Cayuga Lake

General Lake Information

Location	Cayuga, Seneca, and Tompkins counties
Basin	Oswego-Seneca-Oneida
Size	17,326 hectares (42,814 acres)
Lake Origins	Natural
Watershed Area	407,170 hectares (1,006,158 acres)
Retention Time	9.0 years
Mean Depth	55.0 meters
Maximum Depth	133 meters
Public Access	Public ramps, car top/hand launches, several beaches
Major Tributaries	Cayuga Inlet and multiple named and unnamed tributaries
Lake Tributary To…	Seneca River to Oswego River to Lake Ontario
WQ Classification	AA (potable water, bathing, swimming), A (potable water, bathing, swimming), and B (bathing, swimming)
Lake Sites Latitude	North: 42.8178; South: 42.5552
Lake Sites Longitude	North: -76.7257; South: -76.5975
Sampling Years	CSLAP: 2002-2007, 2017 (south site), 2017 (north site)
2017 Samplers	North: Tom Casella, Bill Ebert South: Don Sargent, Michelle Henry, Shannon Barrett
Main Contact	North: Bill Ebert; South: Don Sargent

Background

Cayuga Lake ranks second in size among the Finger Lakes, only Seneca is larger, and it extends northward from the city of Ithaca through Tompkins, Cayuga and Seneca counties. Cayuga Lake has a shallow weedy area at its north end which extends south for approximately six miles and occupies 5,800 acres. Cayuga Lake is a multi-class (AA, A, and B) waterbody. Class AA waterbodies are best utilized for drinking water, culinary or food processing purposes, primary and secondary contact recreation, and fishing.

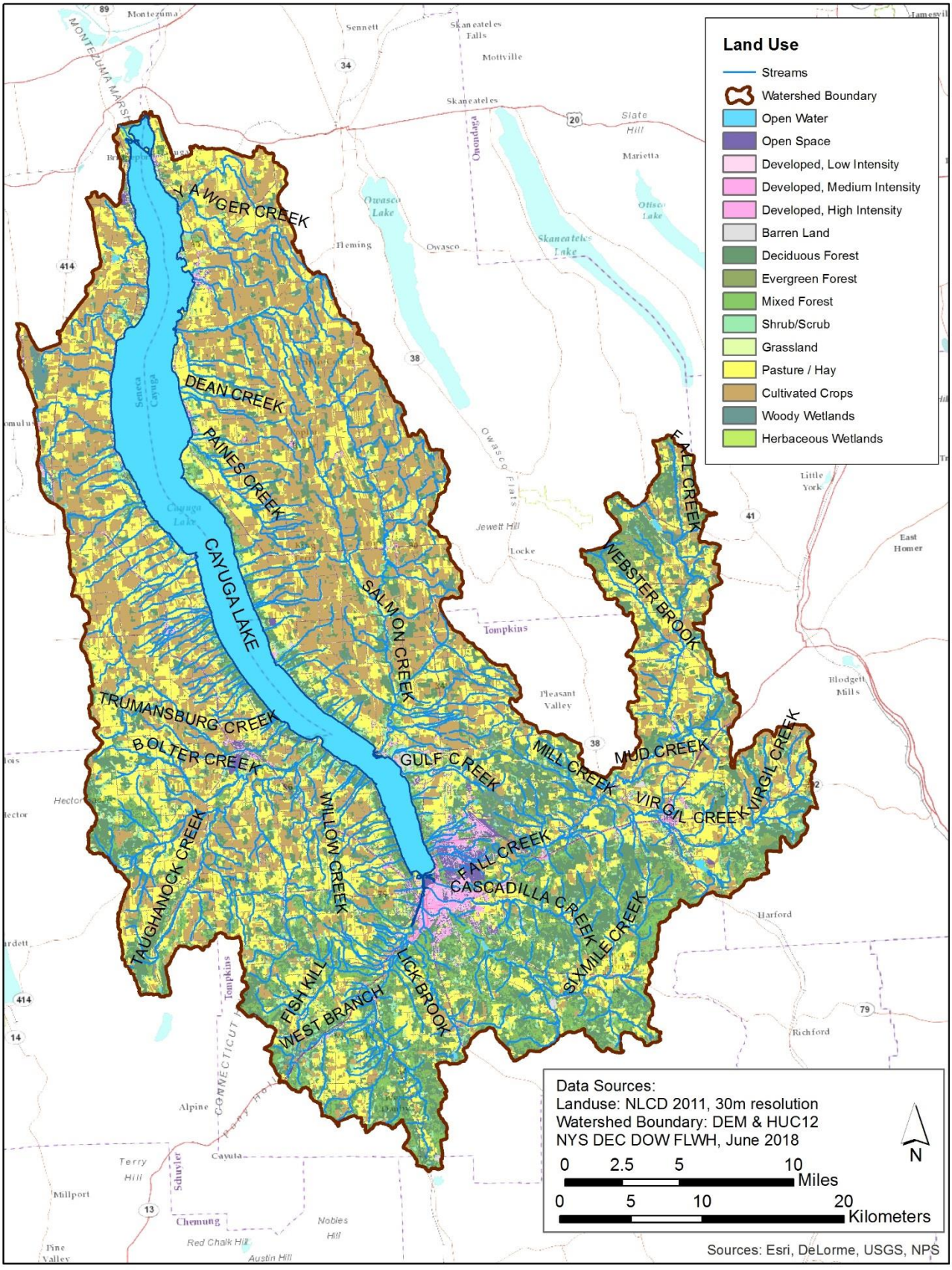
Watershed Management

This waterbody is considered a highly-valued water resource due to its drinking water supply classification and as a multi–use waterbody. In 2017, a collaboration of local municipalities, community groups, interested citizens, and regional planning boards updated and updated the 2001 management plan, the Cayuga Lake Watershed Restoration and Protection Plan (RPP) for the protection of the Cayuga Lake watershed. The original effort in 2001 coincided with the establishment of the Cayuga Lake Watershed Intermunicipal Organization (IO), a voluntary partnership of 31 villages, towns, cities and counties in the watershed working together to implement the RPP.

An effort to develop a Total Maximum Daily Load (TMDL) plan for Cayuga Lake is currently underway.

Governor Cuomo’s HABs initiative has selected 12 New York State waterbodies that are representative of waterbody types, lake conditions, and vulnerability to HABs throughout the State. Cayuga Lake, with its numerous recreational opportunities, aesthetic beauty, importance as a source of drinking water for local communities, and documented HAB occurrences in recent years, was selected as one of the priority waterbodies. The Cayuga Lake HAB Action Plan was completed in May of 2018.

Lake Map


Land Use
Streams
Watershed Boundary
Open Water
Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Grassland
Pasture / Hay
Cultivated Crops
Woody Wetlands
Herbaceous Wetlands
LAWGER CREEK
DEAN CREEK
PAINES CREEK
CAYUGA LAKE
SALMON CREEK
TRUMANSBURG CREEK
BOLTER CREEK
TAUGHANOCK CREEK
WILLOW CREEK
GULF CREEK
MILL CREEK
MUD CREEK
VIRGIL CREEK
FALL CREEK
CASCADILLA CREEK
SIXMILE CREEK
FISH KILL
WEST BRANCH
LICK BROOK
WEBSTER BROOK
FALL CREEK
Data Sources:
Landuse: NLCD 2011, 30m resolution
Watershed Boundary: DEM & HUC12
NYS DEC DOW FLWH, June 2018
0 2.5 5 10 Miles
0 5 10 20 Kilometers
N
Sources: Esri, DeLorme, USGS, NPS

Historic Water Quality Data

CSLAP/DEC Historic Data

CSLAP sampling was conducted on Cayuga Lake from 2002 to 2007 and in 2017. The CSLAP reports for each of the past several years can be found on the NYSFOLA website at http://nysfola.mylaketown.com. The most recent CSLAP report for Cayuga Lake can also be found on the NYSDEC web page at http://www.dec.ny.gov/lands/77821.html. Other monitoring efforts conducted in Cayuga Lake include the Finger Lakes Synoptic Water Quality Investigation (FL/SWQI) from 1996 to 2000, NYSDEC Disinfection by-products (DBPs) Study (Callinan et al. 2013) in 2004, and the Finger Lakes Water Hub winter sampling in 2018.

Non-DEC/CSLAP Data

NYSDEC is currently compiling a list of external water quality lake data. This information will be evaluated for inclusion in next year's report.

Summary of 2017 CSLAP Sampling Results

*Table 1: North Site**

Open Water Indicators	2017 Sampling Results								Seasonal Change	Long Term Avg.
	6/17	6/28	7/10	7/23	8/6	8/21	9/5	9/18		
Chl.a (µg/L)	5.4	8.9	2.8	6.9	5.3	4.2	4.3	2.5		3.4
BG Chl.a (µg/L)	0.0	0.0	0.2	0.0	0.9	0.2	0.2	0.3		0.5
Clarity (m)	2.9	2.5	3.1	2.5	2.7	2.7	3.9	4.3		3.4
pH	7.4	8.3	7.4	7.6	7.5	7.4	7.6	7.9		7.8
Cond (µmho/cm)	409.5	422.3	379.6	353.9	379	381.9	386.6	402.9		320
Surf Temp (°C)	16	19	22	23	24	22	18	20		20
Bott Temp (°C)	11	12	10	13	15	14	10	11		13
TN (mg/L)	1.305	1.284	1.27	1.049	1.16	.737	1.2	1.08		1.190
TP (mg/L)	.013	.016	.02	.027	.016	.015	.018	.014		0.011
Deep TP (mg/L)	.008	.012	.007	.009	.008	.008	.006	.006		0.009
N:P Ratio	100	80	64	39	73	49	67	77		

*Table 2: South Site**

Open Water Indicators	2017 Sampling Results								Seasonal Change	Long Term Avg.
	6/20	7/5	7/19	8/1	8/16	8/29	9/11	9/27		
Chl.a (µg/L)	9.6	.9	14.3	9.8	6	5.9	5.3	6.2		7.3
BG Chl.a (µg/L)	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0		0.3
Clarity (m)	2.5	2	1.8	1.8	3	2.9	4.1	3.2		2.7
pH	7.4	7.1	7.9	7.8	7.3	7.6	7.6	8.0		7.6
Cond (µmho/cm)	393.1	376.2	379.1	360.5	386.7	393.2	396.2	386.5		384
Surf Temp (°C)	23	24	27	25	24	22	20	23		24
Bott Temp (°C)	22	20	24	20	23	22	20	23		22
TN (mg/L)	1.225	1.439	1.098	1.07	.926	.609	1.11	.938		1.052
TP (mg/L)	.022	.023	.035	.017	.012	.015	.013	.015		0.019
Deep TP (mg/L)	.013	.018	.015	.011	.012	.013	.013	.013		0.013
N:P Ratio	56	63	31	63	77	41	85	63		

*Highlighted results indicate eutrophic values

Results Relative to Historic Data

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" Section.

Potable Water Indicators

The 2017 data from the south site indicated slightly lower productivity- slightly higher water clarity in response to slightly lower nutrient and algae levels- than in the north site. There did not appear to be a significant threat for disinfection-by-product (DBP) formation at the southern site, although these threats may be greater at sites further south. It is not known if the shoreline cyanobacteria (HAB) blooms on the lake in 2017 represent an ephemeral event, a significant ecological change in development, or a degradation in water quality.

Potable water conditions, at least as measurable through CSLAP, are summarized in the Lake Scorecard and Lake Condition Summary Table.

Limnological Indicators

The 2017 data suggests that Cayuga Lake is *mesotrophic* (moderately productive) based on intermediate levels of water clarity (Secchi disk between 2-5 m), nutrients (TP between 0.01-0.02 mg/L) and algae levels (Chl.a between 2-8 µg/L). Lake productivity was mostly stable during the summer, with no clear seasonal trends.

The trophic state indices (TSI) evaluation suggests that each of these trophic indicators is "internally consistent"—each of these indicators is in the expected range given the readings of the other indicators.

Overall limnological and trophic state conditions are summarized in the Lake Scorecard and Lake Condition Summary Table.

Biological Conditions

Aquatic invasive species (AIS) plants reported in the lake include Eurasian watermilfoil, water chestnut, hydrilla and curly leafed pondweed. In addition, zebra and quagga mussels, fishhook water flea, Chinese mystery snail, Asian clam, common carp, round goby, and scud have also been documented in the lake. The large number of access points and proximity to other infested lakes includes a high vulnerability to new AIS introductions. The hydrilla findings in the south end of the lake threaten other Cayuga Lake and Finger Lake sites.

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

Lake Perception

This lake is strongly stratified thermally, and deep-water oxygen levels are probably high. Dense macrophyte stands are common at the shallow norther and southern ends of the lake, but aquatic plants stay well below the lake surface in most other locations. Recreational assessments are favorable despite moderate water clarity.

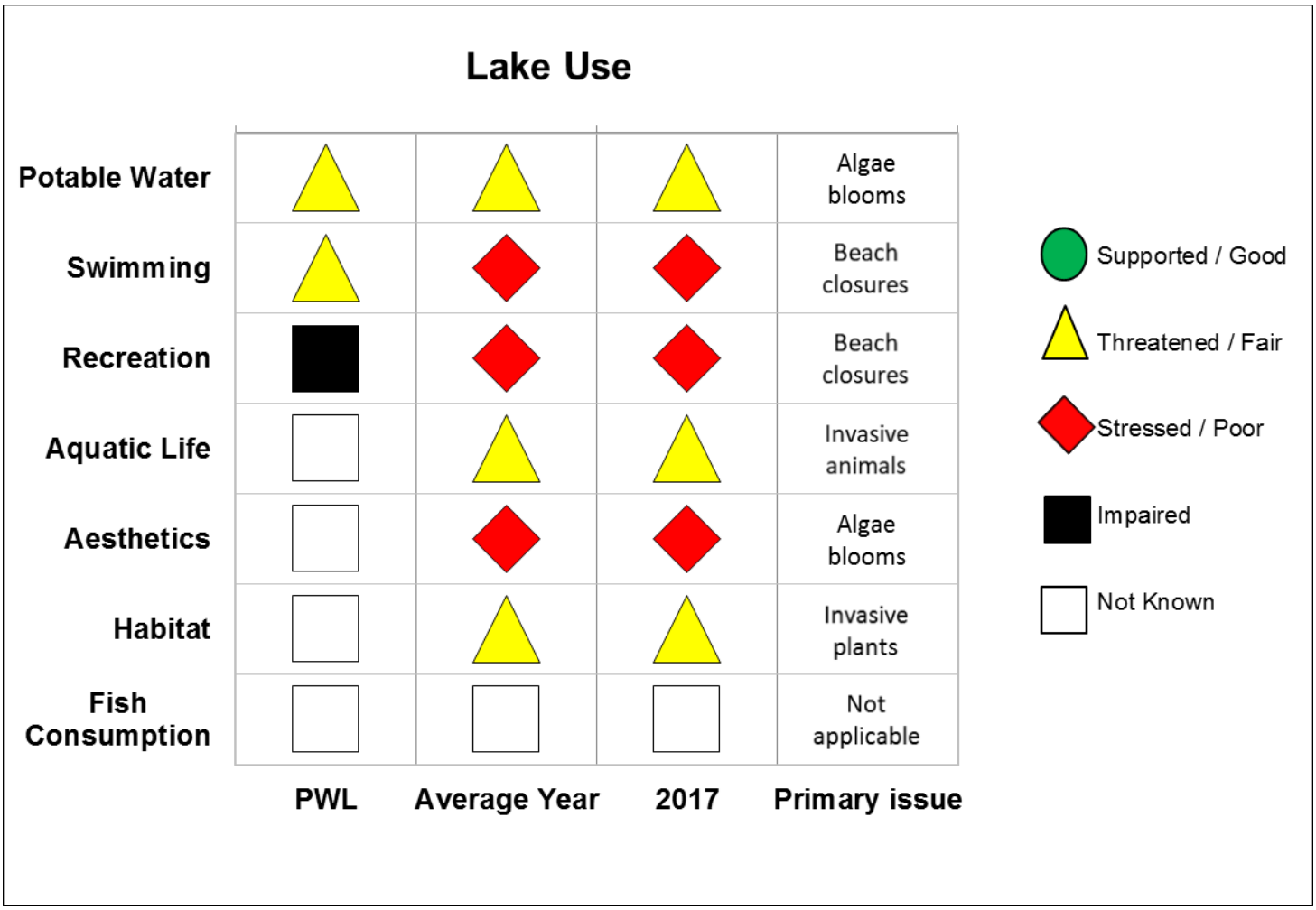
Overall lake perception is summarized on the Lake Scorecard and Lake Condition Summary Table.

Harmful Algal Blooms

Water quality conditions suggest a moderate-elevated susceptibility to blooms, based on nutrient and algae levels, although widespread blooms were reported for a short period of time throughout the lake in 2017. It is not yet known if these water quality conditions, and the unexpected susceptibility to blooms, are representative of normal bloom conditions in the lake, and if these conditions are stable. The cause of these blooms continues to be actively investigated, including the HABs-12 Initiative.

Evaluation of Lake Use

Cayuga Lake is presently among the lakes listed on the Oswego-Seneca-Oneida drainage basin Priority Waterbody List (PWL) as having *minor impacts* for both segments sampled by CSLAP in 2017. Use assessments are compared to the criteria established in the NYSDEC Consolidated Assessment and Listing Methodology (CALM), found at: https://www.dec.ny.gov/docs/water_pdf/asmtmeth17.pdf.



Potable Water

Cayuga Lake is a Class A(T) and Class AA(T) required to support and protect the best use as a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. This waterbody is also designated as a cold water (trout) fishery. The evaluation of water supply focuses on the source water prior to treatment, and does not necessarily reflect the quality of water distributed for use after treatment. Monitoring of water quality at the tap is conducted by local water suppliers and public health agencies. Water supply use of Cayuga Lake is considered to be *threatened* due to an elevated potential for several pollutants that can impact source water, increase the cost and effort to deliver high quality drinking water, and produce post-treatment compounds of concern. This assessment is based on land use and activities in the watershed. It is not known if any of the potable water intakes in this segment are compromised by existing water quality conditions.

Swimming

Primary and secondary contact recreation use are *stressed* and impacts may rise to the level of being *impaired* due to the periodic closure of public bathing beaches for swimming due to harmful algal blooms, and excessive algae growth. It is not yet known if the significant extent and duration of shoreline harmful algal blooms (HABs) reported in 2017 indicate a long-term change in the lake or were a temporary phenomenon. However, visual evidence of HABs resulted in beach closures from 6 to 14 days at several beaches within this segment in 2017, including the Wells College Bathing Beach, Camp Caspar Gregory Bathing Beach, Long Point State Park, Ithaca Yacht Club, and Taughannock Falls State Park.

Non-Contact Recreation

Impacts from habitat and hydrologic modification are also thought to contribute to the weed and algal growth and the impact on recreational uses. Zebra mussel infestation of the lake has increased lake clarity. The increased

clarity allows for greater penetration of light which supports plant growth into the lake. In addition, mussels filter particulate bound phosphorus and release soluble phosphorus that is more readily available for plant growth. In addition to zebra mussels, quagga mussels are now present throughout Cayuga Lake, which establish in deeper, colder water than zebra mussels. Fishing use is considered to be *fully supported* based on a healthy fishery.

Aquatic Life

The main lake supports warm and cold-water species. Gamefish include lake trout, rainbow trout, landlocked salmon, brown trout, northern pike, chain pickerel, largemouth and smallmouth bass. Panfish include crappies, bluegill, pumpkinseed, yellow perch and bullheads. Carp, channel catfish and longnose gar are also found in the lake. The main forage base is alewives, smelt and yellow perch. Cayuga is stocked annually with approximately 60,000 lake trout, 25,000 brown trout and 40,000 landlocked salmon. Cayuga's tributaries are stocked with 50,000 rainbow trout. Although several invasive animals and plants are present in the lake, it is not known if these are adversely affecting aquatic life. Sea lampreys are present in Cayuga Lake and a NYSDEC control program involves applications of the highly selective chemical lampricide, TFM, to known sea lamprey nursery areas.

Aesthetics

Aesthetic conditions are evaluated as *fair to poor* due to turbidity plumes during wet-weather events and rooted plant growth. Aesthetics in some locations may be poor due to shoreline HABs during calm and dry periods.

Fish Consumption

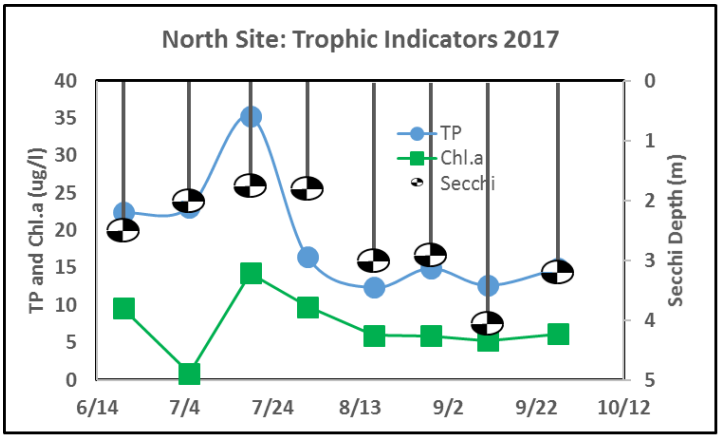
There are no health advisories limiting the consumption of fish from this waterbody (beyond the general advice for all NYS waters). However due to the uncertainty as to whether the lack of a waterbody-specific health advisory is based on actual sampling, fish consumption use is noted as *unassessed*.

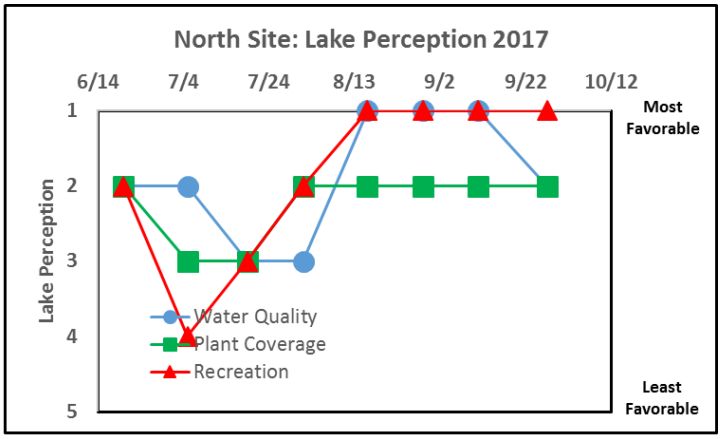
LAKE CONDITIONS SUMMARY – CAYUGA LAKE NORTHERN SITE*								
CATEGORY	**Indicator**	**Min**	**86-17 Avg**	**Max**	**2017 Avg**	**Classification**	**2017 Change?**	**Long Term Change?**
EUTROPHICATION INDICATORS	Water Clarity	1.75	2.65	4.05	2.65	Mesotrophic	Insufficient Data	Insufficient Data
	Chlorophyll *a*	0.90	7.25	14.30	7.25	Mesotrophic	Insufficient Data	Insufficient Data
	Total Phosphorus	0.012	0.019	0.035	0.019	Mesotrophic	Insufficient Data	Insufficient Data
	Total Dissolved Phosphorus	0.003	0.007	0.010	0.007			
POTABLE WATER INDICATORS	Hypolimnetic TN	0.53	1.06	1.44	1.06	Highly Elevated Deepwater N	Insufficient Data	Not yet known
	Hypolimnetic DOC	2.40	2.93	3.30	2.93		Not known	Not known
	Hypolimnetic UV254	0.00	4.81	8.80	4.81		Not known	Not known
	Hypolimnetic SUVA	0.00	1.65	2.67	1.65	Low non-algal DBP risk	Not known	Not known
LIMNOLOGICAL INDICATORS	Hypolimnetic Phosphorus	0.011	0.013	0.018	0.013	Close to Surface TP Readings	Insufficient Data	Insufficient Data
	Hypolimnetic Dissolved P	0.003	0.007	0.010	0.007	~ 1/2 of nitrogen dissolved		
	Nitrate + Nitrite	0.51	0.63	0.75	0.63	High NOx	Insufficient Data	Insufficient Data
	Ammonia	0.02	0.04	0.10	0.04	Low Ammonia	Insufficient Data	Insufficient Data
	Total Nitrogen	0.61	1.05	1.44	1.05	High Total Nitrogen	Insufficient Data	Insufficient Data
	Total Dissolved Nitrogen	0.514	0.960	1.208	0.960	> 1/2 of nitrogen dissolved		
	pH	7.14	7.58	8.03	7.58	Alkaline	Insufficient Data	Insufficient Data
	Specific Conductance	361	384	396	384	Hardwater	Insufficient Data	Insufficient Data
	True Color	1	3	5	3	Uncolored	Insufficient Data	Insufficient Data
	Calcium	21	29	38	29	Highly Susceptible to Zebra Mussels	Insufficient Data	Insufficient Data
	Chloride	43	43	43	43	>75th Percentile of NYS Lakes	Insufficient Data	Not yet known
LAKE PERCEPTION	WQ Assessment	1	1.9	3	1.9	Not Quite Crystal Clear	Insufficient Data	Insufficient Data
	Aquatic Plant Coverage	2	2.3	3	2.3	Subsurface Plant Growth	Insufficient Data	Insufficient Data
	Recreational Assessment	1	1.9	4	1.9	Excellent	Insufficient Data	Insufficient Data
BIOLOGICAL CONDITION	Fish					Coldwater fishery	Not known	Not known
	Invasive Species-Plants					Eurasian watermilfoil; Curly leafed pondweed		
	Invasive Species-Animals					quagga, zebra mussels; mud bithynia; scud; bloody-red shrimp; rudd		
LOCAL CLIMATE CHANGE	Surface Water Temperature	20	23.5	27	23.5		Insufficient Data	Insufficient Data
	Bottom Water Temperature	20	21.8	24	21.8		Insufficient Data	Insufficient Data
HARMFUL ALGAL BLOOMS	Open Water FP Chl.a	3.2	4.6	7.5	4.6	No readings indicate high algae levels	Not known	Not known
	Open Water FP BG Chl.a	0.0	0.1	0.2	0.1	No readings indicate high BGA levels	Not known	Not known
	Open Water Microcystin	<DL	<DL	<DL	<DL	Open water not detectable	Not known	Not known
	Open Water Anatoxin a	<DL	<DL	<DL	<DL	Open water not detectable	Not known	Not known
	Shoreline FP Chl.a	26.4	1887.6	8818.8	1887.6	High algae levels	Not known	Not known
	Shoreline FP BG Chl.a	13.8	1861.7	8756.3	1861.7	High BGA levels	Not known	Not known
	Shoreline Microcystin	<DL	107.8	782.8	98.1	Very high shoreline bloom MC-LR	Not known	Not known
	Shoreline Anatoxin a	<DL	<DL	<DL	<DL	Consistently not detectable	Not known	Not known

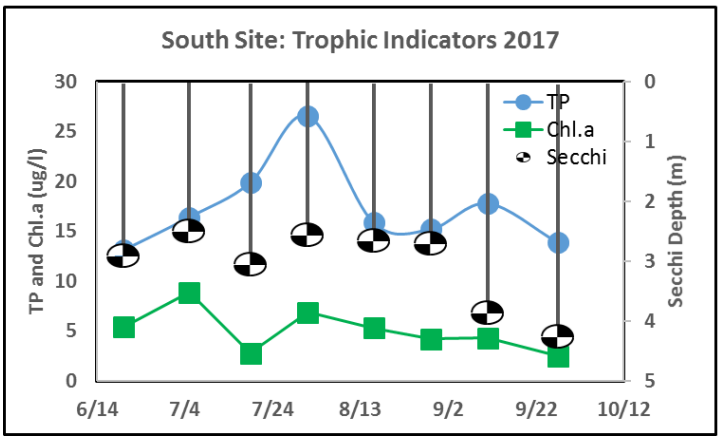
* There is no historic data at this site. Long-term averages are based on 2017 data only.

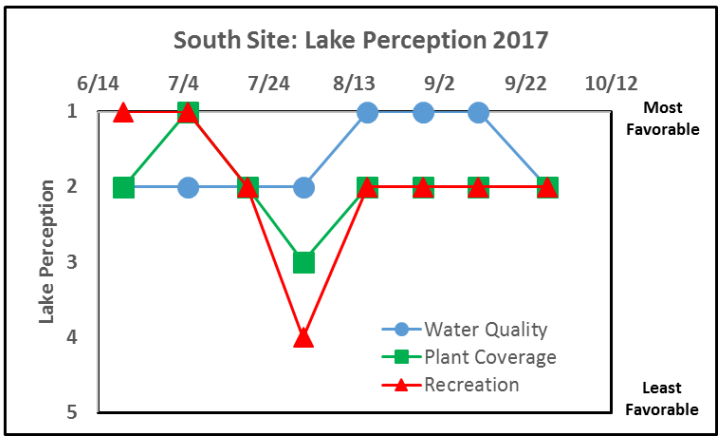
LAKE CONDITION SUMMARY – CAYUGA SOUTHERN SITE								
CATEGORY	**Indicator**	**Min**	**86-17 Avg**	**Max**	**2017 Avg**	**Classification**	**2017 Change?**	**Long Term Change?**
EUTROPHICATION INDICATORS	Water Clarity	1.80	3.67	6.60	3.06	Mesotrophic	Within Normal Range	No Change
	Chlorophyll *a*	0.21	3.75	8.90	5.04	Mesotrophic	Within Normal Range	No Change
	Total Phosphorus	0.003	0.014	0.035	0.017	Mesotrophic	Within Normal Range	No Change
	Total Dissolved Phosphorus	0.003	0.010	0.021	0.008	> 1/2 of P potentially available	Within Normal Range	Not yet known
POTABLE WATER INDICATORS	Hypolimnetic TN	0.51	1.37	1.73	1.26	Highly Elevated Deepwater N	Lower Than Normal	Not yet known
	Hypolimnetic DOC	2.50	2.76	3.10	2.76		Not known	Not known
	Hypolimnetic UV254	0.00	1.90	2.96	1.90		Not known	Not known
	Hypolimnetic SUVA	0.47	1.15	1.34	1.15	Low non-algal DBP risk	Not known	Not known
LIMNOLOGICAL INDICATORS	Hypolimnetic Phosphorus	0.005	0.008	0.015	0.008	Close to Surface TP Readings	Within Normal Range	No Change
	Hypolimnetic Dissolved P	0.003	0.006	0.011	0.006	> 1/2 of bottom P potentially available		
	Nitrate + Nitrite	0.01	0.90	1.65	0.78	High NOx	Within Normal Range	No Change
	Ammonia	0.00	0.14	1.22	0.05	Intermediate Ammonia	Within Normal Range	No Change
	Total Nitrogen	0.62	1.23	2.18	1.14	High Total Nitrogen	Within Normal Range	No Change
	Total Dissolved Nitrogen	0.68	1.04	1.20	1.04	> 1/2 of nitrogen dissolved		
	pH	6.65	7.88	8.71	7.64	Alkaline	Within Normal Range	No Change
	Specific Conductance	135	356	431	389	Hardwater	Within Normal Range	No Change
	True Color	2	14	53	4	Intermediate Color	Within Normal Range	No Change
	Calcium	15	40	58	35	Highly Susceptible to Zebra Mussels	Within Normal Range	No Change
	Chloride	37	42	50	50	>75th Percentile of NYS Lakes	Within Normal Range	Not yet known
LAKE PERCEPTION	WQ Assessment	1	2.1	3	1.6	Not Quite Crystal Clear	Within Normal Range	No change
	Aquatic Plant Coverage	1	2.1	3	2.0	Subsurface Plant Growth	Within Normal Range	No change
	Recreational Assessment	1	2.0	4	2.0	Excellent	Within Normal Range	No change
BIOLOGICAL CONDITION	Fish					Coldwater fishery	Not known	Not known
	Invasive Species-Plants					Eurasian watermilfoil; Curly-leafed pondweed; variable leaf watermilfoil		
	Invasive Species-Animals					quagga mussels; zebra mussels; common carp; scud; European stream valvata		
LOCAL CLIMATE CHANGE	Air Temperature	13	20.8	32	20.8		Within Normal Range	No change
	Water Temperature	14	20.1	26	20.5		Within Normal Range	No change
HARMFUL ALGAL BLOOMS	Open Water FP Chl.a	2.7	4.3	7.2	4.3	No readings indicate high algae levels	Not known	Not known
	Open Water FP BG Chl.a	0.0	0.2	0.9	0.2	No readings indicate high BGA levels	Not known	Not known
	Open Water Microcystin	<DL	<DL	<DL	<DL	Open water MC consistently not detectable	Not known	Not known
	Open Water Anatoxin a	<DL	<DL	<DL	<DL	Open water Anatoxin-a consistently not detectable	Not known	Not known
	Shoreline FP Chl.a	26.4	1887.6	8818.8	1887.6	Most readings indicate high algae levels	Not known	Not known
	Shoreline FP BG Chl.a	13.8	1861.7	8756.3	1861.7	Most readings indicate high BGA levels	Not known	Not known
	Shoreline Microcystin	<DL	107.8	782.8	98.1	Very high shoreline bloom MC	Not known	Not known
	Shoreline Anatoxin a	<DL	<DL	<DL	<DL	Shoreline bloom Anatoxin-a consistently not detectable	Not known	Not known

2017 Time Series: Trophic Indicators

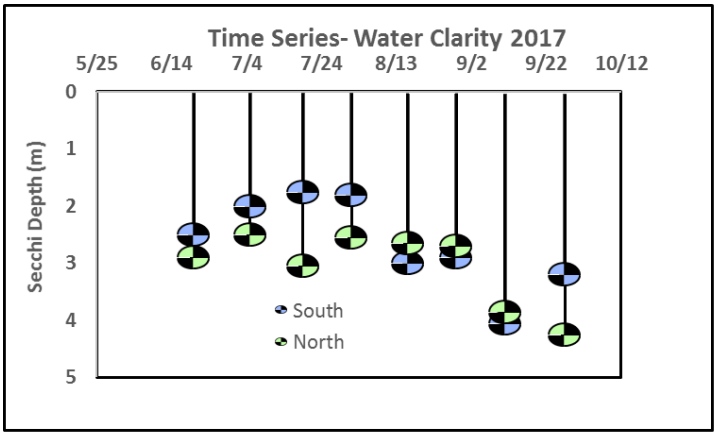


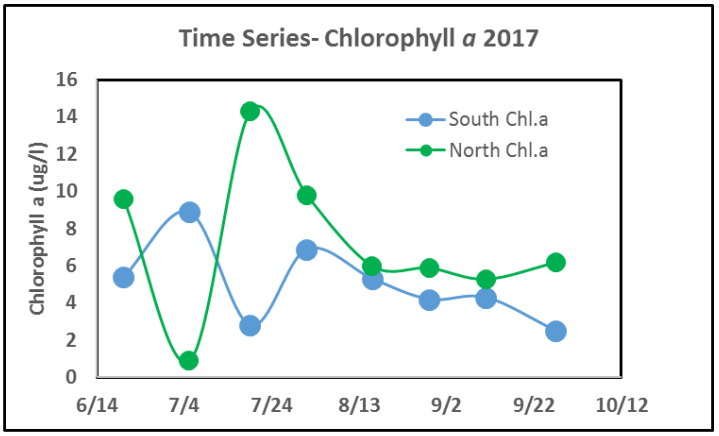


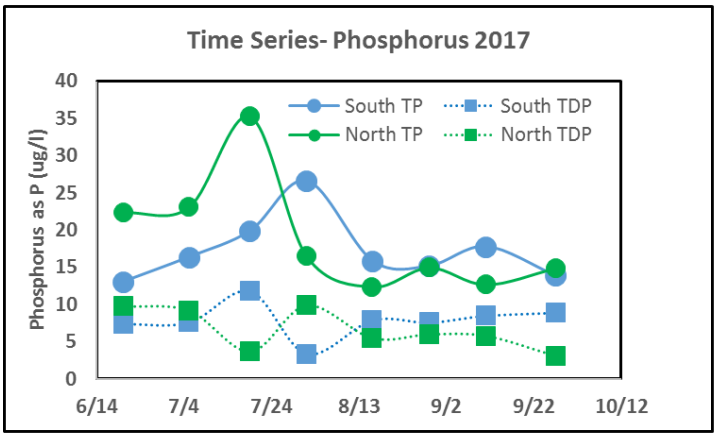


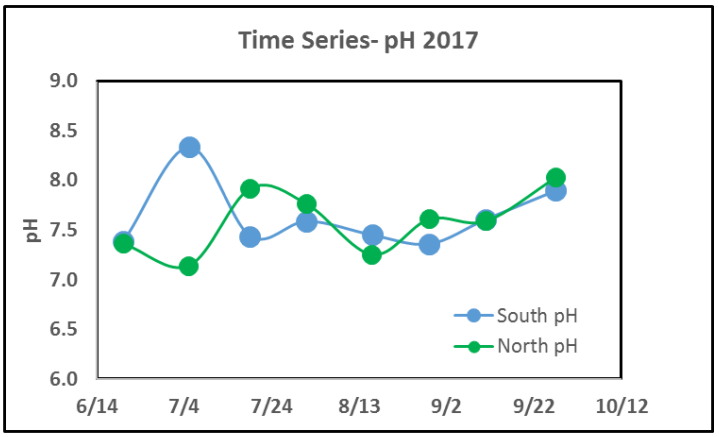


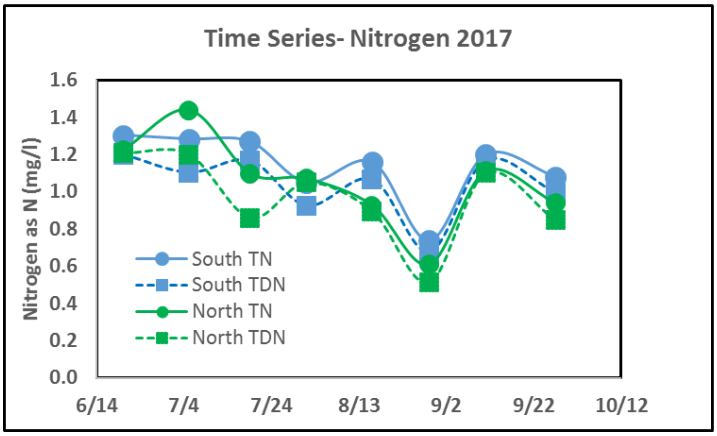
2017 Time Series: Both Sampling Sites

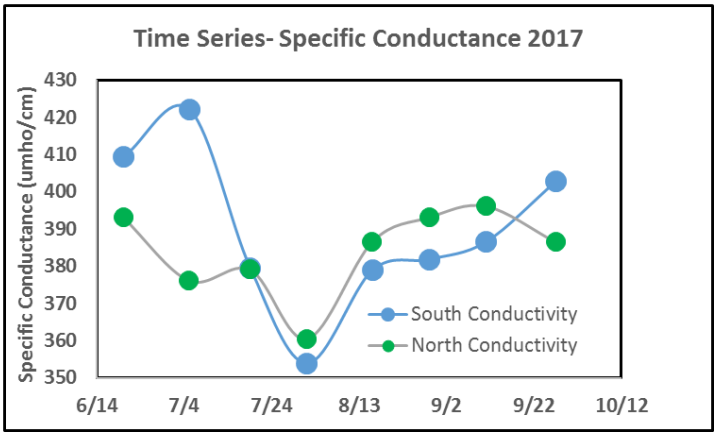




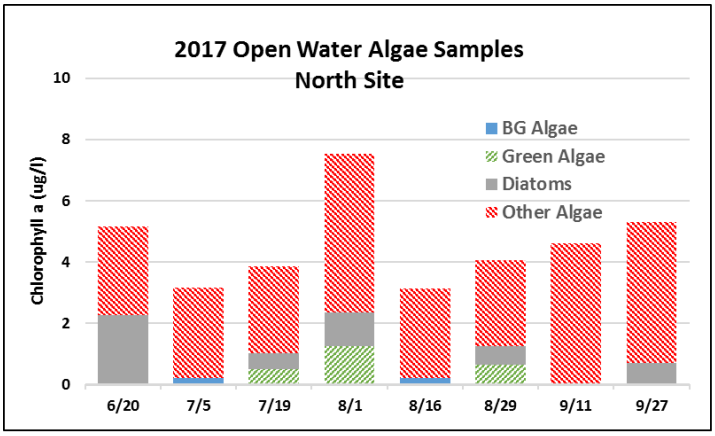


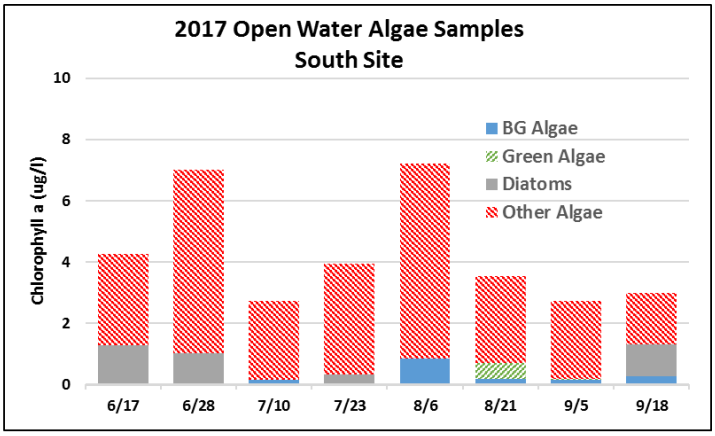


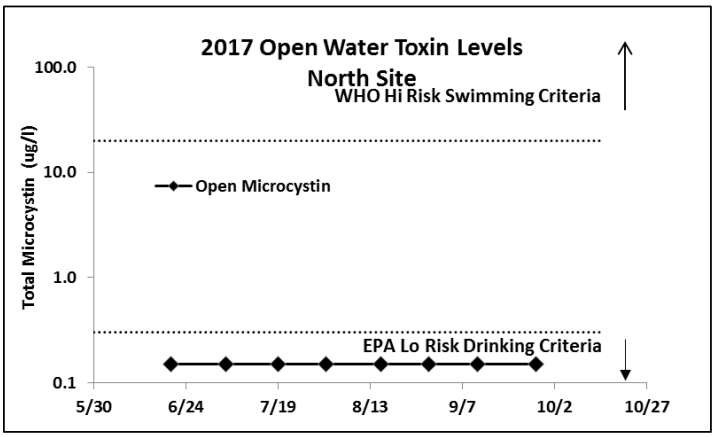


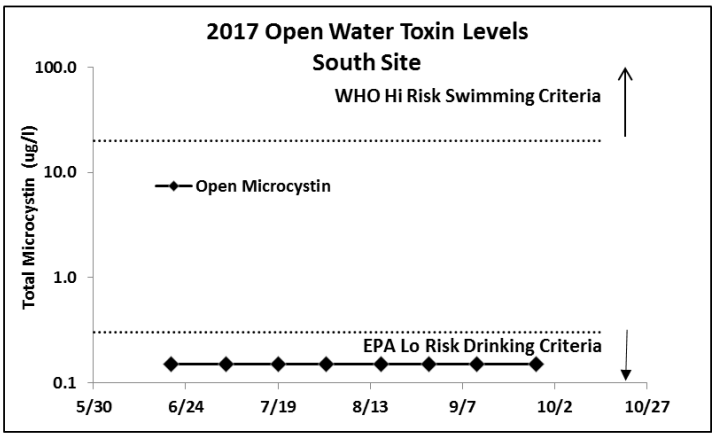


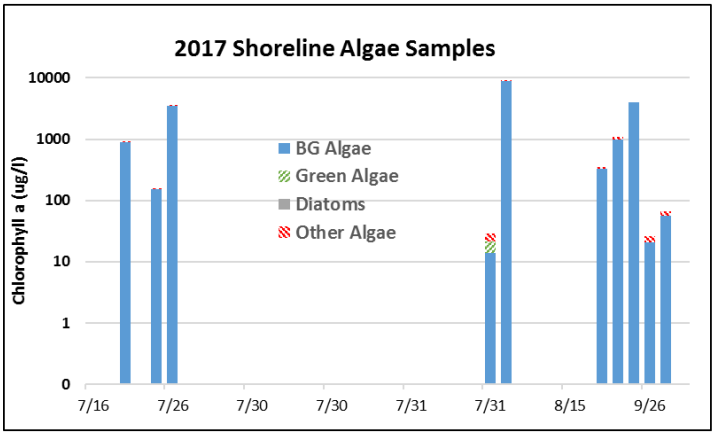
Time Series: Algae and Cyanobacteria

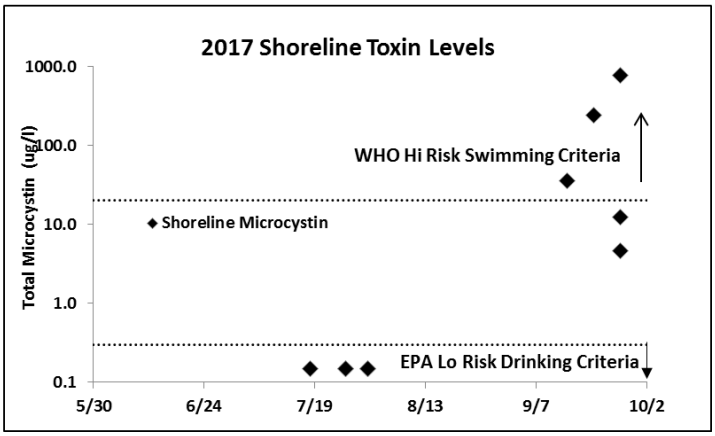








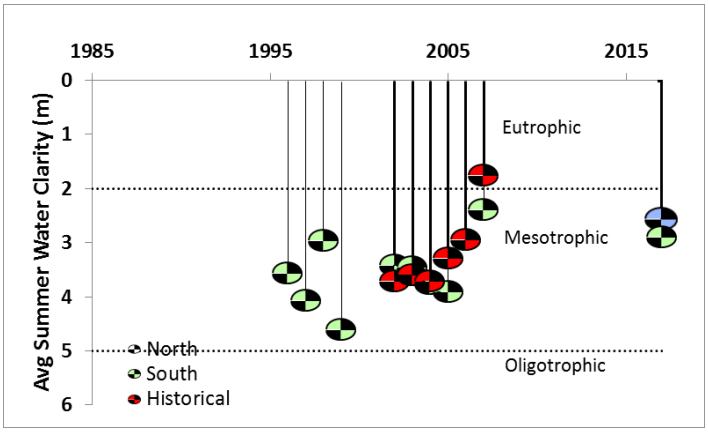




Long-Term Data Series

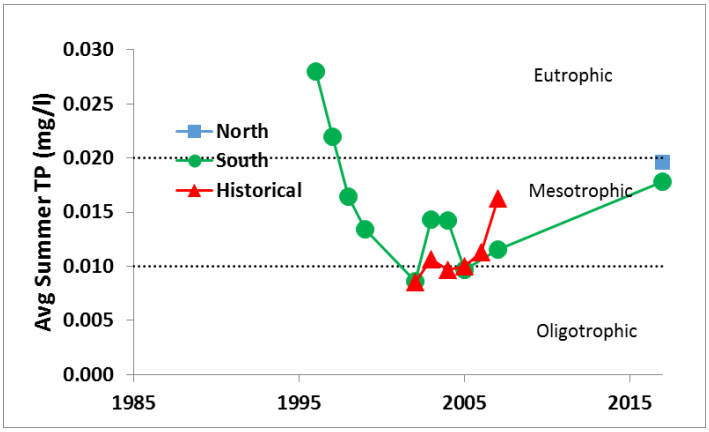
Water Clarity

- A slight decrease in clarity since 1990s, but increase since late 2000s
- Mostly typical of meso-eutrophic lakes



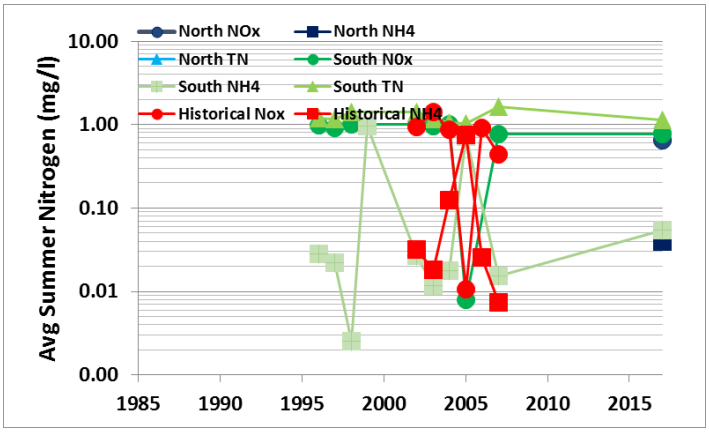
Summer TP

- Slight increase in summer TP since late 2000s
- Readings typical of mesotrophic lakes



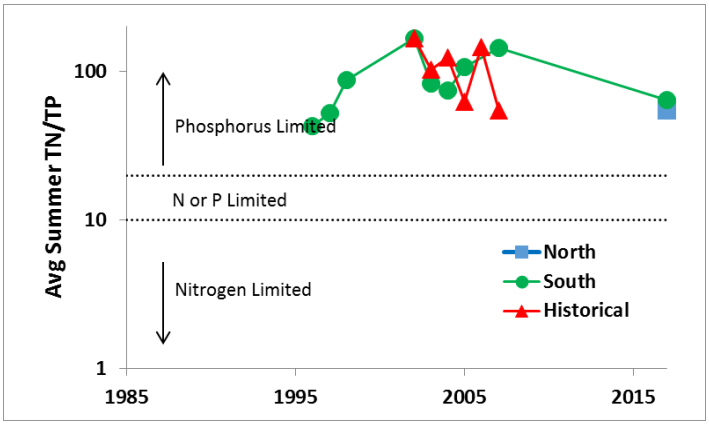
Summer Nitrogen

- Variable, no apparent increase or decrease



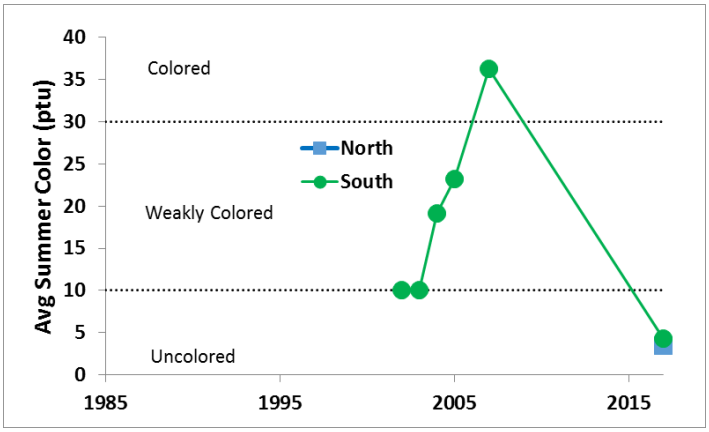
Summer TN/TP Ratio

- Slight decrease since late 2000s
- Readings typical of phosphorus limited lakes



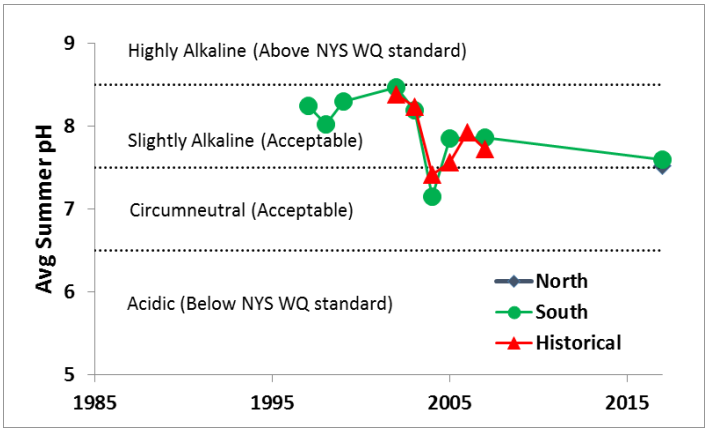
Summer Color

- Uncolored compared to colored in late 2000s



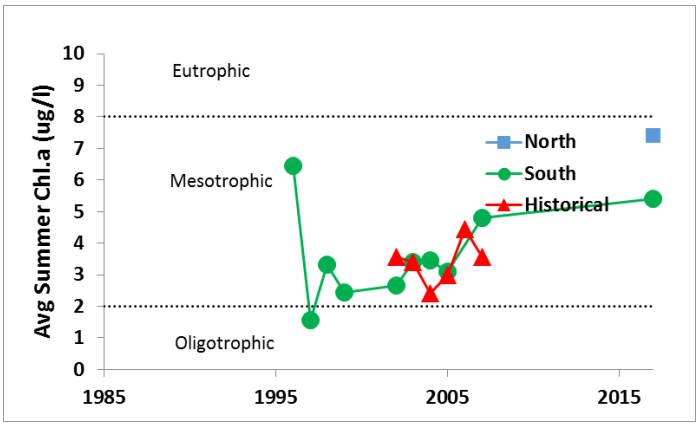
Summer pH

- Slight decrease in pH
- Most readings typical of a slightly alkaline lake



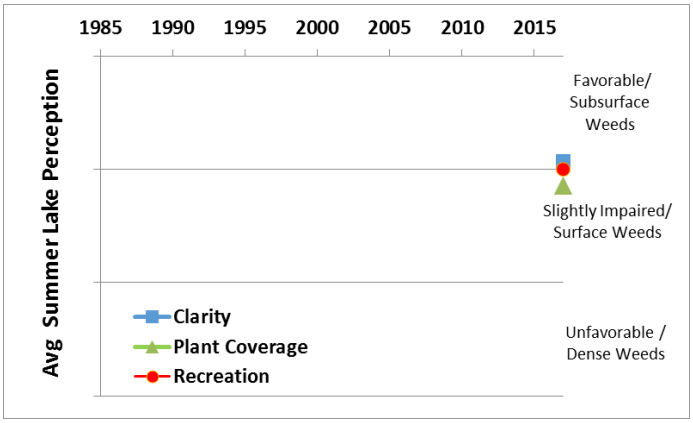
Summer Chl.a

- Slight increase from historic numbers
- Mostly typical of mesotrophic lakes



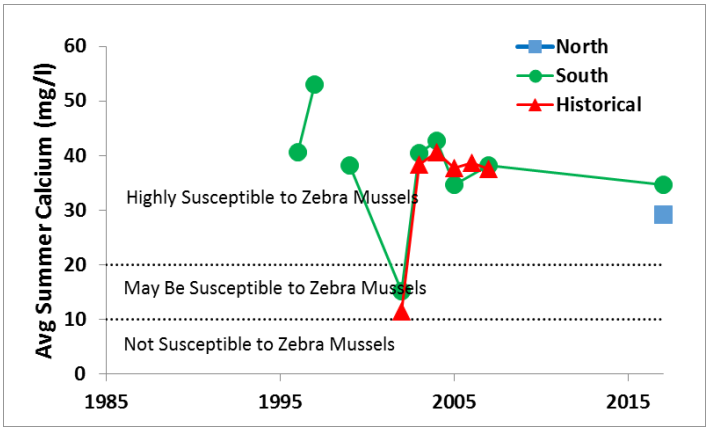
Summer Lake Perception

- No historic lake perception



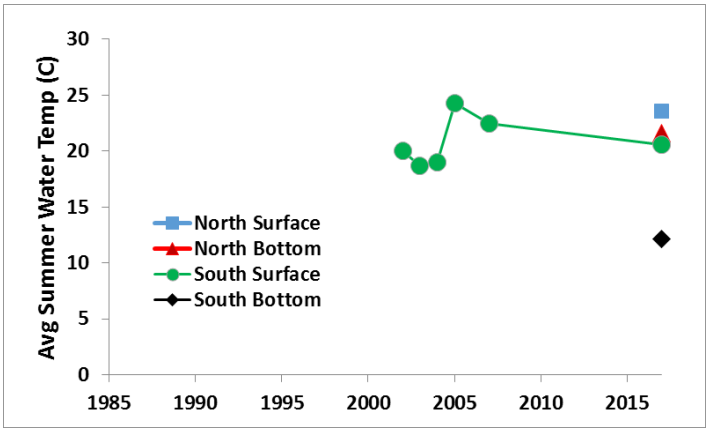
Summer Calcium

- Slight decrease in 2017
- Readings typical of lakes highly susceptible to mussels



Summer Water Temperature

- Fairly consistent surface temperature



Summer Conductivity

- Readings typical of lakes with hardwater