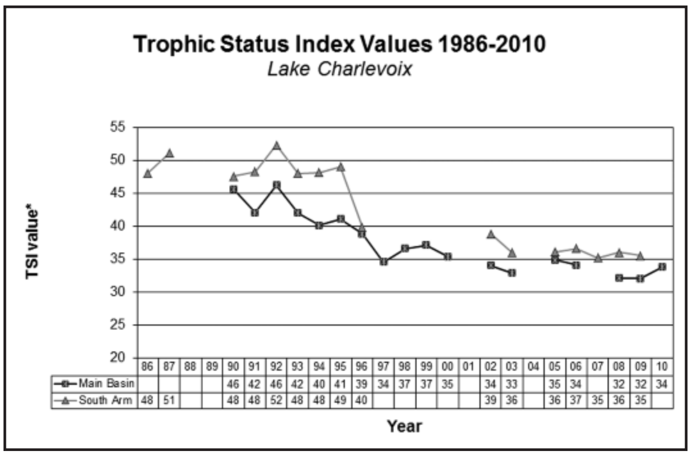
Trophic Status Index (TSI) is a tool developed by Bob Carlson, Ph.D. from Kent State University, to determine the biological productivity of a lake. Formulas developed to calculate the TSI value utilize Secchi disc depth and chlorophyll-a measurements collected by our volunteers. TSI values range from 0 to 100. Lower values (0-38) indicate an oligotrophic or low productive system, medium values (39-49) indicate a mesotrophic or moderately productive system, and higher

*Unit description: µg/l = parts per billion 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 are an indication of a lake's biological productivity. Oligotrophic lakes are characteristically deep, clear, nutrient poor, and with abundant oxygen. On the other end of the spectrum, eutrophic lakes are generally shallow and nutrient rich. A highly productive eutrophic lake could have problems with oxygen depletion whereas the low-productivity oligotrophic lake may have a lackluster fishery. Mesotrophic lakes lie somewhere in between and are moderately productive.

Depending upon variables such as age, depth, and soils, lakes are sometimes naturally eutrophic. However, nutrient and sediment pollution caused by humans can lead to the premature eutrophication of a lake, referred to as "cultural eutrophication". Cultural eutrophication can affect the fisheries, lead to excessive plant growth, and result in algal blooms that can be both a nuisance and a public health concern.

(2010 TSI Values for all lakes on back page.)



	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Main Basin					46	42	46	42	40	41	39	34	37	37	35		34	33		35	34		32	32	34
South Arm	48	51			48	48	52	48	48	49	40						39	36		36	37	35	36	35	

Results from Lake Charlevoix

Lake Charlevoix's main basin is connected to the South Arm by a wide channel near Ironton and, though one lake, the two basins are distinct and merit individualized attention. Therefore, volunteers monitor sites in both basins, which they have done for decades. Efforts by these dedicated volunteers produce results: long-term Secchi disc and chlorophyll-a data that allow Watershed Council staff to assess water quality and examine changes over time.

There is a very pronounced trend of increasing water transparency in Lake Charlevoix. Averaged Secchi disc depth have more than doubled in both basins, from approximately 8-10 feet in the early 1990s to 18+ feet in recent years. In conjunction, averaged chlorophyll-a concentrations decreased in both basins from 1-4 PPB in the early 1990s to less than 1 PPB.

This trend of greater water transparency and reduced planktonic algae is thought to be linked to invasive zebra and quagga mussels, which are known to exist in Lake Charlevoix. Zebra and quagga mussels are filter-feeders that prey 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. This loss of primary productivity (i.e., algae) alters the entire food web, ultimately leading to a reduction in top predator fish populations, such as trout or walleye. Zebra mussels are reportedly no longer as common as they once were in many large lakes in the area, which indicates that they may have passed their peak and that many of these lake ecosystems are approaching a new equilibrium. However, quagga mussels could be relatively new to Lake Charlevoix (first reported in the lake in 2009) and their full effect on the lake ecosystem may still be forthcoming.

Not surprisingly based on Secchi disc depth and chlorophyll-a trends, data show that the trophic state of Lake Charlevoix has changed. Trophic status index scores for both basins were in the mesotrophic category up through the mid 1990s, even reaching eutrophic on a few occasions in the South Arm. During the late 1990s, the biological productivity of both basins began a drop that pushed them firmly into the oligotrophic category. Data from the Comprehensive Water Quality Monitoring program also attest to this decrease in biological productivity as total phosphorous concentrations have dropped considerably since the early 1990s. Invasive mussels appear to have altered the Lake Charlevoix food web and reduced its biological productivity, perhaps for the long term. However, other data show that water quality remains high, with abundant stores of dissolved oxygen throughout the water column.

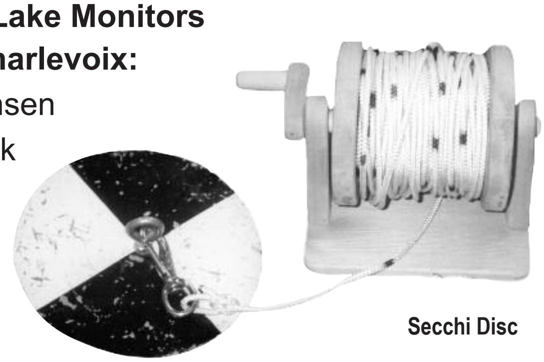
Volunteers are doing an excellent job of monitoring Lake Charlevoix. Without their dedication and enthusiasm, we would have much less data to assess lake health and fewer eyes on our precious waters. Thus, we can not thank our volunteers enough for the critical roles they play in helping protect the lakes of Northern Michigan. We and the waters of Northern Michigan are eternally grateful! Of course, alternate monitors are always needed, so please consider joining the program to help protect and preserve Lake Charlevoix.

If you would like to get involved or would like additional information, please contact the program coordinator, Kevin Cronk, at (231) 347-1181 ext. 109 or by e-mailing kevin@watershedcouncil.org.

Thank you

Volunteer Lake Monitors on Lake Charlevoix:

- Steve Hansen
- Cliff Biddick



Secchi Disc

* 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 2010

Lake	TSI*	Lake	TSI*	Lake	TSI*
Bass Lake	44	Lake Charlevoix, South Arm	37	Pickerel Lake	47
Black Lake	41	Huffman Lake	53	Six Mile Lake	45
Burt Lake, Central Basin	37	Lake Marion	39	Thayer Lake	42
Burt Lake, North	37	Lake Michigan, Bay Harbor	26	Thumb Lake	31
Burt Lake, South	37	Lake Michigan, Little Traverse Bay	31	Twin Lake	42
Crooked Lake	46	Long Lake, Cheboygan County	34	Walloon Lake, Foot Basin	37
Douglas Lake - Cheboygan	40	Mullett Lake, Center	38	Walloon Lake, North	44
Douglas Lake - Otsego	43	Mullet Lake, Pigeon Bay	37	Walloon Lake, West Arm	41
Elk Lake	34	Munro Lake	42	Walloon Lake, Wildwood	40
Lake Charlevoix, Main	34	Paradise Lake	46		

* 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.

Lake Charlevoix Fish Populations

By Dave Clapp, Watershed Council Board Member

Fish are difficult to count. They move constantly, don't leave much behind, and live in underwater realms that make observation difficult. To evaluate fish populations, biologists use "fishery-dependent" (counts of anglers' catch) and "fishery-independent" (netting and electrofishing) surveys. Lake Charlevoix was recently (2006-07) sampled using both strategies, so we have a good understanding of the current status of the lake's fish population. Netting surveys collected 31 species of fish, with more than 100 individuals collected for 9 of these species. Common species included game fish (walleye, northern pike, smallmouth bass) as well as large and small non-game fish (longnose gar, round goby).

Anglers took 20,000 fishing trips on Lake Charlevoix during 2006-07, fishing for more than 57,000 hours. Fishing effort was somewhat reduced, compared to that measured in the most recent previous survey (1996). Smallmouth bass and yellow perch made up the majority of the catch; more than 43,000 yellow perch and more than 8,700 smallmouth bass were caught during the 2006-07 season!

In addition to standard fisheries surveys, research is ongoing on Lake Charlevoix to answer more specific questions. For example, biologists are working to determine the contributions made to Great Lakes populations by fish spawning in Lake Charlevoix and Round Lake. Based on recent surveys, the status of fish populations in Lake Charlevoix is good. The lake supports a diverse fishery and fish community and, together with the Jordan River, Boyne River, and numerous smaller tributary streams, is a unique Michigan resource.

A white perch from Lake Charlevoix. Photo by Dan Traynor, MDNR.

For more information about fish populations, contact:

Lake Charlevoix Association
P.O. Box 294, Charlevoix, MI 49720
www.lakecharlevoixassociation.org

Jordan Valley Voices: Resource Book
Midener, P. (editor). 2002
Friends of the Jordan River Watershed, Inc.
www.friendsofthejordan.org

Michigan DNR
Large Lakes Program, Master Angler
and Fish Stocking databases, lake maps.
www.michigan.gov/dnr