Lime Lake Questions and Answers, 2014 CSLAP

Q1. What is the condition of our lake this year?

A1. Water quality conditions in Lime Lake were more favorable than usual in 2014, and these conditions appear to have improved over the last decade. Fewer (and much shorter duration) shoreline blue green algae blooms were reported in 2014, water clarity was higher and recreational assessments were more favorable.

Q2. Is there anything new that showed up in the testing this year?

A2. The HABs testing includes information about the types of algae found in the water samples. These results showed low open water total and blue green algae levels, and fewer shoreline blue green algae blooms (although these still exhibited high toxins). It is not known if the reduction in shoreline blooms in recent years reflects improved conditions or a temporary phenomenon.

Q3. How does the condition of our lake this year compare with other lakes in the area?

A3. Lime Lake had higher water clarity, and lower nutrient and algae levels, than the typical lake in the area. Aquatic plant coverage was lower than in these other lakes in 2014, but this may be due to the lake treatment.

Q4. Are there any trends in our lake's condition?

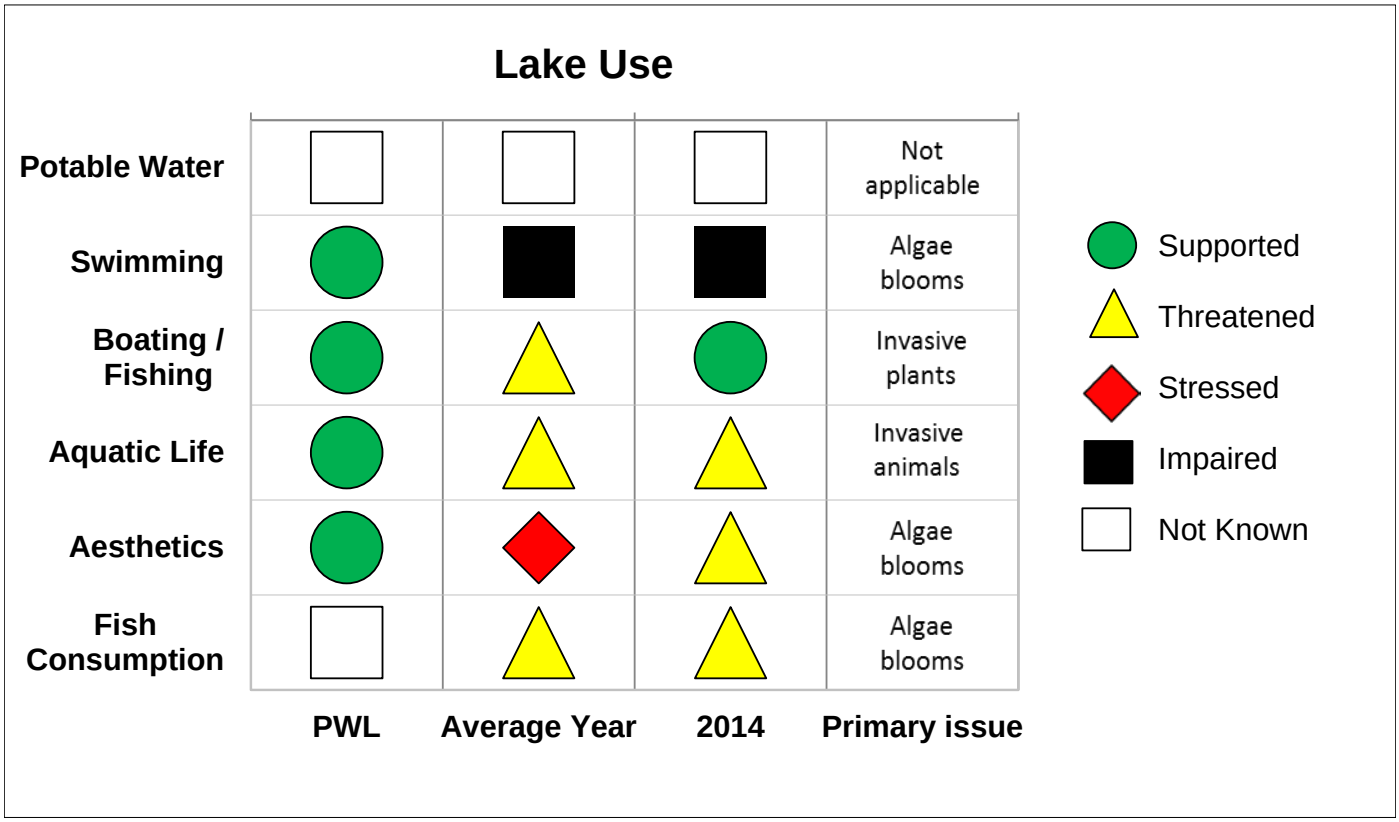
A4. pH has decreased since the early 2000s, consistent with a slight drop in conductivity, and water temperatures have dropped since the late 1990s. Water clarity has increased over the last decade.

Q5. Should we be concerned about the condition of our lake? Are we close to a tipping point?

A5. Lime Lake is highly susceptible to shoreline blue green algae blooms, but the "trigger" in any given year (or time of year) is not yet known. This susceptibility will likely decrease with reductions in nutrient loading to the lake.

Q6. Are any actions indicated, based on the trends and this year's results?

A6. Individual stewardship activities such as pumping your septic system, growing a buffer of native plants next to the water bodies, and reducing erosion from shoreline properties and runoff into the lake will help to maintain lake health by reducing nutrient and sediment loading to the lake. Visiting boats should be inspected to reduce the risk of new invasive species, since nearby lakes harbor several invasive plants not presently found in the lake.



CSLAP 2014 Lake Water Quality Summary:
Lime Lake

General Lake Information

Location	Town of Machias
County	Cattaraugus
Basin	Niagara River/Lake Erie
Size	64. 3 hectares (158.9 acres)
Lake Origins	Augmented by 12’ by 200’ earthen dam built in 1850
Watershed Area	388.5 hectares (960 acres)
Retention Time	1.4 years
Mean Depth	4.6 meters
Sounding Depth	10.7 meters
Public Access	state (DEC) cartop launch
Major Tributaries	None
Lake Tributary To…	Lime Lake Outlet and tribs
WQ Classification	B
Lake Outlet Latitude	42.435
Lake Outlet Longitude	-78.475833
Sampling Years	1997-1999, 2001-2002, 2005, 2011-2014
2014 Samplers	Gail & Tom Reese, Sean and Wendy Thompson, and Marcia and Billy Bender
Main Contact	Gail Reese

Lake Map

Background

Lime Lake is a 159 acre, class B(T) lake found in the Town of Machias in Cattaraugus County, in western New York State. It was first sampled as part of CSLAP in 1997.

It is the only CSLAP lakes among the more than 20 lakes found in Cattaraugus County, and one of two CSLAP lakes among the more than 120 lakes and ponds in the Lake Erie-Niagara River drainage basin.

Lake Uses

Lime Lake is a Class B lake; this means that the best intended use for the lake is for contact recreation—swimming and bathing, non-contact recreation—fishing and boating, aquatic life, and aesthetics. The lake is used by lake residents and invited guests for swimming and passive boating, and the lake has a state cartop launch site (with a parking lot supporting 12 cars) to support the use of the lake by visitors. The village of Lime Lake supports a number of activities associated with the lake.

Approximately 550 12" muskellunge are stocked in Lime Lake by the state of New York. Walleye have also historically been stocked in the lake.

General statewide fishing regulations are applicable in Lime Lake. In addition, the open season for walleye lasts from the first Saturday in May through March 15th, with a minimum take length of 18" and a daily take limit of 3. Ice fishing is allowed.

Historical Water Quality Data

CSLAP sampling was conducted on Lime Lake each year from 1987-1994, 1997-2001, 2004-2005, and 2011-2014. Most of the previous years' CSLAP reports can be found on the NYSFOLA website at http://nysfola.mylaketown.com. The most recent CSLAP report and scorecard for Lime Lake is also found on the NYSDEC web page at http://www.dec.ny.gov/lands/77883.html.

Lime Lake was sampled as part of the DEC Lake Classification and Inventory (LCI) survey in 1985. These data indicate that pH and conductivity were slightly lower, and phosphorus readings were slightly higher, than in the present CSLAP studies, although overall water quality conditions appear to be comparable.

It is not known if local monitoring has been conducted as a fisheries management tool, or to evaluate swimming conditions in the lake.

Lake Association and Management History

Lime Lake is served by the Lime Lake Cottage Owners Association. The lake association is involved in a number of lake management activities, including:

- the use of barley straw to control harmful algal blooms
- the establishment of a launch key policy to reduce boat congestion
- sewer project activities
- offering safe boating courses
- educational activities through newsletters and lake association meetings

- nuisance weed control through the use of aquatic herbicides
- water level control

The lake association maintains a web site at http://www.llcoa.org/.

Summary of 2014 CSLAP Sampling Results

Evaluation of 2013 Annual and Monthly Results Relative to 1997-2013

The summer (mid-June through mid-September) average readings are compared to historical averages for all CSLAP sampling seasons in the "Lake Condition Summary" table, and are compared to individual historical CSLAP sampling seasons in the "Long Term Data Plots –Lime Lake" section in Appendix C.

Evaluation of Eutrophication Indicators

Water clarity readings in Lime Lake were slightly higher than normal in 2013 and 2014, and water clarity has generally risen over the last decade (though not in the long-term). However, algae levels have not seen a similar change, either short-term or over the last decade, and phosphorus readings have increased slightly over this period. This suggests that most of these changes are within the normal range of variability, or are driven by management actions. Although algal blooms have been common in recent years, and very intense in some of these years, the lake suffered fewer blooms in 2013 and especially 2014.

Lake productivity typically increases from June through September, a seasonal pattern that was also apparent in 2014 (despite a spike in water transparency in late July.

The lake continues to be characterized as *mesotrophic*, based on water clarity, chlorophyll *a*, and total phosphorus readings (all typical of *mesotrophic* lakes). The trophic state indices (TSI) evaluation suggests that algae levels are slightly higher than expected given the water clarity and nutrient levels in the lake. It is not known if this contributes to the periodic occurrence of blue green algae blooms along the shoreline. Overall trophic conditions are summarized on the Lake Scorecard and Lake Condition Summary Table.

Evaluation of Potable Water Indicators

Algae levels at times (or in some locations) are high enough to render the lake susceptible to taste and odor compounds, algal toxins or elevated DBP (disinfection by product) compounds that could affect the potability of the water, although the lake is not classified for this use. Any "unofficial" potable water intakes could be compromised within algal blooms, or at times when lakewide algae levels are elevated. Potable water conditions, at least as measurable through CSLAP, are summarized in the Lake Scorecard and Lake Condition Summary Table.

Evaluation of Limnological Indicators

pH readings have decreased significantly over the last two decades, including 2014. However, pH readings are still typical of alkaline lakes, and should still be within normal ranges for most organisms. Water color has increased since 2002, corresponding to the change in laboratories (a phenomenon observed in other CSLAP lakes). These readings were lower in 2014. Ammonia and conductivity have decreased over the last decade, although only ammonia was lower than

usual in 2014. NOx readings have increased slightly over the last decade, although recent readings have been close to the long-term average for the lake. Overall limnological conditions are summarized in the Lake Scorecard and Lake Condition Summary Table.

Evaluation of Biological Condition

Extensive aquatic plant surveys have not been conducted on Lime Lake through CSLAP. The limited data indicate the presence of Eurasian watermilfoil (*Myriophyllum spicatum*) and a variety of native plants. It is likely that a modified floristic quality index (FQI) for the lake would likely indicate "fair" quality of the aquatic plant community.

Fisheries data indicate the presence of at least nine different fish species, including at least four coolwater species, and five warmwater species. The lake can likely best be classified as a coolwater fishery.

Zooplankton and macroinvertebrate information has not been collected through CSLAP at Lime Lake. Zebra mussels have been confirmed in the lake, and harmful algal blooms (HABs) have often been reported in the lake. The fluoroprobe screening samples analyzed by SUNY ESF in the last several years indicated that shoreline algae blooms are dominated by blue green algae, although bloom intensity and frequency was much lower in 2013 and especially than in 2014 than in 2012. Open water blue green algae levels were also much lower in the last two years.

Biological conditions in the lake are summarized in the Lake Scorecard and Lake Condition Summary Table.

Evaluation of Lake Perception

Recreational and water quality assessments have improved over the last decade, coincident with higher water clarity and less extensive aquatic plant coverage (although plant coverage has increased somewhat in recent years). Lake perception usually does not exhibit any clear seasonal patterns, although water quality assessments typically degrade slightly in mid-summer as lake productivity increases (and this was apparent in 2014). Overall lake perception is summarized on the Lake Scorecard and Lake Condition Summary Table.

Evaluation of Local Climate Change

Water and air temperature readings were lower than normal during the summer index period in each of the last several years, part of an apparent long-term decrease in air and water temperatures. It is not yet known if these temperature changes represent local climate change.

Evaluation of Algal Toxins

Algal toxin levels can vary significantly within blooms and from shoreline to lake, and the absence of toxins in a sample does not indicate safe swimming conditions. Open water phycocyanin readings were below the levels indicating susceptibility for harmful algal blooms (HABs), although the fluoroprobe screening samples from 2012 indicate very high blue green algae levels in shoreline blooms and some susceptibility to blooms in the open water. Lower blue green algae levels were found in 2013 and 2014, with some reduction of shoreline blooms. Algal toxins data indicate levels well above the criteria established to protect swimming within some

blooms, but usually below these thresholds in open water. This is consistent with historical information indicating a high susceptibility to HABs.

Lake Condition Summary

Category	Indicator	Min	Overall Avg	Max	2014 Avg	Classification	2014 Change?	Long-term Change?
Eutrophication Indicators	Water Clarity	0.95	2.99	6.98	3.24	Mesotrophic	Within Normal Range	No Change
	Chlorophyll *a*	0.27	5.48	25.50	6.30	Mesotrophic	Within Normal Range	No Change
	Total Phosphorus	0.007	0.017	0.042	0.017	Mesotrophic	Within Normal Range	No Change
Potable Water Indicators	Hypolimnetic Ammonia	0.43	0.45	0.47		Close to Surface NH4 Readings		
	Hypolimnetic Arsenic							
	Hypolimnetic Iron							
	Hypolimnetic Manganese							
Limnological Indicators	Hypolimnetic Phosphorus	0.012	0.214	1.124		Elevated Deepwater TP		
	Nitrate + Nitrite	0.01	0.53	1.72	0.43	High NOx	Within Normal Range	No Change
	Ammonia	0.02	0.12	0.94	0.04	Intermediate Ammonia	Within Normal Range	No Change
	Total Nitrogen	0.30	0.84	1.59	0.82	Intermediate Total Nitrogen	Within Normal Range	No Change
	pH	6.85	7.75	8.34	7.43	Alkaline	Lower Than Normal	Decreasing Significantly
	Specific Conductance	200	381	442	368	Hardwater	Within Normal Range	No Change
	True Color	1	14	45	6	Intermediate Color	Within Normal Range	Increasing Slightly
	Calcium	13.3	42.3	57.1	41.3	Highly Susceptible to Zebra Mussels	Within Normal Range	No Change
Lake Perception	WQ Assessment	1	2.3	5	2.0	Not Quite Crystal Clear	Within Normal Range	No Change
	Aquatic Plant Coverage	1	2.0	4	1.8	Subsurface Plant Growth	Within Normal Range	No Change
	Recreational Assessment	1	2.0	4	1.6	Excellent	Within Normal Range	No Change
Biological Condition	Phytoplankton					Open water-low blue green algae biomass; Shoreline-high blue green algae in bloom	Not known	Not known
	Macrophytes					Fair quality of the aquatic plant community	Not known	Not known
	Zooplankton					Not measured through CSLAP	Not known	Not known
	Macroinvertebrates					Not measured through CSLAP	Not known	Not known
	Fish					Coolwater fishery	Not known	Not known
	Invasive Species					Zebra mussels, Eurasian watermilfoil	Not known	Not known
Local Climate Change	Air Temperature	9	21.5	35	19.9		Within Normal Range	Decreasing Significantly
	Water Temperature	14	22.5	27	21.1		Lower Than Normal	Decreasing Significantly

Category	Indicator	Min	Overall Avg	Max	2014 Avg	Classification	2014 Change?	Long-term Change?
Harmful Algal Blooms	Open Water Phycocyanin	1	22	106	9	Most readings indicate low risk of BGA	Not known	Not known
	Open Water FP Chl.a	0	4	19	2	Few readings indicate high algae levels	Not known	Not known
	Open Water FP BG Chl.a	0	2	14	1	Few readings indicate high BGA levels	Not known	Not known
	Open Water Microcystis	<DL	0.3	15.3	<DL	Mostly undetectable open water MC-LR	Not known	Not known
	Open Water Anatoxin a	<DL	<DL	<DL	<DL	Open water Anatoxin-a consistently not detectable	Not known	Not known
	Shoreline Phycocyanin	63.9	63.9	63.9		Some readings indicate high risk of BGA	Not known	Not known
	Shoreline FP Chl.a	3	300	2325	2325	Most readings indicate high algae levels	Not known	Not known
	Shoreline FP BG Chl.a	1	274	2088	2088	Most readings indicate high BGA levels	Not known	Not known
	Shoreline Microcystis	<DL	253.9	1709.8	1604.0	Very high shoreline bloom MC-LR	Not known	Not known
	Shoreline Anatoxin a	<DL	<DL	<DL	<DL	Shoreline bloom Anatoxin-a consistently not detectable	Not known	Not known

Evaluation of Lake Condition Impacts to Lake Uses

Lime Lake is presently listed among the lakes listed on the Lake Erie-Niagara River drainage basin PWL (2010) as having *no known impacts*. The PWL listing for the lake can be found in Appendix B.

Potable Water (Drinking Water)

The CSLAP dataset at Lime Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, is inadequate to evaluate the use of the lake for potable water, and the lake is not classified for this use. The limited CSLAP data suggest that "unofficial" potable water use may be stressed at times by harmful algal blooms (HABs), particularly for nearshore intakes in areas susceptible to these blooms.

Contact Recreation (Swimming)

The CSLAP dataset at Lime Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggests that swimming and contact recreation may be *impaired* by algal toxins associated with harmful algal blooms, particularly near the shoreline. Bacterial data would need to be collected to evaluate the safety of the water for swimming.

Non-Contact Recreation (Boating and Fishing)

The CSLAP dataset on Lime Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggest that non-contact recreation should be fully supported, although this use may be *threatened* by excessive weeds, particularly Eurasian watermilfoil. These impacts appear to be limited by active management of the weeds.

Aquatic Life

The CSLAP dataset on Lime Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggest that aquatic life may be *stressed* by the presence of zebra mussels, and *threatened* by invasive plants, toxic algae blooms, and occasionally depressed deepwater oxygen levels, although additional data are needed to evaluate the food and habitat conditions for aquatic organisms in the lake.

Aesthetics

The CSLAP dataset on Lime Lake, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggest that aesthetics may be *stressed* by shoreline blue green algae blooms, although reduced impacts were apparent in the last two years.

Fish Consumption

There are no fish consumption advisories posted for Lime Lake.

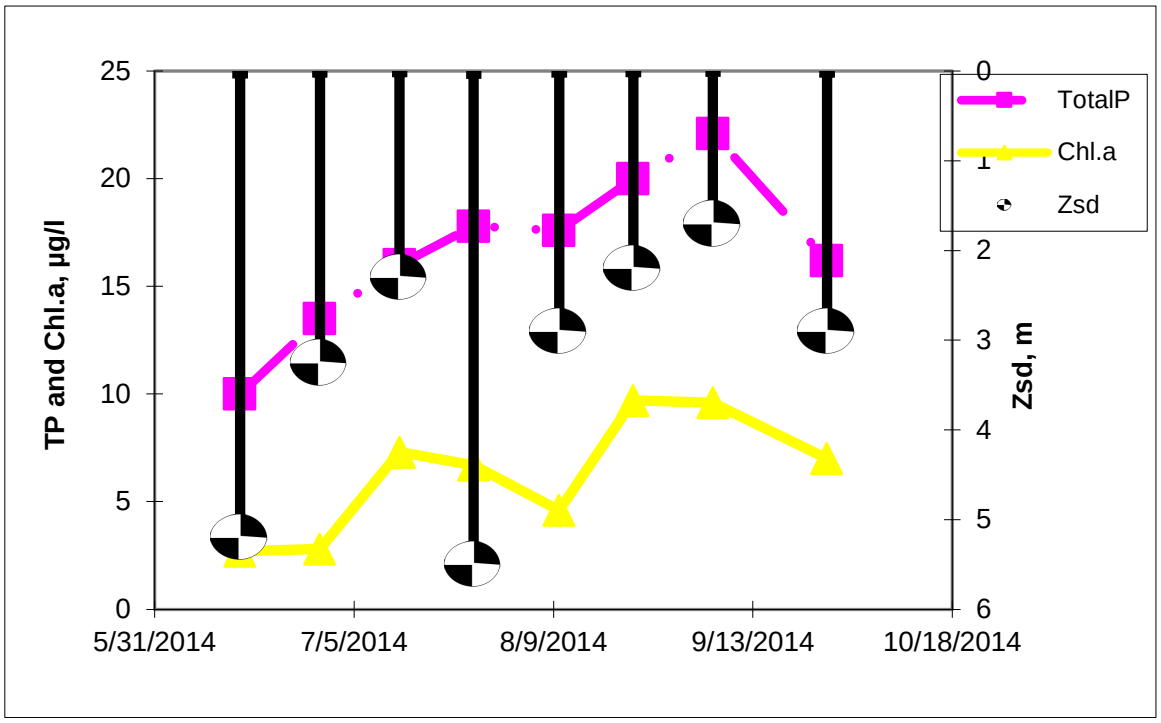
Additional Comments and Recommendations

The lake association should continue to monitor for the presence and persistence of harmful algal blooms (HABs), and report the extent and duration of these blooms throughout the lake. Lake residents and pets should continue to avoid exposure to surface scums or heavily discolored water associated with blue green algae blooms.

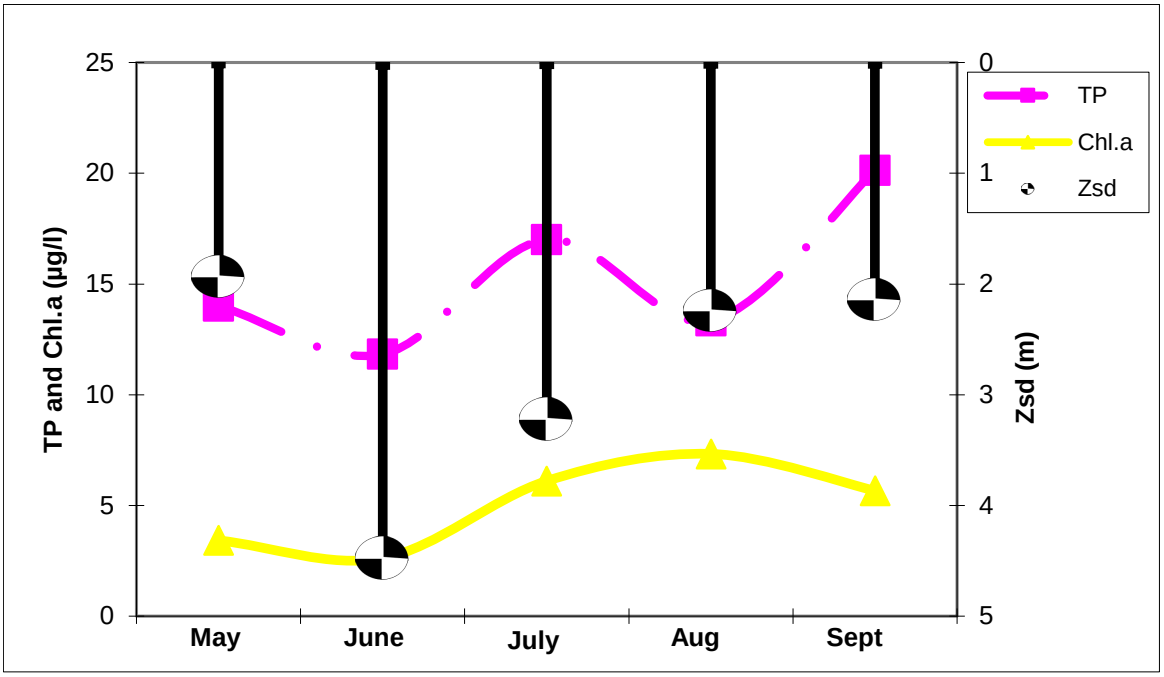
Aquatic Plant IDs-2014

None submitted for identification in 2014.

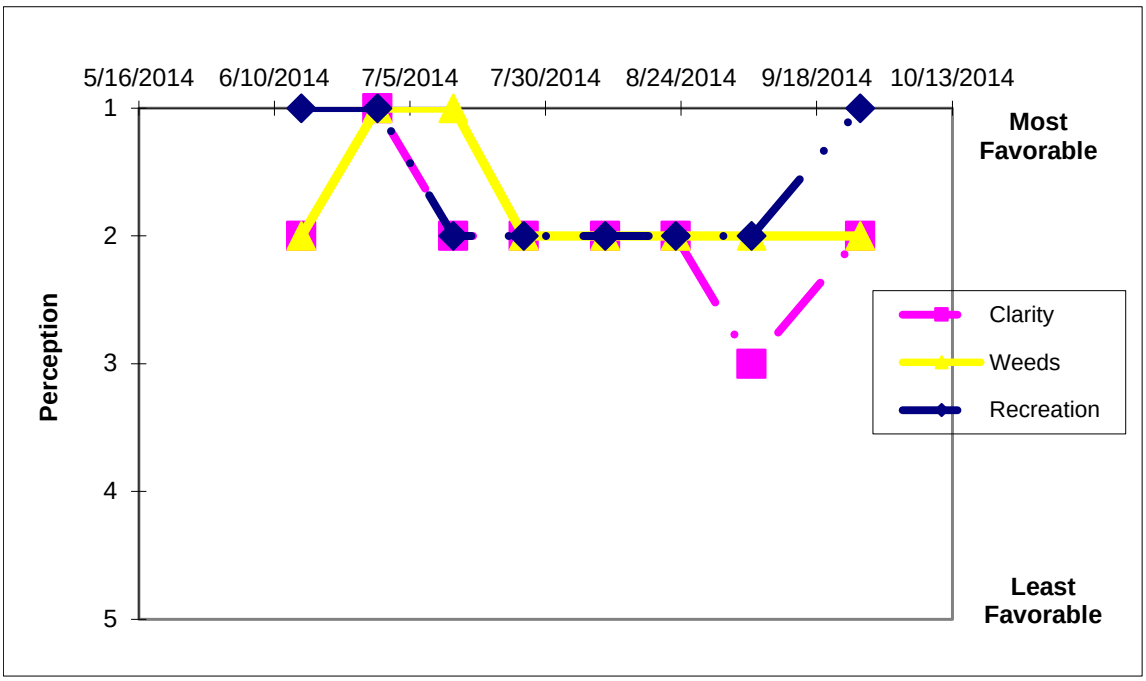
Time Series: Trophic Indicators, 2014



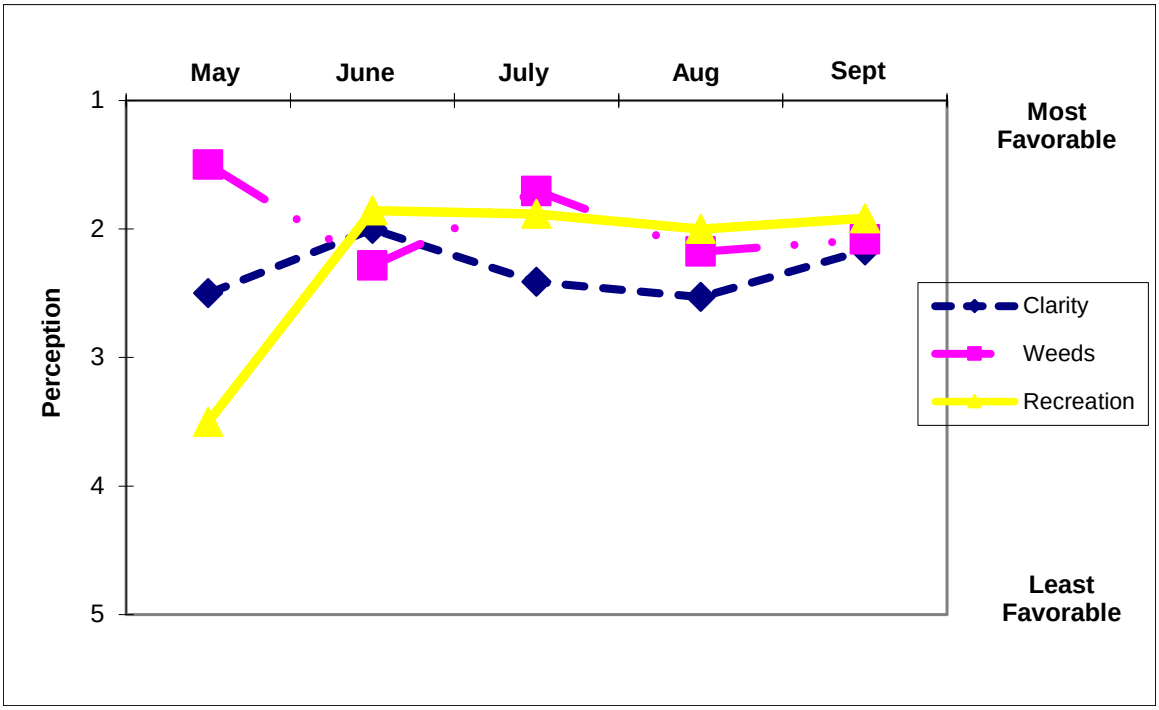
Time Series: Trophic Indicators, Typical Year (1997-2014)



Time Series: Lake Perception Indicators, 2014



Time Series: Lake Perception Indicators, Typical Year (1997-2014)



Appendix A- CSLAP Water Quality Sampling Results for Lime Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
134	Lime L	5/18/1997	9.3	2.05	1.5	0.011	1.72				5	8.07	397		1.16
134	Lime L	5/31/1997	8.5	1.83	1.5	0.017	1.59				5	7.91	324		5.69
134	Lime L	6/14/1997	8.8	4.85	1.5	0.010	1.47				5	8.21	386		1.79
134	Lime L	6/28/1997	10.4	3.75	1.5	0.012	1.15				5	8.17	391		6.25
134	Lime L	7/11/1997	9.9	1.60	1.5	0.015	0.91				5	8.05	395		14.00
134	Lime L	7/26/1997	10.5	2.73	1.5	0.019	0.84				5	8.10	400		5.73
134	Lime L	8/10/1997	10.6	1.86	1.5	0.014	0.71				3	8.02	404		6.41
134	Lime L	8/25/1997	10.0	1.30	1.5	0.015	0.60				6	8.22	405		14.60
134	Lime L	6/9/1998	10.2	2.99	1.5	0.010	1.31				2	8.34	357		0.51
134	Lime L	6/20/1998	10.3	4.30	1.5		1.11				2	8.28	333		2.80
134	Lime L	7/3/1998	10.4	3.73	1.5		0.84				2	8.04	341		2.36
134	Lime L	7/20/1998	10.2	2.13	1.5		0.62				1	7.81	362		6.12
134	Lime L	8/31/1998	9.1	2.88	1.5	0.011					1	8.10	366		3.01
134	Lime L	9/13/1998	9.9	2.70	1.5	0.016					1	8.17	361		5.56
134	Lime L	6/22/1999	9.8	4.58	1.5	0.012	0.48				3	8.09	345		3.30
134	Lime L	7/13/1999	10.7	3.85	1.5	0.007	0.28				15	8.17	359		13.00
134	Lime L	6/10/2001	10.6	3.90	1.5	0.010	1.10				5	8.22	429		1.02
134	Lime L	7/10/2001	9.7	1.95	1.5	0.013	0.59				4	8.11	420		4.81
134	Lime L	7/29/2001	10.0	2.70	1.5	0.021	0.32				3	7.98	427		1.99
134	Lime L	8/19/2001	11.0	2.10	1.5	0.015	0.26				2	8.09	434		4.24
136	Lime L	9/3/2001	10.1	2.05	1.5	0.023	0.20				3	7.37	417		0.27
134	Lime L	9/16/2001	9.5	2.13	1.5	0.013	0.11				7	7.66	420		0.57
134	Lime L	8/1/2002	10.1	1.95	1.5	0.013	0.47	0.05	0.98	77.23	12	8.24	413	13.3	7.86
134	Lime L	8/18/2002	10.0	1.80	1.5	0.016	0.48	0.07	1.04	66.37	4	8.14	414		7.18
134	Lime L	8/25/2002	10.8	2.00	1.5	0.014			0.84	62.43	9	8.08	407		7.33
134	Lime L	6/27/2005	10.2	3.35	1.5	0.012	0.03	0.94	1.10	95.34	1	7.88	403	56.1	4.43
134	Lime L	7/11/2005	9.9	2.00	1.5	0.012	0.03	0.55	0.88	74.78	23	7.80	442		5.42
134	Lime L	8/2/2005	9.2	1.55	1.5	0.011	0.14	0.27	0.38	35.17	31	7.60	387		8.16
134	Lime L	8/16/2005	10.9	2.50	1.5	0.015	0.13	0.08	0.49	33.46	6	7.90	339		13.62
134	Lime L	9/5/2005	11.1	2.65	1.5	0.024	0.03	0.11	0.30	12.48		7.81	369	49.1	
134	Lime L	9/25/2005	11.0	1.90	1.5	0.021	0.04	0.07	0.32	15.06	8				10.84
134	Lime L	6/18/2011	10.7	3.75	1.5	0.011	1.17	0.07	1.41	274.51	43	7.11	419	57.1	0.90
134	Lime L	7/4/2011		5.00	1.5	0.018	0.94	0.07	1.59	198.25	32	7.29	390		1.00
134	Lime L	7/16/2011	10.7	5.40	1.5	0.012	0.90	0.05	1.20	220.00	35	7.29	382		0.40
134	Lime L	7/30/2011	10.7	4.93	1.5	0.012	0.68	0.05	1.20	213.26	45	7.47	344		3.10
134	Lime L	7/30/2011	grab		bloom										
134	Lime L	8/13/2011	10.7	2.71	1.5	0.015	0.50	0.06	1.05	154.59	30	8.11	317	37.8	4.10
134	Lime L	8/27/2011	10.7	1.60	1.5	0.018	0.23	0.03	1.00	121.86	19	7.60	347		7.50
134	Lime L	8/27/2011	grab		bloom										
134	Lime L	9/11/2011	grab		bloom										
134	Lime L	9/11/2011	10.7	2.43	1.5	0.015	0.17	0.07	0.69	100.45	23	7.70	343		5.10
134	Lime L	6/10/2012	9.1	6.98	1.5	0.013	0.80	0.02	1.15	195.27	33	7.27	393	44.9	2.90
134	Lime L	6/23/2012	10.7	5.33	1.5	0.014	0.50	0.19	0.83	131.06	28	7.50	348		3.20
134	Lime L	7/7/2012		4.05	1.5	0.028	0.18	0.08	0.83	64.90	37	7.68	356		0.90
134	Lime L	7/7/2012			Bloom										
134	Lime L				Bloom										
134	Lime L	7/21/2012	10.7	0.95		0.041	0.03	0.06	0.93	49.86	19	7.42	368		25.50
134	Lime L	7/21/2012			Bloom										
134	Lime L	8/4/2012	10.7	0.95	1.5	0.034	0.01	0.03	0.84	54.77	9	8.07	382	39.8	2.70
134	Lime L	8/5/2012			Bloom										
134	Lime L	8/19/2012	10.7	1.35	1.5	0.042	0.07	0.11	0.85	44.69	8	7.72	370		16.00
134	Lime L	8/19/2012			Bloom										
134	Lime L	9/2/2012	9.1	1.48	1.5	0.028	0.01	0.10	0.58	45.40	13	7.10	377		7.50
134	Lime L	9/2/2012			Bloom										
134	Lime L	9/16/2012	9.1	1.15	1.5	0.025	0.03	0.17	0.68	58.96	7		370		6.90
134	Lime L	6/9/2013		4.85	1.5	0.014	0.59	0.07	0.88	136.34	24	7.20	408		1.50
134	Lime L	6/23/2013		5.65	1.5	0.016			1.17	156.68	37	7.63	341		2.60
134	Lime L	7/7/2013		2.78	1.5		0.48	0.10	0.81	32.34	22	7.26	417		2.80
134	Lime L	7/20/2013		3.25	1.5	0.017			0.65	86.08	23	7.30	394		2.70
134	Lime L	8/2/2013		3.05	1.5		0.21	0.03	0.68	17.18	30	7.39	400		3.20
134	Lime L	8/17/2013		5.45	1.5	0.022			0.71	72.45	26	7.34	399		4.40
134	Lime L	8/29/2013			Bloom										
134	Lime L	8/29/2013			bloom										

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
134	Lime L	9/2/2013		1.95	1.5	0.018	0.12	0.06	0.51	63.60	29	7.87	412		5.20
134	Lime L	9/5/2013			Bloom										
134	Lime L	9/5/2013			bloom										
134	Lime L	9/28/2013		2.70	1.5	0.020			0.61	66.88	35	7.38	394		3.80
134	Lime L	6/15/2014	9.1	5.20	1.5	0.010	0.92	0.06	1.14	250.14	6	7.10	417	46.3	2.70
134	Lime L	6/29/2014	9.1	3.25	1.5	0.014			1.21	196.86	13	6.85	383		2.80
134	Lime L	6/29/2014													
134	Lime L	7/13/2014	9.1	2.30	1.5	0.016	0.56	0.04	1.05	144.38	6	7.50	428		7.30
134	Lime L	7/26/2014	9.1	5.50	1.5	0.018			0.77	94.92	2	7.45	392		6.70
134	Lime L	8/10/2014	9.1	2.90	1.5	0.018	0.23	0.04	0.80	100.38	5	7.55	390	36.2	4.60
134	Lime L	8/23/2014	9.1	2.20	1.5	0.020			0.52	56.76	6	7.38	386		9.70
134	Lime L	9/6/2014	9.1	1.70	1.5	0.022	0.02	0.04	0.33	33.25	6	8.06	200		9.60
134	Lime L	9/26/2014	9.1	2.90	1.5	0.016			0.76	103.62	6	7.54	351		7.00
134	Lime L	6/9/1998			7.5	0.013									
134	Lime L	7/3/1998			9.0	0.157									
134	Lime L	8/31/1998				0.310									
134	Lime L	7/13/1999	10.7		9.9	0.037									
134	Lime L	8/1/2002	10.1		8.0	0.012	0.13	0.46	0.89	77.64					
134	Lime L	8/18/2002	10.0		8.0	0.022	0.14	0.47							
134	Lime L	8/25/2002	10.8		8.0	0.020		0.43	0.78	39.28					
134	Lime L	6/27/2005				0.012									
134	Lime L	7/11/2005				0.039									
134	Lime L	8/2/2005				0.027									
134	Lime L	8/16/2005				1.124									
134	Lime L	9/5/2005				0.201									
134	Lime L	9/25/2005				0.815									

LNum	PName	Date	Site	TAir	TH20	QA	QB	QC	QD	QF	QG	AQ-PC	AQ-Chla	MC-LR	Ana-a	Cyl	FP-Chl	FP-BG	HAB form	Shore HAB
134	Lime L	5/18/1997	epi	20	14	2	1	3	5											
134	Lime L	5/31/1997	epi	19	16	3	2	4	5											
134	Lime L	6/14/1997	epi	21	22	3	2	2	1											
134	Lime L	6/28/1997	epi	32	25	3	1	2												
134	Lime L	7/11/1997	epi	26	24	5	1	3	3											
134	Lime L	7/26/1997	epi	23	24	2	1	1												
134	Lime L	8/10/1997	epi	28	25	3	1	1												
134	Lime L	8/25/1997	epi	25	21	3	1	2												
134	Lime L	6/9/1998	epi	35	27	2	3	2	5											
134	Lime L	6/20/1998	epi	25	24	2	2	1	6											
134	Lime L	7/3/1998	epi	22	25	2	1	2												
134	Lime L	7/20/1998	epi	28	27	3	1	2												
134	Lime L	8/31/1998	epi	22	25	1	2	1												
134	Lime L	9/13/1998	epi	28	23	2	1	2	6											
134	Lime L	6/22/1999	epi	30	25	2	3	1												
134	Lime L	7/13/1999	epi	23	24	3	1	2												
134	Lime L	6/10/2001	epi	22	19	3	2	2	6											
134	Lime L	7/10/2001	epi	31	24	2	2	2	0											
134	Lime L	7/29/2001	epi	21	25	3	2	1												
134	Lime L	8/19/2001	epi	24	25	2	1	2												
136	Lime L	9/3/2001	epi	22	22	3	1	2												
134	Lime L	9/16/2001	epi	19	22	2	1	3	6											
134	Lime L	8/1/2002	epi	24	25	3	3	2	1											
134	Lime L	8/18/2002	epi	27	25	3	3	2	7											
134	Lime L	8/25/2002	epi	20	22	3	1	2	7											
134	Lime L	6/27/2005	epi	22	24	2	3	3	2											
134	Lime L	7/11/2005	epi	32	25	2	2	2	27											
134	Lime L	8/2/2005	epi	23	25	3	3	2	12											
134	Lime L	8/16/2005	epi	32	24	3	3	2	27											
134	Lime L	9/5/2005	epi	19	21	2	2	1	7											
134	Lime L	9/25/2005	epi	30	27	3	2	2	3											
134	Lime L	6/18/2011	epi	15	20	1	2	1	0		5	10.60	1.40							
134	Lime L	7/4/2011	epi	21	22	1	2	1	0	0	0	8.90	1.50							
134	Lime L	7/16/2011	epi	18	24	2	2	2	2	4	4	7.50	0.90							

LNum	PName	Date	Site	TAir	TH20	QA	QB	QC	QD	QF	QG	AQ-PC	AQ-Chla	MC-LR	Ana-a	Cyl	FP-Chl	FP-BG	HAB form	Shore HAB
134	Lime L	7/30/2011	epi	22	25	2	1	1	0	0	0	18.50	1.90							
134	Lime L	7/30/2011	bloom											20.37						
134	Lime L	8/13/2011	epi	15	24	3	3	3	2	0	0	30.40	2.50	8.31						
134	Lime L	8/26/2011	epi											6.16						
134	Lime L	8/26/2011	bloom											124.95						
134	Lime L	8/27/2011	epi	16	21	3	3	3	23	4	4	55.10	6.90							
134	Lime L	8/27/2011	epi																	
134	Lime L	9/9/2011	epi											15.28						
134	Lime L	9/9/2011	bloom											344.77						
134	Lime L	9/9/2011	bloom											1710						
134	Lime L	9/11/2011	epi											109.76						
134	Lime L	9/11/2011	epi	15	19	2	4	2	2	0	0	53.70	3.60							
134	Lime L	6/10/2012	epi	25	20	1	3	3		5		5.00	0.20	0.49	<0.417		0.77	0.56		
134	Lime L	6/23/2012	epi	15	24	2	4	3	25		5	9.80	0.40	1.55	<0.410		3.16	2.93	F	
134	Lime L	7/7/2012	epi	22	25	3	3	3	1	4	4	47.00	1.40	6.79	<0.392		11.07	6.86	FG	
134	Lime L	7/7/2012												188.97	<0.820		328.00	324.00		
134	Lime L													403.45	<0.846		538.00	523.00		
134	Lime L	7/21/2012		17	22	3	3	3	15	4	4	105.50	2.00	5.57	<0.292		18.62	13.59	F	
134	Lime L	7/21/2012												15.28	<0.657		21.20	15.20		
134	Lime L	8/4/2012	epi	20	25	3	2	3	13	0	0	54.00	2.10	3.19	<0.330		14.90	7.07	I	
134	Lime L	8/5/2012												8.09	<1.318		15.96	10.63		
134	Lime L	8/19/2012	epi	12	21	3	3	3	13	0	0	90.70	2.30	1.73	<0.223		2.59	1.69	CF	
134	Lime L	8/19/2012												2.76	<1.314		6.49	1.75	ABEF	
134	Lime L	9/2/2012	epi	16	21	2	3	2	1	4	4	22.60	1.40	1.41	<0.725		7.13	3.11	C	
134	Lime L	9/2/2012												8.96	<1.038		15.59	7.97		
134	Lime L	9/16/2012	epi	9	18	2	3	3	58	47		18.60	1.30	1.86	<6.409		5.73	2.60	FI	
134	Lime L	6/9/2013	epi	11	17	2	2	2	0	0	0	2.10	0.70	<0.30	<0.420		0.30	0.00		
134	Lime L	6/23/2013	epi	21	22	2	2	2	0	0	0	2.20	1.30	<0.30	<0.370		1.00	0.20		I
134	Lime L	7/7/2013	epi	21	24	2	2	1	0	0	0	3.60	1.70	<0.30	<0.510		2.30	0.40	I	I
134	Lime L	7/20/2013	epi	19	25	2	2	2	5	0	0	9.60	2.20	<0.30	<0.910		2.50	0.00	I	I
134	Lime L	8/2/2013	epi	16	21	2	2	1	0	0	0	9.60	0.90	<0.30	<0.650		1.70	0.40	I	I
134	Lime L	8/17/2013	epi	14	21	1	2	1	0	0	0	11.00	1.80	0.41	<0.390		2.20	0.30	I	I
134	Lime L	8/29/2013	Bloom											<0.60	<1.000		5.00	3.70	d	
134	Lime L	8/29/2013	bloom											12.97	<1.000		33.50	31.20	d	
134	Lime L	9/2/2013	epi	20	22	2	2	2	0	0	0	14.20	2.00	0.99	<1.100		4.40	2.20	I	B
134	Lime L	9/5/2013	bloom											<0.60	<1.000		3.20	1.10	d	
134	Lime L	9/5/2013	Bloom											<0.60	<1.000		4.60	2.40	d	
134	Lime L	9/28/2013	epi	20	17	1	2	1	0	0	0									
134	Lime L	6/15/2014	epi	14	19	2	2	1	0	0	0	2.00	0.10	<0.53	<0.08	<0.002	0.15	0.15	i	
134	Lime L	6/29/2014	epi	21	23	1	1	1	0	0	0	7.60	0.20	<1.60	<0.48	<0.002	0.69	0.00	i	
134	Lime L	6/29/2014	bloom											1603.95	<0.67	<0.005	2325	2088		ab
134	Lime L	7/13/2014	epi	23	23	2	1	2	0	0	0	6.70	0.70	<0.40	<0.21	<0.003	3.78	0.14	i	
134	Lime L	7/26/2014	epi	20	22	2	2	2	0	0	0	6.40	0.40	<0.31	<0.24	<0.002	2.52	0.67	i	i
134	Lime L	8/10/2014	epi	21	22	2	2	2	0	0	4	21.60	0.30	<0.28	<0.05	<0.001	1.33	0.55	i	i
134	Lime L	8/23/2014	epi	21		2	2	2	5	0	0	1.20	0.10	<0.26	<0.10	<0.002	3.03	1.42	i	i
134	Lime L	9/6/2014	epi	18	22	3	2	2	0	0	0	21.80	0.50	<0.29	<0.14	<0.002	4.88	1.83	i	i
134	Lime L	9/26/2014	epi	21	17	2	2	1	5	0	0	6.00	0.30	<0.19	<0.12	<0.001	2.33	1.28	i	i
134	Lime L	6/9/1998	hypo		18	1	2	1	0		5	10.60	1.40							
134	Lime L	8/31/1998	hypo		13	1	2	1	0	0	0	8.90	1.50							
134	Lime L	8/1/2002	hypo	24	10	2	2	2	2	4	4	7.50	0.90							
134	Lime L	8/18/2002	hypo	27	11	2	1	1	0	0	0	18.50	1.90							
134	Lime L	8/25/2002	hypo	20	14									20.37						

Legend Information

Indicator	*Description*	*Detection Limit*	*Standard (S) / Criteria (C)*
General Information			
Lnum	lake number (unique to CSLAP)		
Lname	name of lake (as it appears in the Gazetteer of NYS Lakes)		
Date	sampling date		
Field Parameters			
Zbot	lake depth at sampling point, meters (m)		
Zsd	Secchi disk transparency or clarity	0.1m	1.2m (C)
Zsamp	water sample depth (m) (epi = epilimnion or surface; bot = bottom)	0.1m	none
Tair	air temperature (C)	-10C	none
TH20	water temperature (C)	-10C	none
Laboratory Parameters			
Tot.P	total phosphorus (mg/l)	0.003 mg/l	0.020 mg/l (C)
NOx	nitrate + nitrite (mg/l)	0.01 mg/l	10 mg/l NO3 (S), 2 mg/l NO2 (S)
NH4	total ammonia (mg/l)	0.01 mg/l	2 mg/l NH4 (S)
TN	total nitrogen (mg/l)	0.01 mg/l	none
TN/TP	nitrogen to phosphorus (molar) ratio, = (TKN + NOx)*2.2/TP		none
TCOLOR	true (filtered) color (ptu, platinum color units)	1 ptu	none
pH	powers of hydrogen (S.U., standard pH units)	0.1 S.U.	6.5, 8.5 S.U. (S)
Cond25	specific conductance, corrected to 25C (umho/cm)	1 umho/cm	none
Ca	calcium (mg/l)	1 mg/l	none
Chl.a	chlorophyll a (ug/l)	0.01 ug/l	none
Fe	iron (mg/l)	0.1 mg/1	1.0 mg/l (S)
Mn	manganese (mg/l)	0.01 mg/l	0.3 mg/l (S)
As	arsenic (ug/l)	1 ug/l	10 ug/l (S)
AQ-PC	Phycocyanin (aquaflor) (unitless)	1 unit	none
AQ-Chl	Chlorophyll *a* (aquaflor) (ug/l)	1 ug/l	none
MC-LR	Microcystis-LR (ug/l)	0.01 ug/l	1 ug/l potable (C) 20 ug/l swimming (C)
Ana	Anatoxin-a (ug/l)	variable	none
Cyl	Cylindrospermposin (ug/l)	0.1 ug/l	none
FP-Chl, FP-BG	Fluoroprobe total chlorophyll, fluoroprobe blue-green chlorophyll (ug/l)	0.1 ug/l	none
Lake Assessment			
QA	water quality assessment; 1 = crystal clear, 2 = not quite crystal clear, 3 = definite algae greenness, 4 = high algae levels, 5 = severely high algae levels		
QB	aquatic plant assessment; 1 = no plants visible, 2 = plants below surface, 3 = plants at surface, 4 = plants dense at surface, 5 = surface plant coverage		
QC	recreational assessment; 1 = could not be nicer, 2 = excellent, 3 = slightly impaired, 4 = substantially impaired, 5 = lake not usable		
QD	reasons for recreational assessment; 1 = poor water clarity, 2 = excessive weeds, 3 = too much algae, 4 = lake looks bad, 5 = poor weather, 6 = litter/surface debris, 7 = too many lake users, 8 = other		
QF, QG	Health and safety issues today (QF) and past week (QG); 0 = none, 1 = taste/odor, 2 = GI illness humans/animals, 3 = swimmers itch, 4 = algae blooms, 5 = dead fish, 6 = unusual animals, 7 = other		
HAB form, Shore HAB	HAB evaluation; A = spilled paint, B = pea soup, C = streaks, D = green dots, E = bubbling scum, F = green/brown tint, G = duckweed, H = other, I = no bloom		

Appendix B: Priority Waterbody Listing for Lime Lake

Lime Lake (0104-0001) NoKnownImpct

Waterbody Location Information

Revised: 06/02/2010

Water Index No:	Ont 158..E-23-48-3-P130			**Drain Basin:**	Lake Erie-Niagara River
Hydro Unit Code:	04120103/010	**Str Class:**	B		Buffalo/Eighteenmile
Waterbody Type:	Lake			**Reg/County:**	9/Cattaraugu Co. (5)
Waterbody Size:	159.5 Acres			**Quad Map:**	DELEVAN (L-07-1)
Seg Description:	entire lake				

Water Quality Problem/Issue Information

(CAPS indicate MAJOR Use Impacts/Pollutants/Sources)

Use(s) Impacted	Severity	Problem Documentation
NO USE IMPAIRMNT		

Type of Pollutant(s)

Known: - - -
Suspected: - - -
Possible: - - -

Source(s) of Pollutant(s)

Known: - - -
Suspected: - - -
Possible: - - -

Resolution/Management Information

Issue Resolvability: 8 (No Known Use Impairment)
Verification Status: (Not Applicable for Selected RESOLVABILITY)
Lead Agency/Office: n/a
Resolution Potential: n/a
TMDL/303d Status: n/a

Further Details

Water Quality Sampling
Lime Lake has been sampled as part of the NYSDEC Citizen Statewide Lake Assessment Program (CSLAP) in 1985 , then from 1997 through 2002 and most recently 2005. An Interpretive Summary report of the findings of this sampling was published in 2006. These data indicate that the lake continues to be best characterized as mesotrophic or moderately productive. Phosphorus levels in the lake typically fall below the state guidance values indicating impacted/stressed recreational uses. Corresponding transparency measurements consistently meet the recommended minimum for swimming beaches. Measurements of pH typically fall within the state water quality range of 6.5 to 8.5. The lake water is weakly colored, and color does not limit water transparency. (DEC/DOW, BWAM/CSLAP, July 2006)

Recreational Assessment
Public perception of the lake and its uses is also evaluated as part of the CSLAP program. This assessment indicates recreational suitability of the lake to be generally favorable since the lake was first evaluated and continuing through the most recent assessment. The recreational suitability of the lake is described most frequently as "excellent." The lake itself is most often described as "not quite crystal clear" or "having definite algal greenness," assessments that are consistent with measured water quality characteristics. Assessments have noted that aquatic plants only occasionally grow to the lake surface. Aquatic plants are dominated by a mix of native and non-native species and have not been cited as impacting recreational uses. The presence of Eurasian water milfoil has been noted at the lake. Herbicide applications have been

used to help control aquatic growth. (DEC/DOW, BWAM/CSLAP, July 2006)

Lake Uses

This lake waterbody is designated class B, suitable for use as a public bathing beach, general recreation and aquatic life support, but not as a water supply. Water quality monitoring by NYSDEC focuses primarily on support of general recreation and aquatic life. Samples to evaluate the bacteriological condition and bathing use of the lake or to evaluate contamination from organic compounds, metals or other inorganic pollutants have not been collected as part of the CSLAP monitoring program. Monitoring to assess potable water supply and public bathing use is generally the responsibility of state and/or local health departments.

Watershed Management

The are approximately 300 lakeside residences. No obvious on-site septic systems failures have been documented, but small lots result in inadequate separation of systems. Soil conditions (gravel) are thought to contribute to high nitrogen levels in groundwater and lake. There has been some local interest in wastewater facility planning. The community applied for a 2002 WQCC Tier 3 grant. (DEC/DOW, Region 9, April 2003)

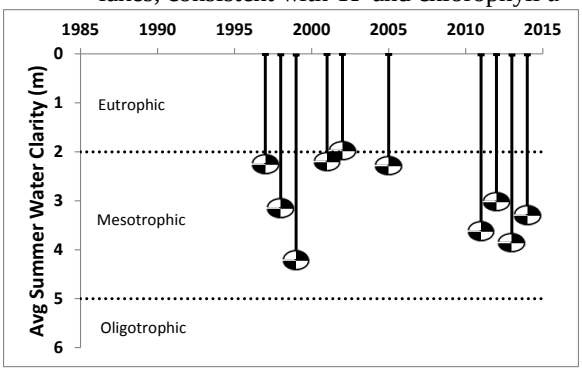
Segment Description

This segment includes the entire area of Lime Lake.

Appendix C- Long Term Trends: Lime Lake

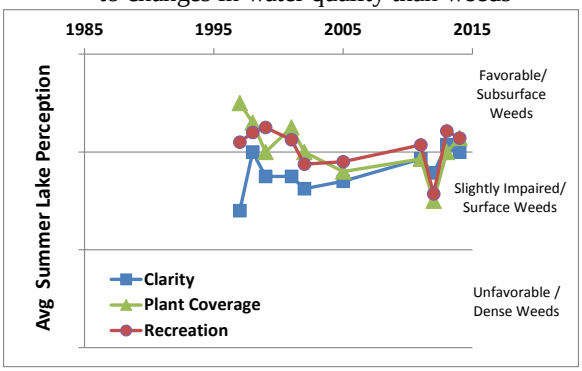
Long Term Trends: Water Clarity

- ↑ clarity early 00s-14, but no long term trend
- Most readings now typical of *mesotrophic* lakes, consistent with TP and chlorophyll *a*



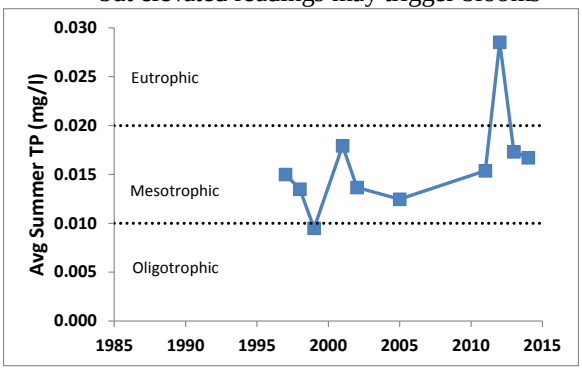
Long Term Trends: Lake Perception

- Improving assessments since early 00s
- Recreational perception more closely linked to changes in water quality than weeds



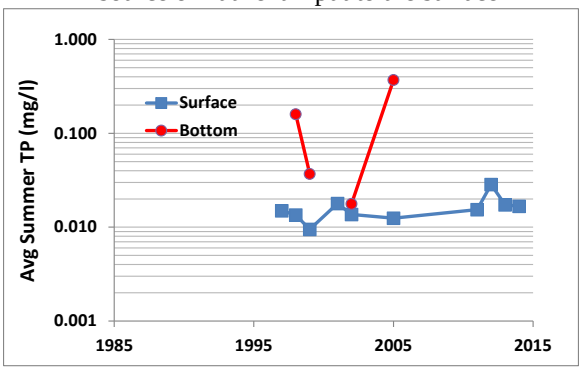
Long Term Trends: Phosphorus

- Slight ↑ TP since early 00s, but no trends
- Most readings typical of *mesotrophic* lakes, but elevated readings may trigger blooms



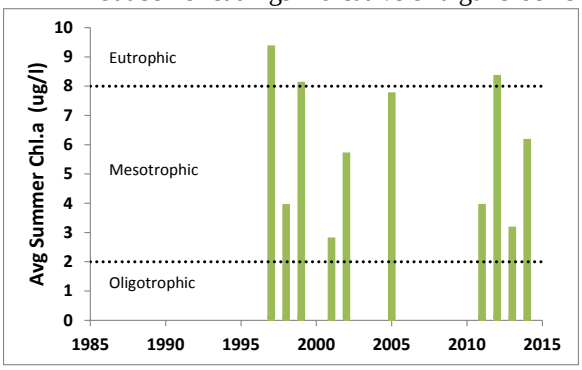
Long Term Trends: Bottom Phosphorus

- Deepwater TP much higher than surface TP
- Deepwater data indicates potentially major source of nutrient input to the surface TP



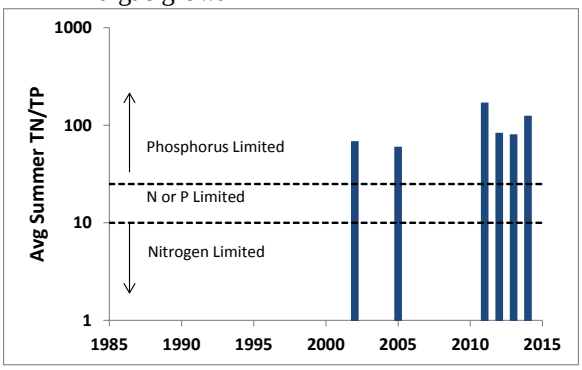
Long Term Trends: Chlorophyll a

- Highly variable year to year
- Most readings typical of *mesotrophic* lakes, but some readings indicative of algal blooms



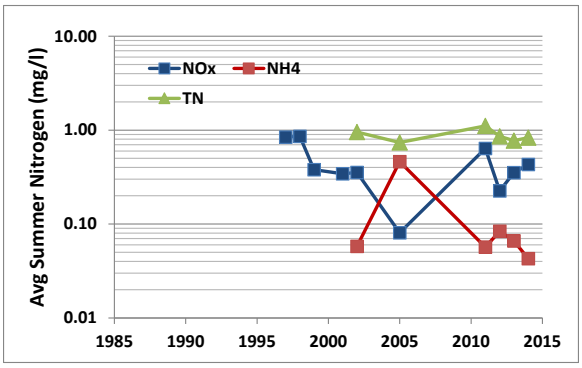
Long Term Trends: N:P Ratio

- No trends apparent
- Most readings indicate phosphorus limits algae growth



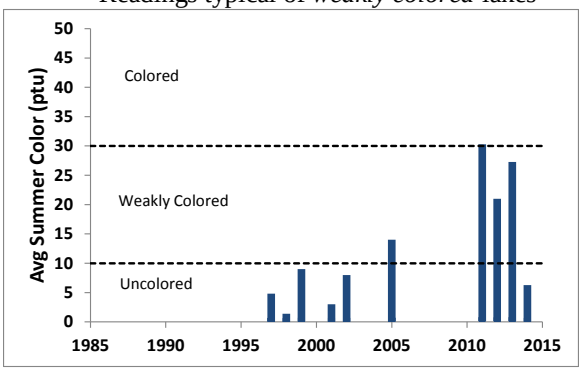
Long Term Trends: Nitrogen

- ↓ NH4 and ↑ NOx 05-14
- Occasionally elevated NOx appears to be natural



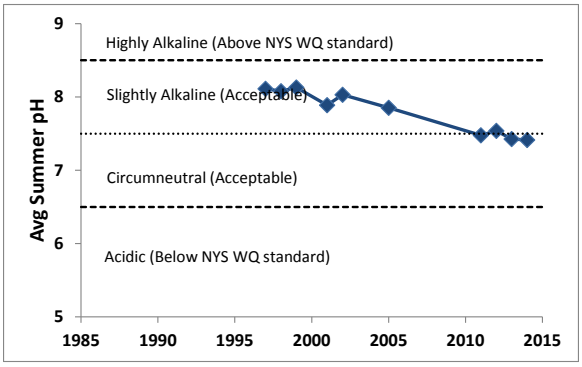
Long Term Trends: Color

- Higher readings since 2002 likely due to lab change
- Readings typical of *weakly colored* lakes



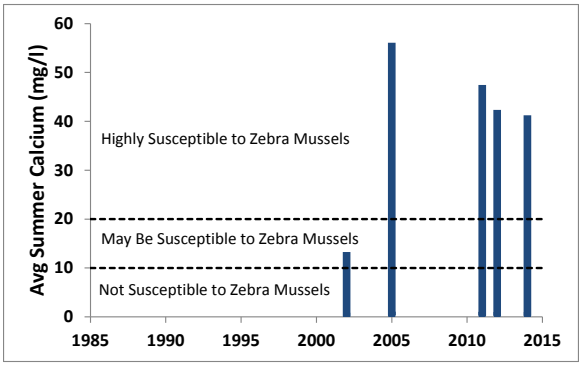
Long Term Trends: pH

- Decreasing significantly since early 2000s
- Most readings typical of *slightly alkaline* to *circumneutral* lakes



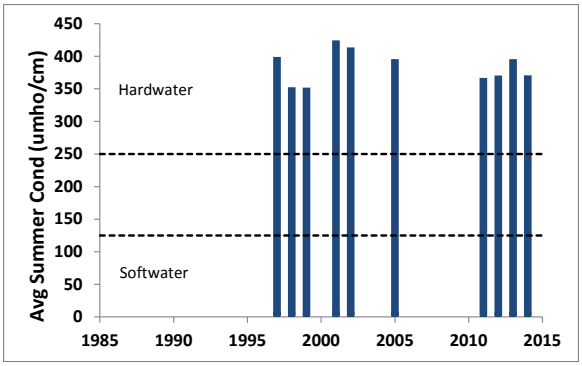
Long Term Trends: Calcium

- No trends apparent
- Data confirming high susceptibility to zebra mussels, which are found in lake



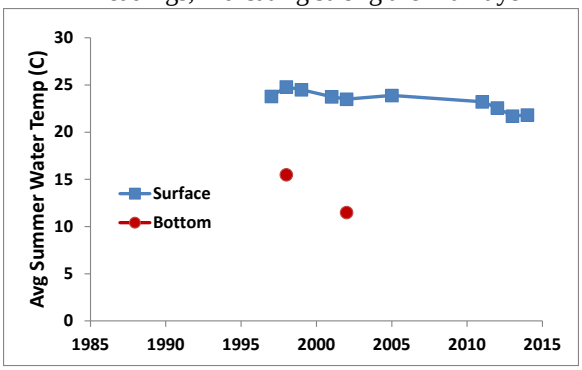
Long Term Trends: Conductivity

- ↓ slightly early 2000s - 2014
- Most readings typical of *hardwater* lakes



Long Term Trends: Water Temperature

- Surface readings decreasing slightly
- Bottom temperatures well below surface readings, indicating strong thermal layer



Appendix D:
Algae Testing Results from SUNY ESF Study

Most algae are harmless, naturally present, and an important part of the food web. However excessive algae growth can cause health, recreational, and aesthetic problems. Some algae can produce toxins that can be harmful to people and animals. High quantities of these algae are called harmful algal blooms (HABs). CSLAP lakes have been sampled for a variety of HAB indicators since 2008. This was completed on selected lakes as part of a NYS DOH study from 2008-2010. In 2011, enhanced sampling on all CSLAP lakes was initiated through an EPA-funded project that has continued through the current sampling season. This study has evaluated a number of HAB indicators as follows:

- Algae types - blue green, green, diatoms, and "other"
- Algae densities
- Microscopic analysis of bloom samples
- Algal toxin analysis

Some of these results are reported in other portions of these reports. This appendix the seasonal change in blue green algae, other algae types, and the primary algal toxin (microcystin-LR, a liver toxin). Analysis was completed on open water samples and, for some lakes, shoreline samples that were collected when visual evidence of blooms were apparent. Results are compared to the DEC criteria of 30 ug/l blue green chlorophyll a and 20 ug/l microcystin-LR (based on the World Health Organization (WHO) threshold for unsafe swimming conditions) and the WHO provisional criteria for long-term protection of treated water supplies (= 1 ug/l microcystin-LR). The data for algae types are drawn from a high end fluorometer used by SUNY ESF. While these results are useful for timely approximation of lake conditions, they are not as accurate as the total chlorophyll results measured as a regular part of CSLAP since 1986 in all open water samples. Therefore these results are used judiciously in the assessment of sampled waterbodies.

Two separate samples are evaluated. A sample is taken at the CSLAP sample point at the deepest point of the lake at every sample session. In addition, shoreline samples can be taken when a bloom is visible. It should be noted that shoreline conditions can vary significantly over time and from one location to another. The shoreline bloom sampling results summarized below are not collected as routinely as open water samples, and therefore represent snapshots in time. It is assumed that sampling results showing high blue green algae and/or toxin levels indicate that algae blooms may be common and/or widespread on these lakes. However, the absence of elevated blue green algae and toxin levels does not assure the lack of shoreline blooms on these lakes. Elevated open water readings may indicate a higher likelihood of shoreline blooms, but in some lakes, these shoreline blooms have not been (well) documented.

The results from these samples are summarized within the CSLAP report for the lake.

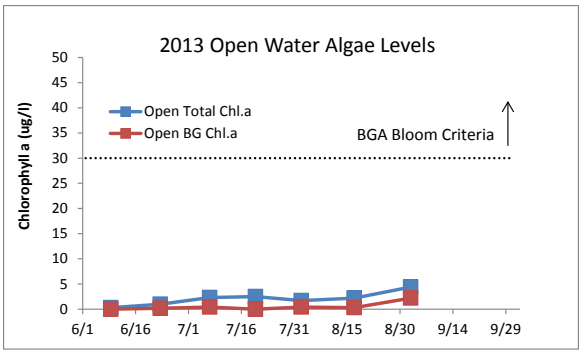


Figure D1:
2013 Open Water Total and BGA Chl.a

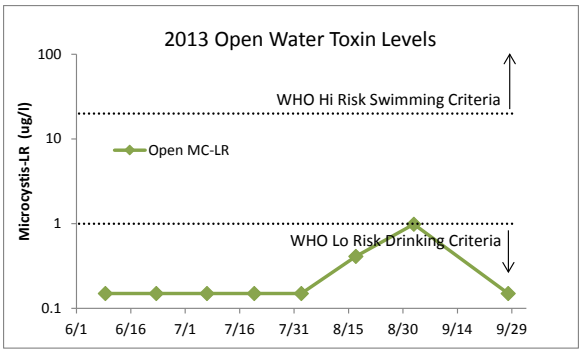


Figure D2:
2013 Open Water Microcystin-LR

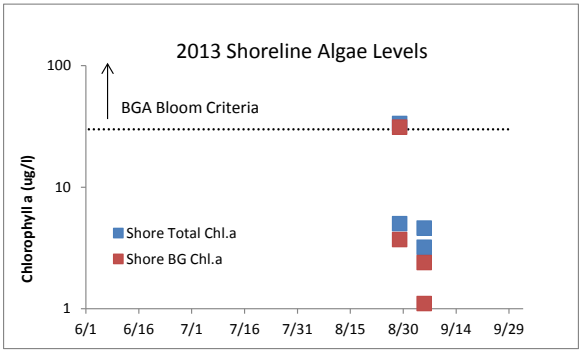


Figure D3:
2013 Shoreline Total and BGA Chl.a

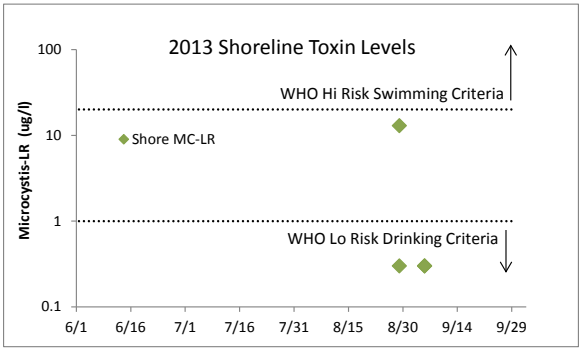


Figure D4:
2013 Shoreline Microcystin-LR

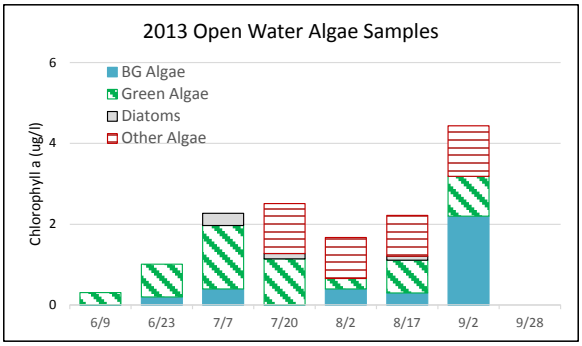


Figure D5:
2013 Open Water Algae Types

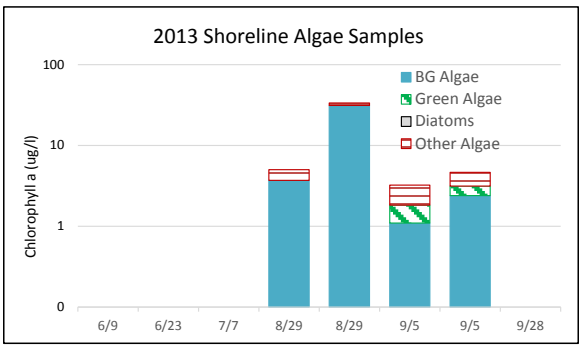


Figure D6:
2013 Shoreline Algae Types

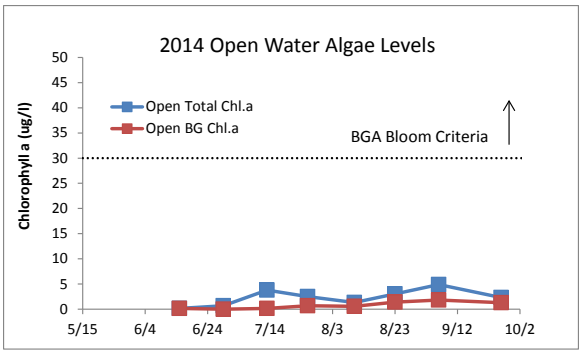


Figure D7:
2014 Open Water Total and BGA Chl.a

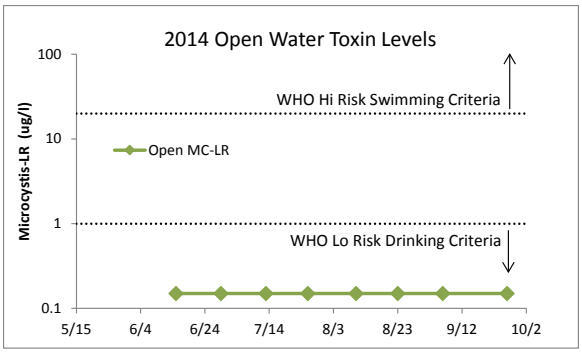


Figure D8:
2014 Open Water Microcystin-LR

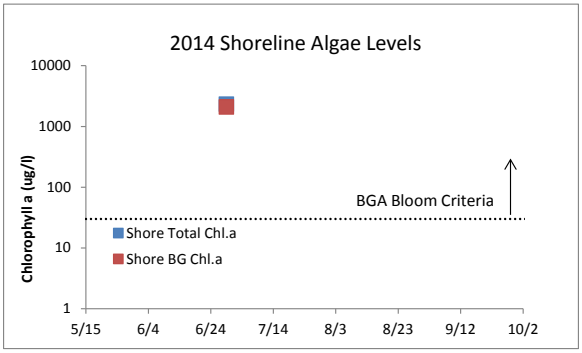


Figure D9:
2014 Shoreline Total and BGA Chl.a

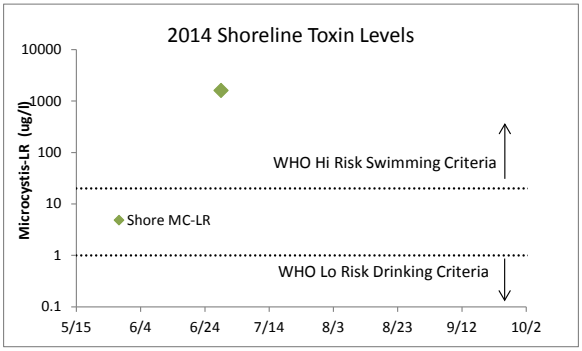


Figure D10:
2014 Shoreline Microcystin-LR

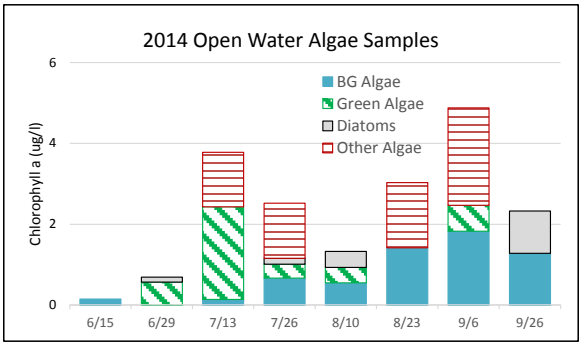


Figure D11:
2014 Open Water Algae Types

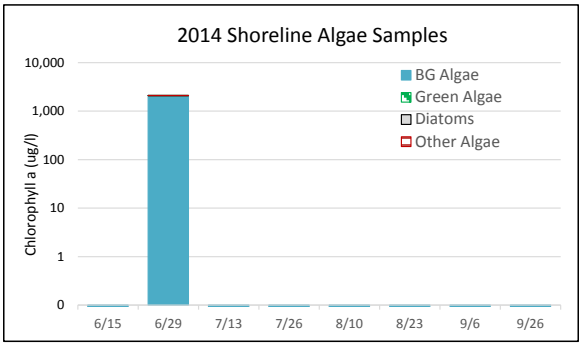


Figure D12:
2014 Shoreline Algae Types

Appendix E:
AIS Species in Cattaraugus County

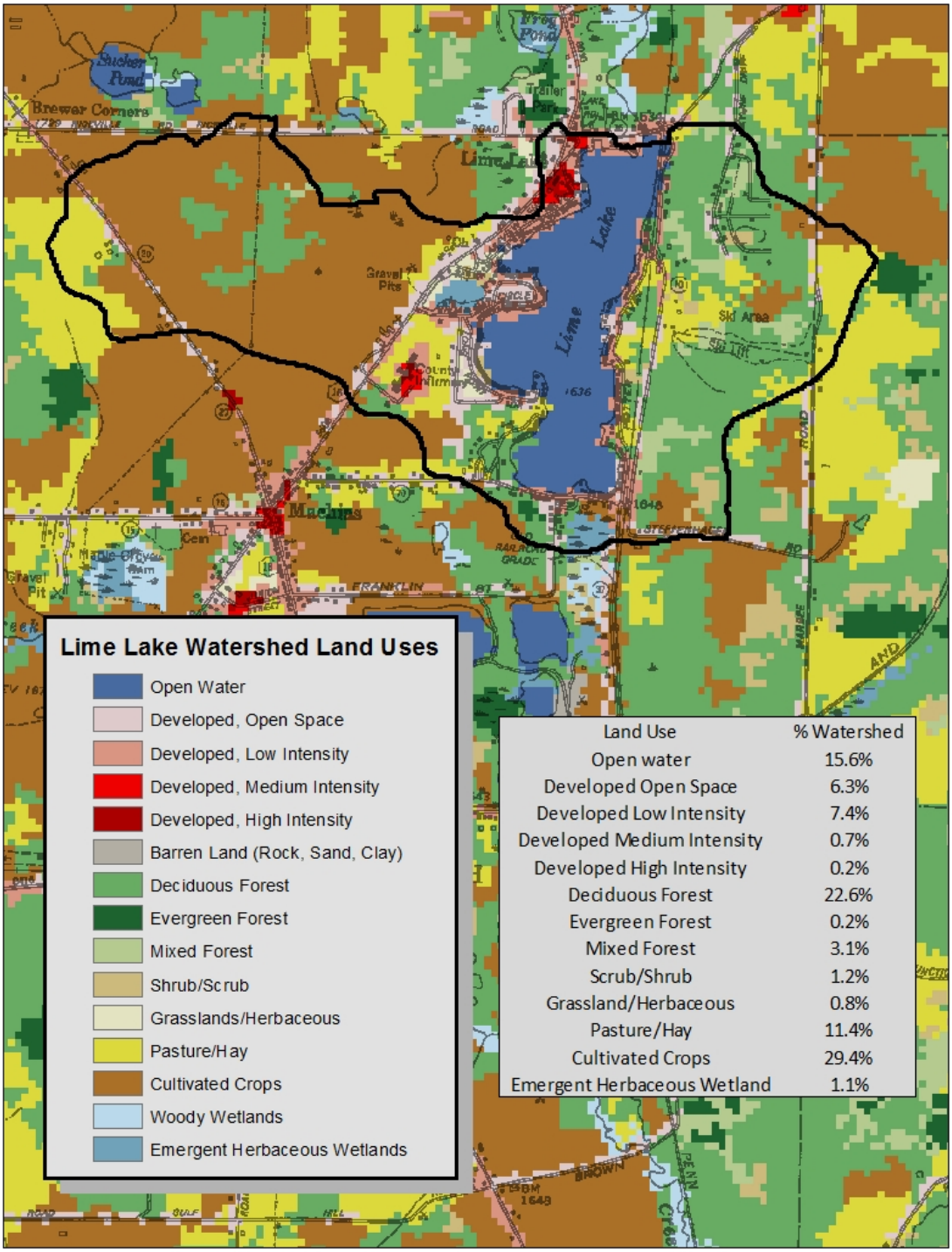
The table below shows the invasive aquatic plants and animals that have been documented in Cattaraugus County, as cited in either the iMapInvasives database (http://www.imapinvasives.org/) or in the NYSDEC Division of Water database. These databases may include some, but not all, non-native plants or animals that have not been identified as "Prohibited and Regulated Invasive Species" in New York state regulations (6 NYCRR Part 575; http://www.dec.ny.gov/docs/lands_forests_pdf/islist.pdf).

This list is not complete, but instead represents only those species that have been reported and verified within the county. If any additional aquatic invasive species (AIS) are known or suspected in these or other waterbodies in the county, this information should be reported through iMap invasives or by contacting NYSDEC at dowinfo@dec.ny.gov.

Aquatic Invasive Species - Cattaraugus County			
Waterbody	**Kingdom**	**Common name**	**Scientific name**
Allegheny Reservoir	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Allegheny Reservoir	Animal	Allegheny crayfish	*Orconectes obscurus*
Case Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Case Lake	Plant	Curly leafed pondweed	*Potamogeton crispus*
Crystal Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Cuba Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Cuba Lake	Plant	Brittle naiad	*Najas minor*
Cuba Lake	Plant	Curly leafed pondweed	*Potamogeton crispus*
Lime Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Linlyco Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Quaker Lake	Animal	Common carp	*Cyprinus carpio*
Quaker Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Quaker Landing - unnamed pond	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*
Red House Lake	Plant	Eurasian watermilfoil	*Myriophyllum spicatum*

Appendix F: Watershed and Land Use Map for Lime Lake

This watershed and land use map was developed using USGS StreamStats and ESRI ArcGIS using the 2006 land use satellite imagery. The actual watershed map and present land uses within this watershed may be slightly different due to the age of the underlying data and some limits to the use of these tools in some geographic regions and under varying flow conditions. However, these maps are intended to show the approximate extent of the lake drainage basin and the major land uses found within the boundaries of the basin.



Land Use	% Watershed
Open water	15.6%
Developed Open Space	6.3%
Developed Low Intensity	7.4%
Developed Medium Intensity	0.7%
Developed High Intensity	0.2%
Deciduous Forest	22.6%
Evergreen Forest	0.2%
Mixed Forest	3.1%
Scrub/Shrub	1.2%
Grassland/Herbaceous	0.8%
Pasture/Hay	11.4%
Cultivated Crops	29.4%
Emergent Herbaceous Wetland	1.1%