9353 Hill Road • Swartz Creek, MI 48473
(810) 635-4400 • Fax (810) 635-4404
www.lakeproinc.com

2024 Lower Long Lake Water Quality Review

Introduction

The goals of this testing protocol were to monitor various water quality parameters of the lake, compare results to historical data, and identify any potential risks to the health of Lower Long Lake. Water samples were taken at four different locations and tested for 14 parameters. Tests were conducted once in the spring and once in the late summer. Tests were conducted with a YSI ProDSS Multiparameter Water Quality Meter or LaMotte SMART2 Colorimeter.

Test results were compared to historical data from the report "Lower Long Lake 2023 WQ Report" by LakePro, Inc.

In this report, we included historical data from Water Quality Investigators. Their report provided annual averages for many of the parameters from 2002 to 2009. Including this data allows us to see more accurate trends in the water quality data. In order to make the analysis easier, we added annual averages for our data and trendlines on the graphs. The trend lines allow us to see the direction each water quality parameter is moving.

Results

Parameter	2024 Season Average	Target Range	Status
Temperature	68.2 ˚F	Less Than 75 ˚F	● Healthy
Dissolved Oxygen	7.6 mg/L	4.0 – 12.0 mg/L	● Healthy
Total Phosphorus	76 ppb	0 – 100 ppb	● Healthy
Phosphate	40 ppb	0 – 100 ppb	● Healthy
Nitrate	53 ppb	0 – 200 ppb	● Healthy
Chlorophyll-a	1.9 ppb	0 – 7.3 ppb	● Healthy
Transparency	19.3 feet	More than 6.5 feet	● Healthy
pH	8.3 S.U.	7.0 – 9.0 S.U.	● Healthy
Total Dissolved Solids	520 ppm	0 – 1,000 ppm	● Healthy
Conductivity	731 ppm	0 – 1,500 ppm	● Healthy
Alkalinity	128 ppm	100 – 250 ppm	● Healthy
Sulfate	11.0 ppm	3 – 30 ppm	● Healthy
Fluoride	0.10 ppm	0.01 – 0.30 ppm	● Healthy
Chloride	141 ppm	0 – 230 ppm	● Healthy

Preface

2024 was LakePro's fourteenth year testing water quality on Lower Long Lake. The historical data reveals trends over the testing history. The trend lines on the following graphs show the change from 2002 to 2024. Each successive year of testing will provide more insight into how the lake changed.

Discussion

The results of this year's testing indicate that the water of Lower Long Lake remained outstanding throughout the summer. The results show that the aquatic environment was very suitable to support natural wildlife. Also, the lake was safe for recreational uses, such as swimming, boating, fishing, etc., as there are no signs of pollution.

The **Temperature** of the surface water was warmer than usual to start the season due to the warm winter we observed. The temperature then increased slightly into the late summer as expected. The **Dissolved Oxygen** in the lake remained excellent throughout the summer. Furthermore, the sufficient oxygen concentration was a positive attribute headed into winter when ice seals the lake off from atmospheric oxygen.

The concentrations of both **Total Phosphorus** and Phosphate were within the target range throughout the summer. **Phosphate** is the usable form of phosphorus.

The **Nitrate** concentrations remained comfortably within the target range throughout the entire summer. We observed a slight increase this year, and it should be noted that it is important that residents take measures to ensure their property is not contributing excess fertilizers to the lake.

We tested water samples for **Chlorophyll** as a direct indicator of plant production. The chlorophyll concentrations responded strongly to the water temperatures, increasing over the course of the summer and overall, surpassing last year's results. During all tests the plant pigment was within the target range at all four sites.

The **Transparency** was excellent during every test, measuring deeper than most other lakes that we tested. Transparency can be affected by many different factors, including suspended solids, dissolved solids, acids, and algae growth. The clear water is generally a positive attribute, but it also allows more sunlight to reach the lake bottom to fuel plant growth.

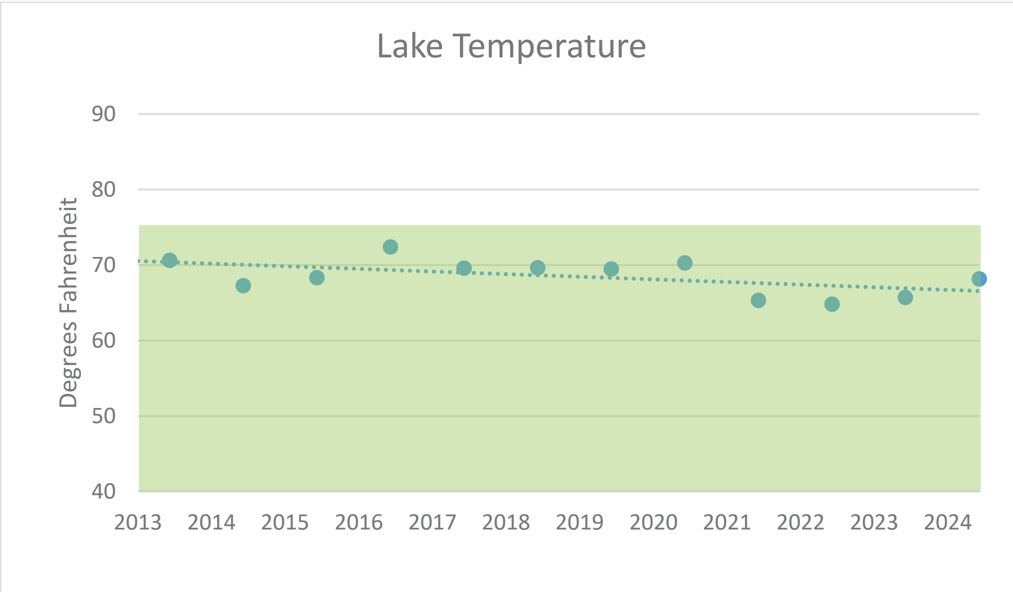
The **pH** was within the target during all testing events.

The **Total Dissolved Solids** and **Conductivity** consistently remained within their designated target ranges during all tests. As the summer progressed and rainfall increased, these parameters experienced a gradual rise due to heightened runoff, introducing foreign substances into the lake. Overall, this years test shows a gradual decrease in TDS, and a small increase in conductivity.

The **Alkalinity** was within the target range all summer but decreased throughout the summer. The major reason for the decrease in the late summer was productivity. As lake organisms become more active in the summertime, they produce more carbon dioxide. As this gas dissolves, it needs to be buffered, using up the carbonate ions. Rainfall in July infiltrated the ground and reached limestone bedrock. As this additional water reached the lake, it replenished the alkalinity in August.

The **Sulfate, Fluoride,** and **Chloride** were all within their target ranges for the entire summer.

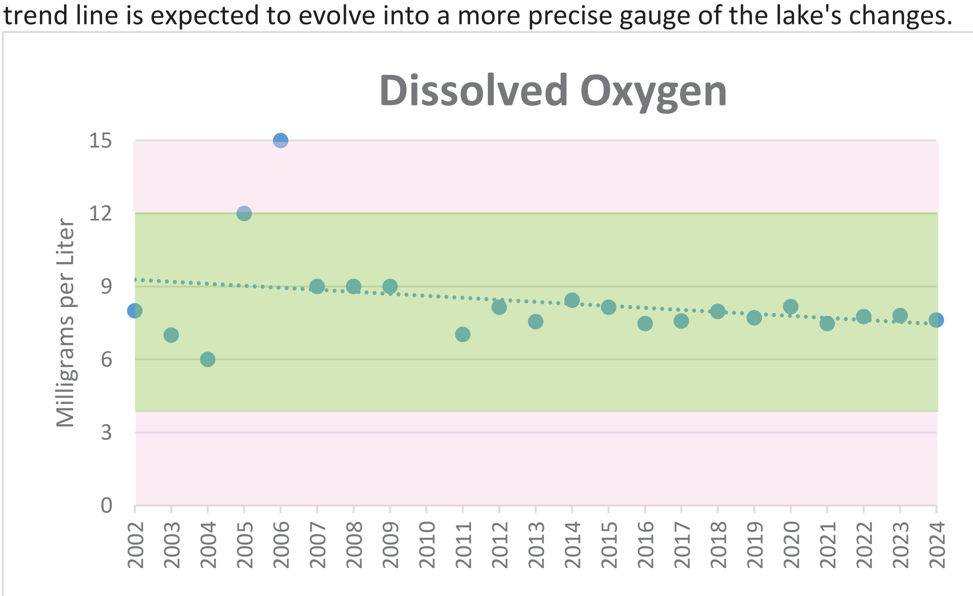
Historical Trends



Temperature (°F)		
	May	August
Site 1	54.2	81.1
Site 2	54.5	80.8
Site 3	55.6	80.3
Site 4	58.5	80.1
	Season Average	68.1

Target Range: < 75˚F

The historical temperature trend has shown minimal alteration. Temperature fluctuations were influenced by the chosen testing dates and the annual weather variations. As we continue gathering data in the years ahead, the trend line is expected to evolve into a more precise gauge of the lake's changes.



Dissolved Oxygen		
	May	August
Site 1	8.1	7.3
Site 2	8.2	7.0
Site 3	7.9	7.0
Site 4	8.2	7.2
	Season Average	7.6

Target Range: 4.0 – 12.0 mg/L

The dissolved oxygen trend showed a slight decrease over the testing history and an upward tick during last year and this year’s testing events. Oxygen concentrations remained extremely healthy, showing the lake carries a healthy oxygen concentration despite temperature changes. Monitoring this trend will persist, and if a more pronounced decline occurs, we will advise additional measures accordingly.

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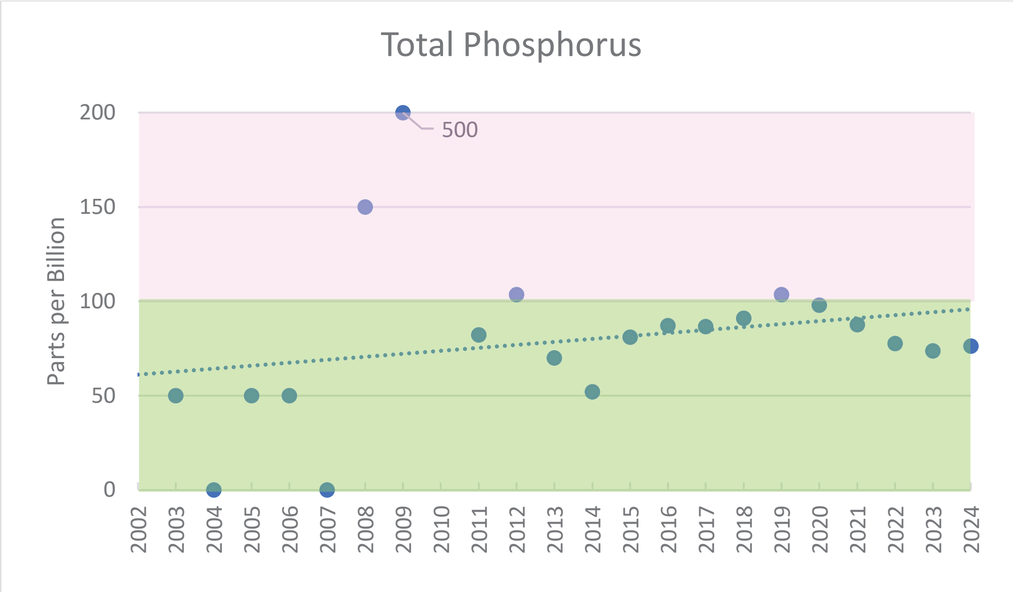
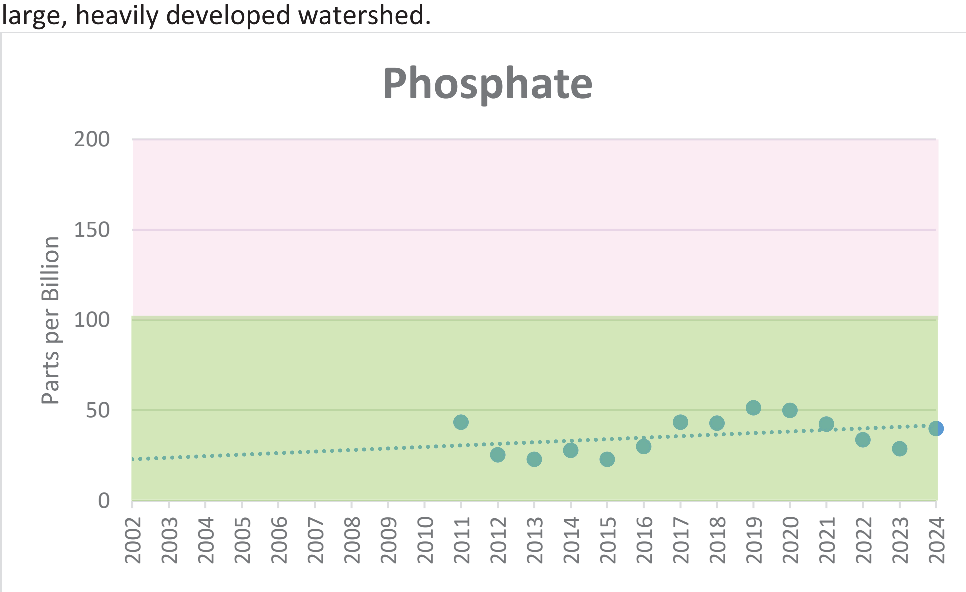


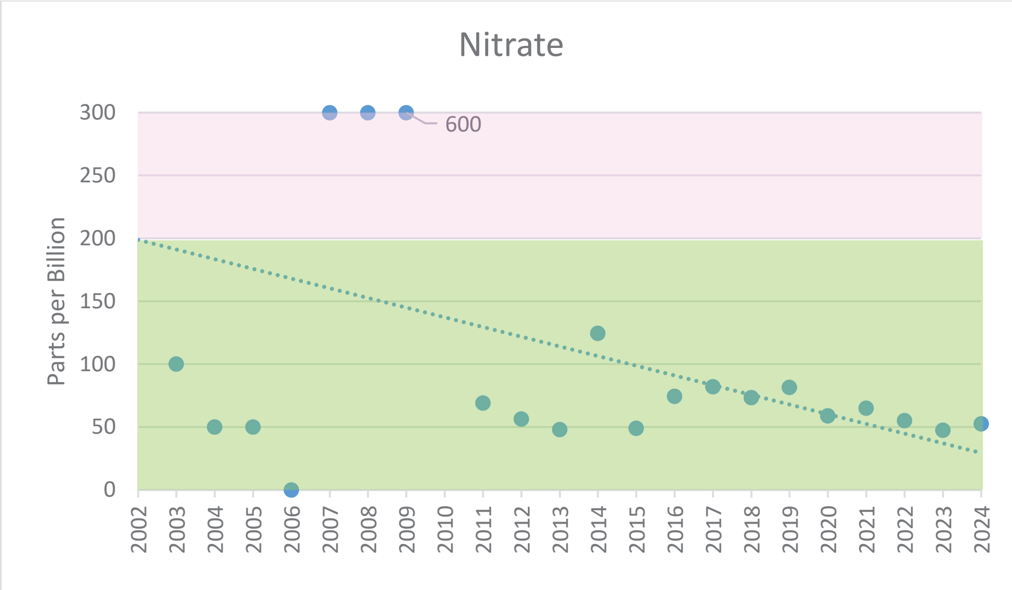
Total Phosphorus		
	May	August
Site 1	90	70
Site 2	90	60
Site 3	86	58
Site 4	100	50
	Season Average	76

Target Range: 0 – 100 ppb
The total phosphorus annual averages showed a steady increase up until 2019. The last 5 years however have showed a decrease, on par with 2022 data. Lakes generally accumulate substances, including nutrients, in the process of eutrophication. The state law banning phosphorus fertilizers and active plant management will help decrease phosphorus continuing in the future. The phosphorus concentrations were exceptionally good for a large, heavily developed watershed.



Phosphate		
	May	August
Site 1	44	40
Site 2	42	36
Site 3	40	37
Site 4	41	37
	Season Average	40

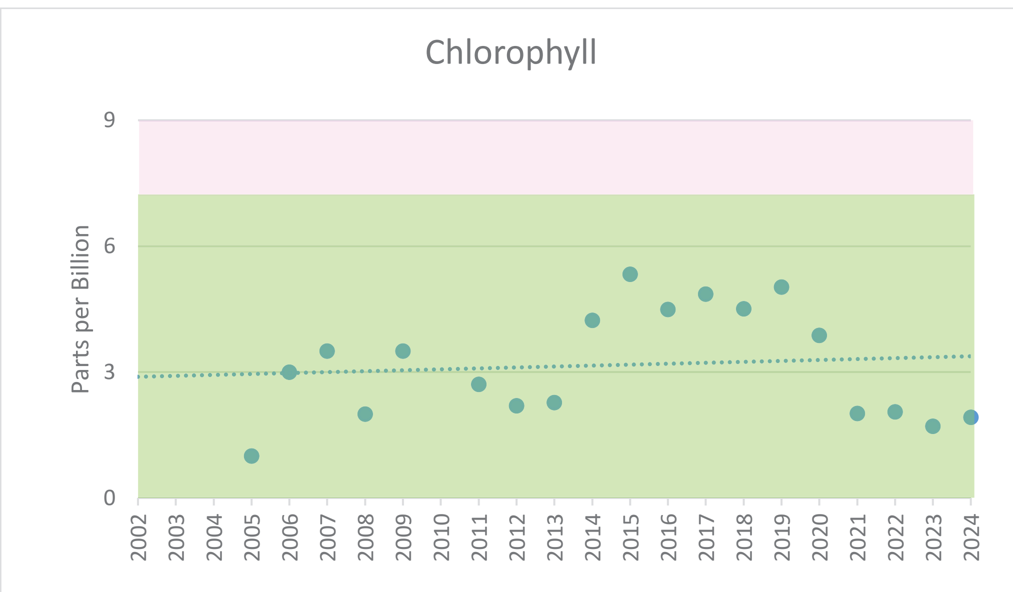
Target Range: 0 – 100 ppb
Phosphate is the form of phosphorus that is usable to aquatic plants. The phosphate data also showed a slightly upward trend since we began testing this parameter in 2011. Despite the increase, the phosphate remained within the target range with a slight decline and helped to limit plant and algae growth in the lake.



Nitrate		
	May	August
Site 1	75	25
Site 2	77	30
Site 3	90	30
Site 4	74	20
	Season Average	53

Target Range: 0 – 200 ppb

Nitrate is another vital nutrient for the growth of aquatic plants. Water Quality Investigators obtained high results early in the testing history, so the recent data resulted in a downward historical trend. It is important residents continue to be conscience of their property and practices to ensure more nutrients do not enter the lake.



Chlorophyll		
	May	August
Site 1	1.1	2.9
Site 2	0.9	3.0
Site 3	1.2	2.7
Site 4	0.9	2.1
	Season Average	1.9

Target Range: 0 – 7.2 ppb

Chlorophyll concentrations were tested as an indicator of plant production, primarily algae in the water column. Over the testing history, the results increased steadily, which matched the increase in total phosphorus. This is also common with invasive plants in the lake, such as Eurasian Milfoil. This reinforces the urgency for responsible land management in the watershed to prevent additional phosphorus from entering the lake. Over the past 4 years however, both chlorophyll and total phosphorus have been on the lower end.

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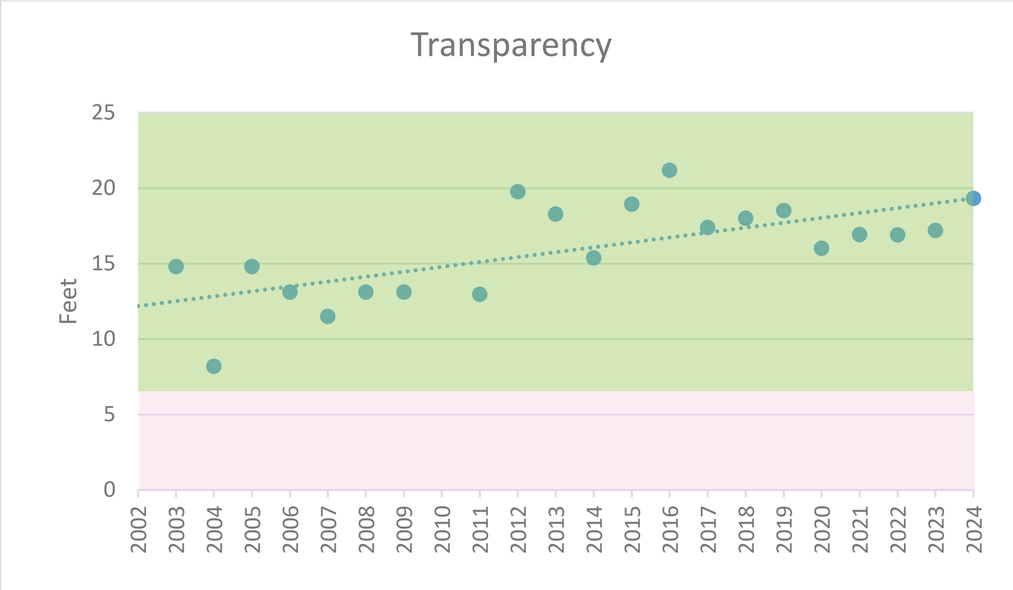
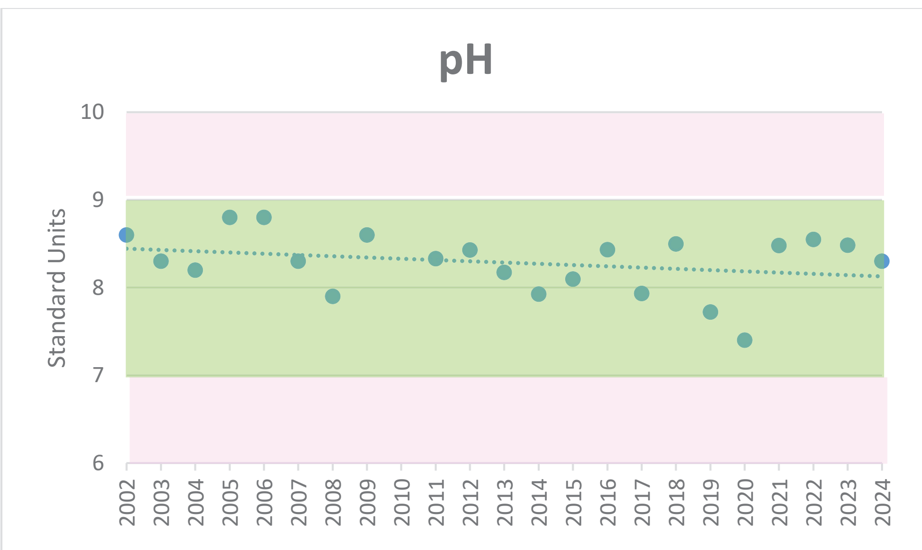


Transparency

	May	August
Site 1	19.3	19.6
Site 2	18.2	19.7
Site 3	18.8	18.8
Site 4	19.5	20.1
	Season Average	**19.3**

Target Range: > 6.5 feet

Transparency was affected by total dissolved solids, total suspended solids, algae growth, and rain frequency and amount. Overall, the transparency of the lake increased over the testing history



pH

	May	August
Site 1	8.4	8.2
Site 2	8.6	8.4
Site 3	8.3	8.1
Site 4	8.2	8.1
	Season Average	**8.3**

Target Range: 7.0 – 9.0 S.U.

There was a slight decrease in pH over the testing history, but it stayed in the target range of 7 to 9. We will look for the pH to remain level in future years. If the pH ever drops drastically, we will look for the cause of that change in order to mitigate the trend.

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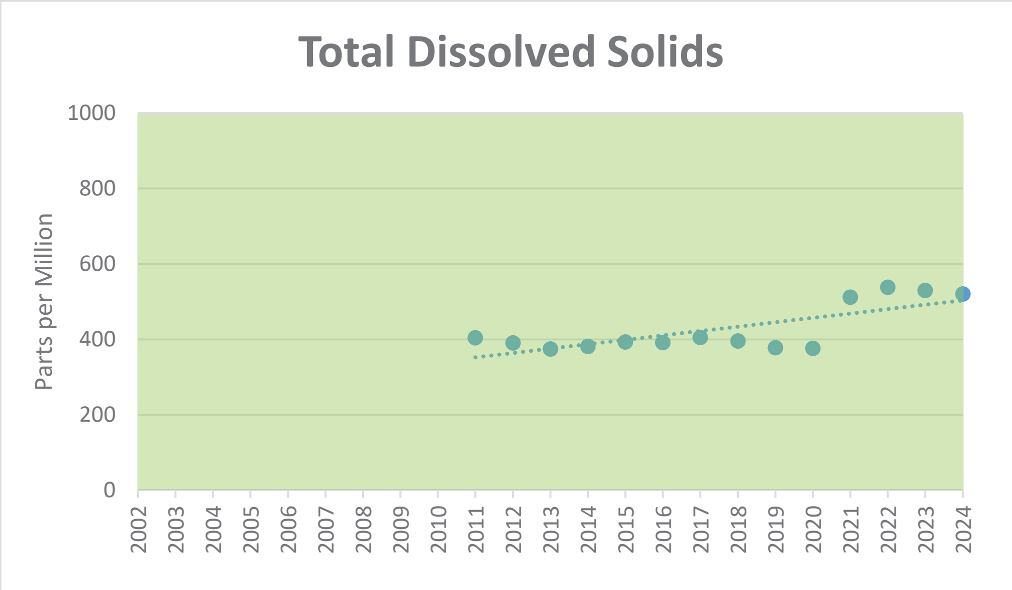
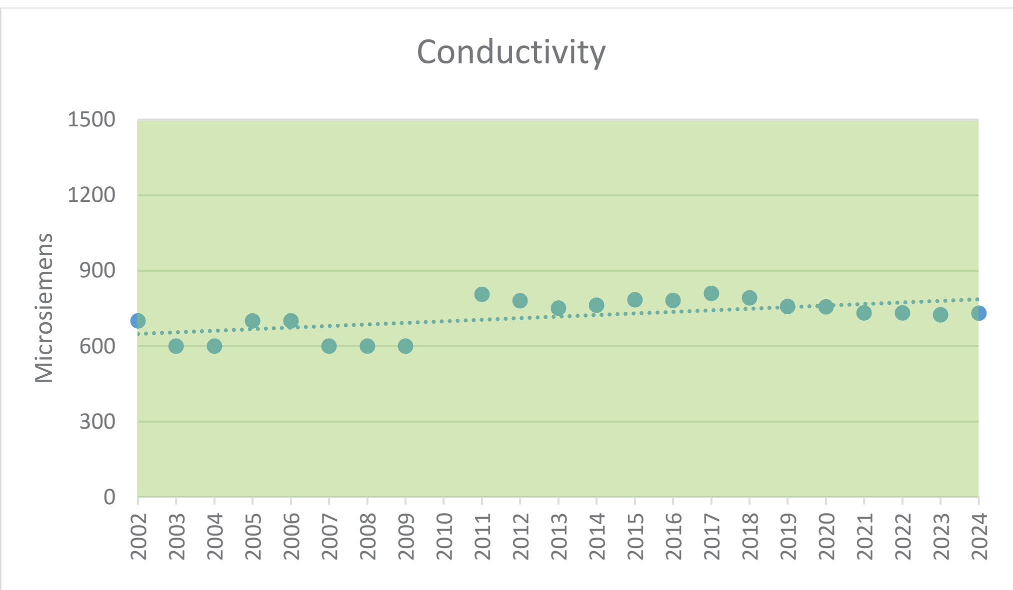
Target Range: 0 – 1,000 ppm



Total Dissolved Solids		
	May	August
Site 1	511	531
Site 2	521	498
Site 3	520	505
Site 4	536	540
	Season Average	520

The Total Dissolved Solids showed a slight upward trend over the testing history. This is common for inland lakes as they accumulate more substances from their watershed and the atmosphere.



Conductivity		
	May	August
Site 1	733	724
Site 2	729	740
Site 3	732	720
Site 4	741	726
	Season Average	731

Target Range: 0 – 1,500 µS

Like the TDS, Conductivity showed a slight upward trend. Conductivity is an extension of TDS and measures the number of ionic molecules in the water (which conduct electricity, usually salts).

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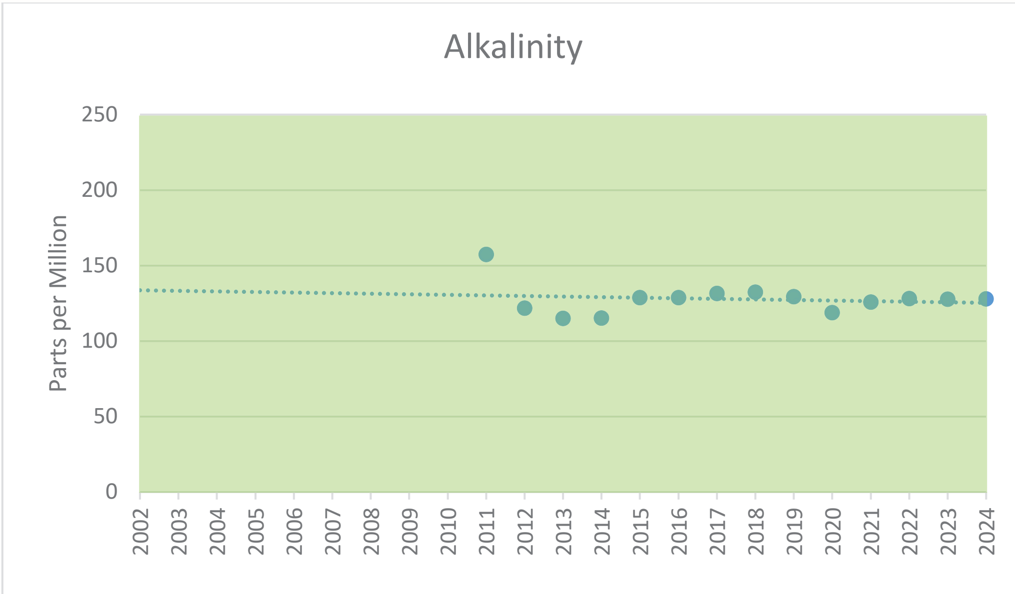
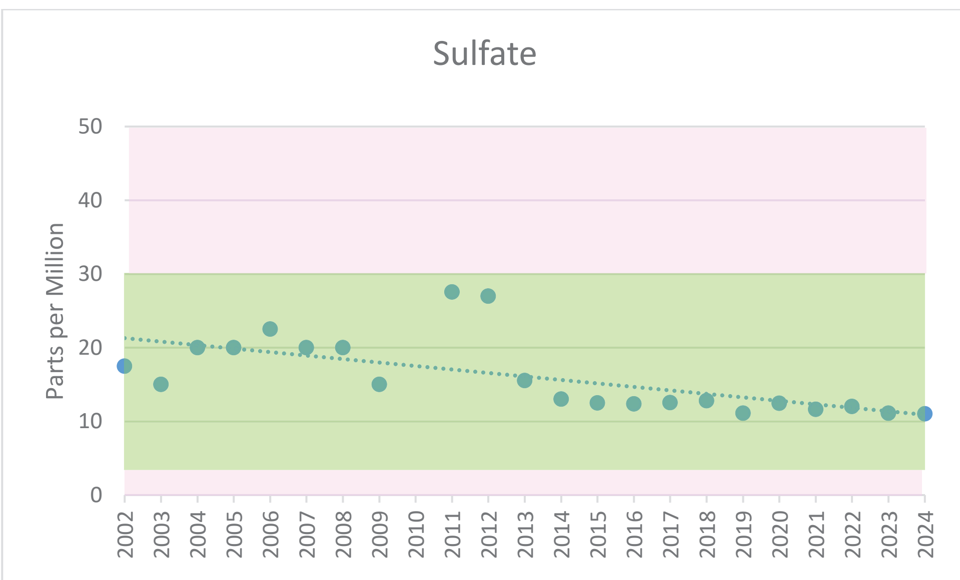


Alkalinity

	May	August
Site 1	132	135
Site 2	135	126
Site 3	129	124
Site 4	121	119
	Season Average	128

Target Range: 0 – 250 ppm

LakePro started testing this parameter in 2011. Since then, the alkalinity decreased slightly. Alkalinity works as a buffer to stabilize the pH when foreign substances enter the lake, so it is important this parameter stay at a healthy level to protect the lake from other changes.



Sulfate

	May	August
Site 1	12.0	11.0
Site 2	16.0	10.0
Site 3	10.0	10.0
Site 4	9.0	10.0
	Season Average	11.0

Target Range: 3 – 30 ppm

Calcium sulfate and magnesium sulfate are common minerals in surface water, so some sulfate should be present. Elevated levels of sulfate can indicate pollution. Over the testing history, sulfate remained within the target range and decreased toward the bottom of the target range.

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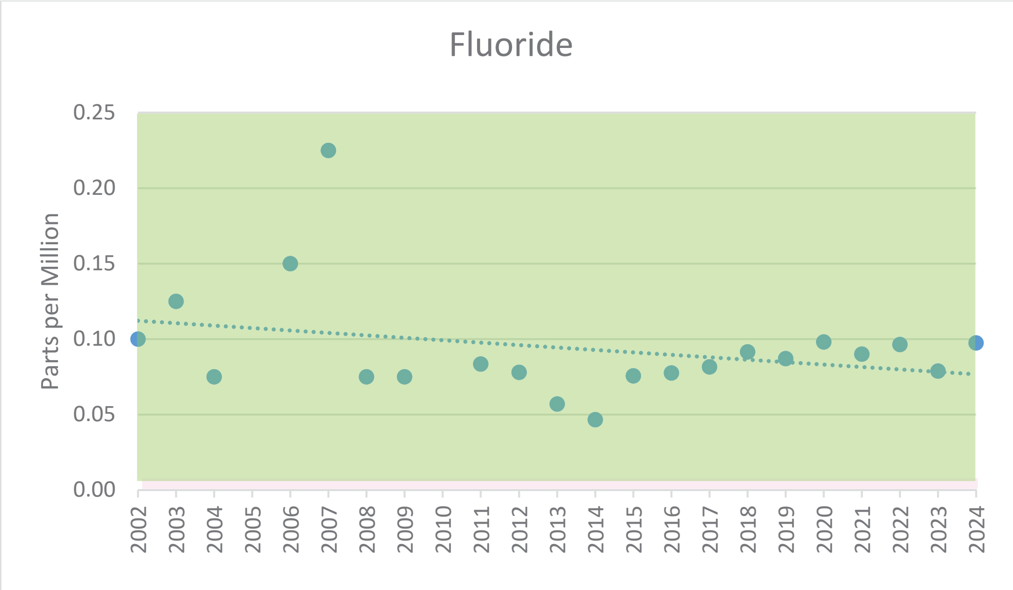
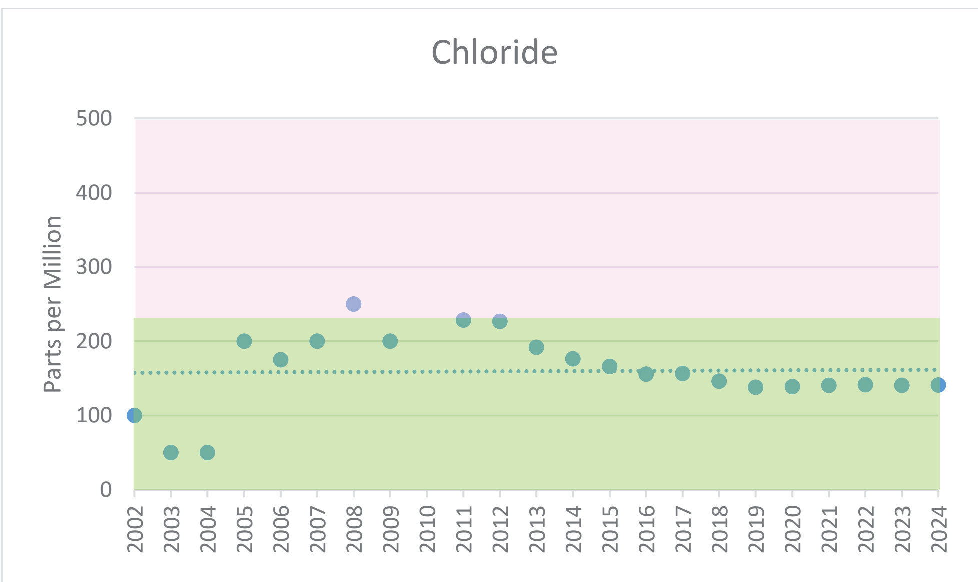


Fluoride		
	May	August
Site 1	0.07	0.10
Site 2	0.08	0.11
Site 3	0.09	0.10
Site 4	0.10	0.12
	Season Average	0.10

Target Range: 0.01 – 0.30 ppm

Fluoride occurs naturally in ground water, so some may be present in the lake surface water. Elevated levels can indicate pollution but are not physiologically harmful. Over the testing history, fluoride remained comfortably within the target range.



Chloride		
	May	August
Site 1	149	138
Site 2	146	135
Site 3	146	131
Site 4	137	142
	Season Average	141

Target Range: 0 – 230 ppm

Chloride is a major anion found in water. This substance may be due to the natural process of water passing through salt formations in the earth or may be evidence of the intrusion of pollution from industrial processes or road salting. The trend was slightly upward due to high concentrations from 2005 to 2012. Since then, there has been a steady downward trend.

Conclusion

Overall, the water quality of Lower Long Lake was excellent again this year. All other parameters remained within their target ranges, and some were the best we saw across the state. To continue this path in keeping the waterbody healthy, it is vital that everyone within the watershed take steps to limit their nutrient input to the lake.

Despite being situated within a densely developed watershed and being bordered by residential properties, Lower Long Lake stands as a remarkable water resource boasting exceptional water quality. While there are inevitably aspects where water quality enhancements are possible, the lake consistently ranks among the top performers in our evaluations. You should take pride in your association with this lake and continue in your diligent efforts towards its ongoing enhancement.

Thanks for choosing LakePro,

Michael Smith

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Brighton Analytical L.L.C. ™

2105 Pless Drive Brighton, Michigan 48114 Phone (810)229-7575 Fax (810)229-8650 E-mail labs@brightonanalytical.com

August 26, 2024

Lake Pro, Inc.
9353 Hill Road
Swartz Creek, MI 48473

Subject: Lower Long Lake

Dear : Mr. Smith

Thank you for making Brighton Analytical, L.L.C. your laboratory of choice. Attached are the results for the samples submitted on 08/21/2024 for the above mentioned project. NELAP/TNI Accredited Analysis and EGLE Drinking Water Certified Analysis will be identified in their respective reporting formats. Hard copies can be supplied at your request for a fee of $20.00 per copy.

The invoice for this project will be emailed separately. If you have any questions concerning the data or invoice, please don't hesitate to contact our office. We welcome your comments and suggestions to improve our quality systems. Please reference Brighton Analytical, L.L.C. Project ID 102314 when calling or emailing. We thank you for this opportunity to partner with you on this project and hope to work with you again in the future.

Sincerely,
Brighton Analytical, L.L.C.

EGLE
Environment, Great Lakes, and Energy

Brighton Analytical LLC
2105 Pless Drive
Brighton, Michigan 48114
Phone: (810)229-7575 (810)229-8650 e-mail: labs@brightonanalytical.com
EGLE Certified #9404
NELAC Accredited #176507

Sample Date: 08/20/2024
Submit Date: 08/21/2024
Report Date: 08/26/2024

To:
Lake Pro, Inc.
9353 Hill Road
Swartz Creek, MI 48473

BA Report Number: **102314** Project Name: **Lower Long Lake**

BA Sample ID: **CW02656** Project Number:

Sample ID: **Site #3**

Parameters	Result	Units	DL	Method Reference		
Total Metal Analysis						
Total Arsenic	**2**	ug/L	1	EPA 200.8 rev5.4	LT	08/22/2024
Total Cadmium	**Not detected**	ug/L	0.2	EPA 200.8 rev5.4	LT	08/22/2024
Total Chromium	**Not detected**	ug/L	5	EPA 200.8 rev5.4	LT	08/22/2024
Total Copper	**Not detected**	ug/L	4	EPA 200.8 rev5.4	LT	08/22/2024
Total Iron	**70**	ug/L	20	EPA 200.8 rev5.4	LT	08/22/2024
Total Lead	**Not detected**	ug/L	3	EPA 200.8 rev5.4	LT	08/22/2024
Total Mercury	**Not detected**	ug/L	0.2	EPA 245.1	LT	08/23/2024
Total Nickel	**Not detected**	ug/L	20	EPA 200.8 rev5.4	LT	08/22/2024
Total Silver	**Not detected**	ug/L	0.2	EPA 200.8 rev5.4	LT	08/22/2024
Total Zinc	**Not detected**	ug/L	10	EPA 200.8 rev5.4	LT	08/22/2024
Mercury (digestion)	**Digested**			7470/7471	LT	08/23/2024
Metal Water Total (digest)	**Extracted**			3020A	MH	08/22/2024

DL=Reported detection limit for analytical method requested. Some compounds require special analytical methods to achieve EGLE designated target detection limits (TDL).

Released by Cynthia L Williams

Date 8/26/2024

Brighton Analytical L.L.C.

METHODS REGULATED BY NELAC AND OR STATE OF MICHIGAN

- EPA 120.1-1982
- EPA 150.1-1982
- EPA 160.2-1979
- EPA 160.3-1979
- EPA 1631E-2002
- EPA 200.7-1994
- EPA 200.8 REV 5.4-1994
- EPA 245.1-1994
- EPA 245.2-1974
- EPA 300.0R2.1-1993
- EPA 310.1-1978
- EPA 335.1-1974
- EPA 335.4-1993
- EPA 350.1 REV.2-1993
- EPA 351.2 REV.2-1993
- EPA 365.2-1971
- EPA 405.1-1974
- EPA 410.4 REV.2-1993
- EPA 415.1-1974
- EPA 420.1-1978
- EPA 524.4-2013
- EPA 608.3-2016
- EPA 615-1993
- EPA 624-1984
- EPA 624.1-2016
- EPA 625-1984
- EPA 625.1-2016
- SM 2540C-1997
- SM 2540D-1997
- SM 4500 H+B-1996
- SM 4500 PE-1997
- SM 5210B-1997
- SM 5310B-1996
- SM 9223B-1997
- SW846 6010B-1996
- SW846 6020A-2007
- SW846 7471-1994
- SW846 8081B-2007
- SW846 8082A-2000
- SW846 8151A-1996
- SW846 8260C-2006
- SW846 8270D-2007
- SW846 9040B-1994

Brighton Analytical L.L.C.

BRIGHTON ANALYTICAL, LLC

QUALITY ASSURANCE/QUALITY CONTROL

REPRESENTATIVE BATCH QUALITY CONTROL

Accuracy & Precision

Analyst: LT **Parameter:** Mercury

Analysis Date: 08/23/24 **Method Reference:** 245.1/7470/7471

Matrix: Total **Batch:** W1

SPIKE - ACCURACY					
Laboratory ID	**Spike Concentration (ug/L)**	**Background (ug/L)**	**Recoveries (%)**	**Acceptable Range (%)**	**Method Blank Concentration (ug/L)**
CW02504	2.00	0.029	102 / 105	70 - 130	<0.2

SPIKE - ACCURACY					
Laboratory ID	**Observed A (ug/L)**	**Observed B (ug/L)**	**RPD (%)**	**Acceptable Range (%)**	
CW02504	2.06	2.13	0.73	0 - 20	

Method Standard (Laboratory Control Spike):				
	Standard ID #	**Recovery (%)**	**Acceptable Range (%)**	
Independent Secondary Reference Material:	Spex 082324	94.6	90 - 110	
Method Standard (Laboratory Control Spike):	Hg- 082324	100.9	85 - 115	

COMMENTS: ______________________________

ICP-MS

EPA METHOD 200.8/6020

REPRESENTATIVE BATCH PRECISION AND ACCURACY QUALITY CONTROL SUMMARY

Analysis Date: 8/22/2024 Standard ID: 081924 H2O Batch: 08/22/2024 W1

Matrix Spike Lab ID: CW02669 Matrix: Total Analyst: LT

Metals	Matrix Spike - Precision *			Matrix Spike - Accuracy**				Miscellaneous***		
	Matrix Spike (ug/L)	Matrix Spike Dup (ug/L)	RPD (%)	Spk Conc (ug/L)	MS Recovery (%)	MSD Recovery (%)	Sample Conc (ug/L)	Method Blk (ug/L)	LCS-Method STD (%)	Ind. Std. SPEX 1&3 (%)
Beryllium	937	938	0.1	1000	93.7	93.8	0	<1	102.5	94.5
Sodium	39624	42287	6.5	10000	77.6	104.3	31862	<1000	96.2	95.1
Magnesium	16703	17842	6.6	10000	85.5	96.8	8158	<100	98.2	91.8
Aluminium	945	1010	6.6	1000	92.4	98.9	21	<50	95.4	93.5
Potassium	27791	29434	5.7	10000	87.4	103.9	19047	<100	97.6	94.7
Calcium	643093	682903	6.0	10000	0.0	190.3	663872	<100	97.7	93.2
Vanadium	1029	1043	1.4	1000	102.9	104.3	0	<1	106.4	98.0
Chromium	1039	1055	1.5	1000	102.3	103.9	16	<1	105.6	98.7
Manganese	1034	1035	0.1	1000	101.9	102.0	15	<5	102.1	98.8
Iron	9981	10351	3.6	10000	94.4	98.1	540	<20	100.4	97.2
Cobalt	1041	1035	0.6	1000	104.1	103.5	0	<10	101.7	98.6
Nickel	977	982	0.5	1000	97.3	97.8	4	<1	100.9	98.5
Copper	1246	1249	0.2	1000	105.0	105.3	196	<1	107.4	101.1
Zinc	1276	1257	1.5	1000	108.8	106.9	188	<10	107.4	100.4
Arsenic	1042	1044	0.2	1000	104.0	104.2	2	<1	104.2	95.6
Selenium	1043	1074	2.9	1000	104.3	107.4	0	<1	101.0	94.5
Molybdenum	986	1040	5.3	1000	97.5	102.9	11	<10	108.0	96.2
Silver	9.76	10.16	4.1	10	97.6	101.6	0	<0.2	97.8	103.3
Cadmium	925	959	3.6	1000	92.5	95.9	0	<0.2	98.4	94.1
Antimony	932	1030	10.0	1000	92.9	102.7	3	<1	88.3	109.6
Barium	1115	1157	3.7	1000	102.5	106.7	90	<5	113.9	94.3
Thallium	1008	1012	0.4	1000	100.8	101.2	0	<0.5	93.0	96.7
Lead	1042	1055	1.2	1000	104.0	105.3	2	<1	97.8	99.7

* Matrix spike precision range +/- 20% RPD
** Matrix spike accuracy range +/- 30% recovery
*** LCS accuracy range +/- 15% recovery / Ind std accuracy range +/- 10% recovery

Comments: Ca out of range due to sample matrix

Analysis Information

Temperature:	The water temperature directly affects the amount of oxygen that can dissolve into the water. The temperature of surface waters is not indicative of the entire water column.
Transparency:	The ability of light to penetrate the water column is determined by the amount of dissolved and suspended particles in the water. Although aesthetically desirable, transparent water allows increased light to reach the lakebed and may result in vegetation growth.
pH:	pH is a measure of acidity or alkalinity. pH is a general measure of lake health and can roughly indicate the range of other measurements such as alkalinity and hardness.
TDS:	Total Dissolved Solids is the amount of all organic and inorganic substances in the water in a molecular or ionized state. Higher values generally indicate richer and more productive water. Lower values usually indicate cleaner and less productive water.
Conductivity:	Conductivity is a measure of the ability of water to conduct electricity. Dissolved ions in the water increase conductivity, thus TDS and Conductivity are closely related.
Alkalinity:	Alkalinity refers to the ability of the water to neutralize acids, mainly through the hydrogenation of carbonate ions. Therefore, the alkalinity is expressed as “ppm as $CaCO_3$”. However, other basic molecules in the water can also contribute to alkalinity.
Dissolved Oxygen:	D.O. is a measure of the amount of oxygen dissolved in the water. This oxygen is available to fish and other animals for respiration. Vegetation generally increases DO, particularly during the day and early evening. Animals and other respiring organisms consume the oxygen, mostly during the day. Oxygen is also added to the lake through wave action, rain, fountains and aerators.
Total Phosphorus:	Phosphorus is an essential nutrient for plant growth. However, concentrations exceeding 100 ppb can impair the water and results in nuisance vegetation growth.
Phosphates:	Phosphate is the form of phosphorous that is most readily available to plants and algae.
Nitrate:	Nitrogen is also essential for plant growth. Nitrate is the predominant form of nitrogen in water. Excessive nitrate concentrations may also result in pollution and increased vegetation.
Chlorophyll-a:	Chlorophyll-a is a direct measurement of the amount of green pigment produced by plants and phytoplankton. This indicates the amount of plant growth and is used to calculate a Trophic State Index.
Sulfate:	Sulfate occurs naturally as minerals, such as calcium sulfate and magnesium sulfate. In fresh water, sulfate is usually the second or third most abundant anion. Other sources of sulfate include water material from pulp mills, steel mills, food processing operations, and municipal wastes. Under low oxygen conditions, sulfate can by reduced to hydrogen sulfide gas, which smells like rotten eggs.
Fluoride:	Fluoride may occur naturally or be added to public drinking water supplies.
Chloride:	Chloride is one of the major anions found in water and sewage. The presence of chlorides may be due to water passing through salt formations in the earth or pollution from industrial processes, domestic wastes, or road salt. The salt content of water affects the

distribution of plant and animal life in an aquatic system, based on the amount of slat they can tolerate.

Fecal Coliforms: Non-fecal coliforms are naturally found as soil organisms. Fecal Coliforms, such as *E. coli*, are coliforms found in the intestines of warm-blooded animals and humans. The presence of fecal coliforms indicates contamination from either animals or humans.

Trophic States

Oligotrophic: Water is very clear. Nutrient levels are generally low. Plant and algae productivity are also low. Sufficient dissolved oxygen in the bottom, cooler waters allow cold-water fish to survive, such as salmon and trout.

Mesotrophic: Water is moderately clear. Nutrient levels are slightly elevated. Plant and algae productivity are present, but generally not a nuisance. Oxygen and temperature in the lower portion of the lake allow walleye and perch to survive.

Eutrophic: Water is not clear due to high nutrients levels, increased turbidity, and excessive algal growth. There is no oxygen in the bottom, cooler waters, restricting the lake to warm water species, such as bass and bluegill.

Hypereutrophic: Nutrient levels are extremely high, promoting very high algae productivity. Blue-green algae blooms are likely. High turbidity and algae growth make the water opaque. Little plant growth is restricted to invasive plants. The only fish that can survive this environment are rough fish, such as carp, catfish, and mudminnows.

Sample Sites: