LCI Lake Water Quality Summary

General Information

Lake Name: Black Lake

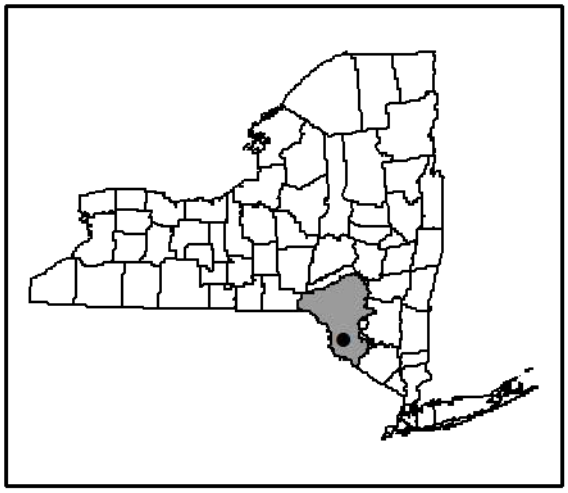
Location: Town of Bethel, Sullivan County
Basin: Delaware River Basin
Size: 80.3 hectares (= 198 acres)
Lake Origins: Dam constructed in 1917 for flood control
Major Tributaries: Lemons Brook & Lake Superior
Lake Tributary to: Toronto Reservoir
Water Quality Classification: B (best intended use: primary contact recreation)

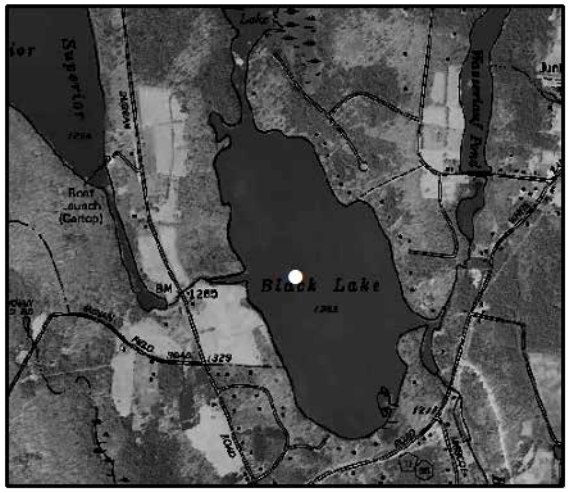
Average Sounding Depth: 7.0 meters (23 feet)
Sampling Coordinates: Latitude: 41.65664, Longitude: -74.859905
Sampling Access Point: Black Lake Estates Private Beach

Monitoring Program: Lake Classification and Inventory (LCI) Survey
Sampling Date: 7/28/09, 6/8/2010, 7/13/2010, 8/11/2010 & 9/14/2010
Samplers: David Newman, Jeff Myers, Steven Finnemore, Scott Kishbaugh, & John Donlon, NYSDEC Division of Water, Albany

Contact Information: David Newman, NYSDEC Division of Water
djnewman@gw.dec.state.ny.us; 518-402-8201

Lake Map
(sampling location marked with a circle)





Background and Lake Assessment

Black Lake is private waterbody managed by Black Lake Preserve, Inc. (formed by the Black Lake Estates and Oxford Country Estates homeowners associations). Black Lake and Oxford Country Estates border the lake on the eastern and southwestern shorelines, respectively. Lake Superior State Park, managed by Sullivan County, borders the western side of the lake. The majority of the watershed is forested or lightly developed, although small portions of the watershed are agricultural (predominantly hay fields). The lake is currently used by Black Lake Preserve members for boating, fishing and swimming.

Black Lake was included in the NYSDEC Division of Water's Lake Classification Inventory (LCI) screening (single sampling event) survey of the Delaware River Basin in 2009. The data collected during the 2009 survey indicated possible water quality problems related to high nutrient levels. The survey also found reduced water clarity, elevated chlorophyll *a* levels and an exotic invasive species (water chestnut). To verify these findings Black Lake was included in the intensive (monthly sampling) of the Delaware River Basin in the summer of 2010.

Black Lake can generally be characterized as *eutrophic*, or highly productive. The average water clarity reading (TSI = 55, typical of *eutrophic* lakes) was expected given the average chlorophyll *a* reading (TSI = 55, typical of *eutrophic* lakes), but the average water clarity reading was lower than expected given the total phosphorus reading (TSI = 51, at the low end of *eutrophic* lakes). These data indicate that the elevated total phosphorus levels may at times lead to high levels of chlorophyll *a* (algae) in the lake. These elevated algae levels can reduce the water clarity in the lake. Four of the five total phosphorus surface samples were above the State Department of Health's (DOH) guidance value of 0.02 mg/l, with one of the five water clarity readings falling below the DOH guidance value of 1.2 meters. The average water clarity reading between 2009 and 2010 was 1.4 meters. This is at the low end of the range (1.2 to 2.6) of values collected during fisheries surveys between 2000 and 2002; this may indicate that water clarity is slowly decreasing over time.

During all of the LCI sampling events, the surface water color was recorded as brown or tan. This tannic color comes from natural tannic and/or humic acids entering the lake from the watershed and is commonly seen at other waterbodies in the Delaware River Basin. Water shield (*Brasenia schreberi*) and water lilies (*Nymphaea sp.* & *Nuphar lutea*) were the most common plants seen in the shallow near-shore areas of the lake. In addition to these plant species several more native plant species were observed in 2010 and included: *Utricularia vulgaris* (common bladderwort), *Utricularia gemniscapa* (hiddenfruit bladderwort), *Potamogeton natans* (broad-leaved pondweed), *Potamogeton epihydrus* (ribbonleaf pondweed), *Sagittaria sp.* (arrowhead), *Najas flexilis* (slender naiad), and *Fontinalis sp.* (aquatic moss). Slender naiad and the aquatic mosses were not noted in a 1998 report by Aquatic Control Technology Inc., but both species are commonly found throughout the Delaware River Basin.

A single rosette of the exotic invasive species, water chestnut (*Trapa natans*) was discovered in 2009 near the Black Lake Estate's beach/boat launching area. This single rosette was removed by DEC staff and no additional water chestnut plants were observed during sampling in 2010. Any additional water chestnut plants observed on the lake should be removed to prevent the

plant from becoming established in the lake. No other exotic invasive species were observed in the lake during LCI sampling.

Black Lake exhibits thermal stratification, in which depth zones (warm water on top, cold water on the bottom during the summer) are established, as in most NYS lakes greater than 6 meters deep. The thermocline during the summer was at a depth between 3 and 5 meters. Between the mid August and mid September sampling events the lake destratified, allowing the hypolimnion (bottom waters) and the epilimnion (surface waters) to mix. This turning over or mixing of the lake occurs naturally and is likely to occur both in the fall and spring, coinciding with changing water temperatures.

The dissolved oxygen (DO) profiles indicate that during the summer anoxic (devoid of oxygen) conditions occur at 5 meters and below. These summer temperature and dissolved oxygen measurements indicate the lake may not be suitable for cold water species. These oxygen poor conditions in the summer may occur naturally but may also be exacerbated by high nutrient levels elevating primary production in the form of algae. Increased algae production also causes decomposition rates in the bottom waters to rise, which in turn increases the biological oxygen demand of the bottom waters.

pH readings varied between 6.4 and 8.85 with low alkalinity (buffering capacity to acidic inputs) readings. The naturally low alkalinity readings may explain some of the pH variation. The summer of 2010 was abnormally dry, limiting acidic rain and associated runoff from entering the lake. Elevated algae levels in summer remove carbon dioxide from the water during photosynthesis, causing a rise in pH. The June and August 2010 pH readings (6.4 and 8.85 respectively) fall outside the state's water quality standards and may stress aquatic life. The conductivity readings indicate soft water (low ionic strength), which is typical of other lakes in the Delaware River Basin.

Black Lake appears to be typical of circumneutral, soft water, slightly colored lakes. Other lakes with similar water quality characteristics often support warmwater fisheries, although fisheries habitat cannot be fully evaluated through this monitoring program. Coldwater fisheries are unlikely to be supported, given the lack of cold water and high oxygen refuguia necessary to protect any salmonids or aquatic life susceptible to high summer temperatures. More specifics regarding the status of fisheries on the lake can be found in reports previously complied by David Green from Cornell University. A new fisheries survey may be warranted due to the length of time since the last survey was conducted.

Nitrate and ammonia levels continued to be low in the surface waters in 2010. The ammonia levels were elevated in the bottom waters, which are typically seen in waterbodies experiencing persistent oxygen deficits in the bottom waters. Phosphorus, iron and manganese readings continued to be elevated in the bottom waters in 2010, typical of other waterbodies experiencing anoxic conditions. Manganese levels were slightly elevated in the surface waters with one of the five LCI samples exceeding drinking water guidance values. Taste and/or odor problems can be associated with elevated manganese. All of the 2009 and 2010 bottom water samples exceeded the drinking water guidance values for iron and manganese. Arsenic levels were above the laboratory detection limits in two of the three samples collected between 2009 and 2010, although these readings were well below the maximum contaminant level (MCL) established by the federal government as indicative of impaired conditions. Chloride and other ions continued to

be in the elevated in 2010, indicating moderate impacts to the lake from road salting and/or runoff through developed areas in the upstream watershed.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Black Lake is not classified for use as a potable water supply. Although the LCI data are not sufficient to evaluate potable water use, these data suggest that surface water withdrawals would be impacted by elevated total phosphorus levels as well as algae and manganese levels. Deep water withdrawals would be impacted by iron and manganese levels. Although deepwater arsenic levels are well below drinking water criteria, they should be re-evaluated should the lake be considered for potable water use.

Contact Recreation (Swimming)

Black Lake is classified for contact recreation, including swimming and bathing. It is believed that residence of Black Lake Estates and Oxford Country Estates and their guests currently swim in the lake. Bacteria data are needed to evaluate the safety of Black Lake for swimming; however, these data are not collected through the LCI. The data collected through the LCI indicate that swimming may be threatened by low water clarity, high algae levels, and plant growth. The average water clarity reading was just above the Department of Health's guidance of 1.2 meters to protect the safety of swimmers. Plant growth in the shallow areas of the lake may also hinder the ability of the lake to be used for swimming. If water clarity continues to decline, the lake may require management of nutrient sources to reduce the algae levels and provide safe and aesthetically acceptable swimming conditions.

Non-Contact Recreation (Boating and Fishing)

Boating and fishing are currently supported on Black Lake. The data collected through the LCI indicate that these uses should continue to be supported. Aquatic vegetation may hinder either of these uses in some portions of the lake and connected waterbodies.

Aquatic Life

The only indications of stressors to aquatic life are the anoxic conditions observed in the bottom waters and variable pH levels. Additional biological studies would need to be conducted to determine if there are any other stressors to aquatic life.

Aesthetics

These data indicate that the lake should be aesthetically pleasing to most people. Aquatic plants and reduced water clarity may detract slightly from the appearance of the lake.

Additional Comments

1. Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of any new invaders, given the escalating problems with exotic aquatic weeds in nearby lakes. This is especially important with the 2009 finding of water chestnut in the lake.

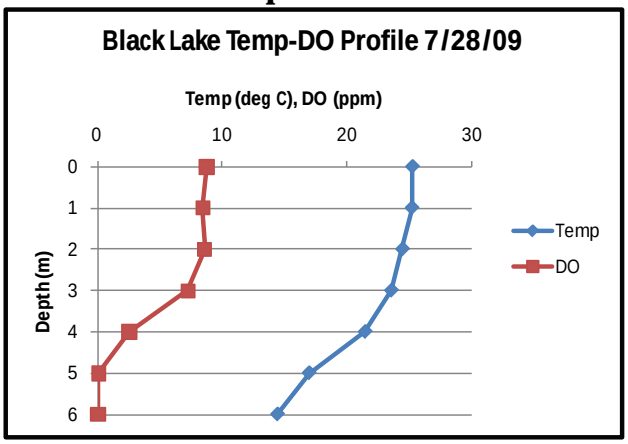
2. Water chestnut is an exotic species native to Eurasia and is known only to a few other waterbodies in the Delaware River Basin. More information about water chestnut is provided in a fact sheet below.
3. As outlined in the recommendation by Aquatic Control Technology Inc., annual in-lake maintenance may be required to keep native and exotic plants at an acceptable level.
4. Future use of the lake for contact recreation should include bacteria monitoring throughout the swimming season to determine the relative safety of the lake for these uses. Baseline data collected yearly by the Town of Thompson, Water Sewer Department indicate low total coliform levels, but many of these readings were taken outside of the normal swimming season. For logistic reasons, this sampling is not conducted though the LCI, but regular bacteria monitoring could be conducted by the lake association at a local certified laboratory.
5. The 2010 LCI survey helped to confirm the findings of the 2009 survey. With the 2009 readings for almost all parameters falling within the range of values collected in 2010. This would suggest that the water quality conditions found through the LCI are typical for the lake.

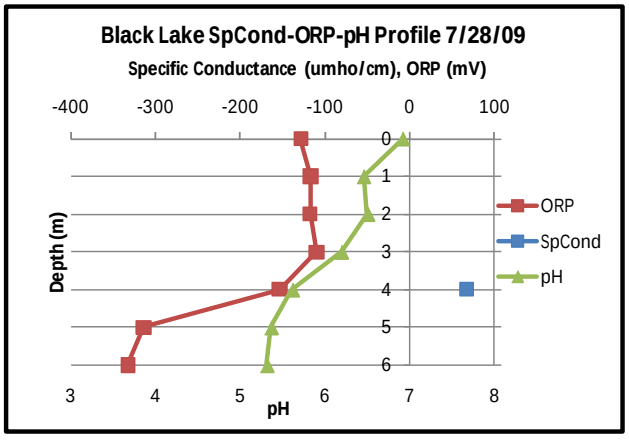
Aquatic Plant IDs

Exotic Plants: *Trapa natans* (water chestnut) (single individual removed in 2009)

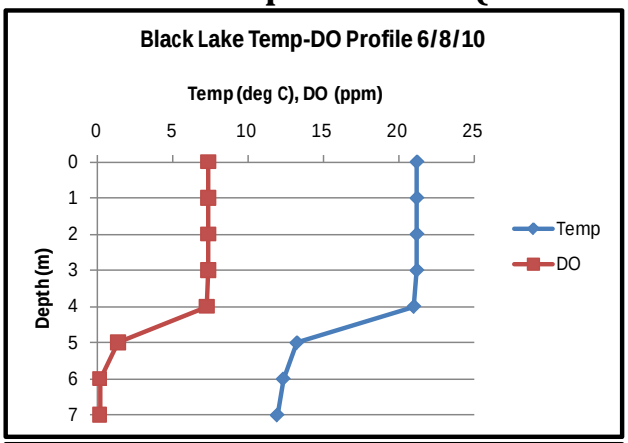
Native Plants:
Brasenia schreberi (water shield)
Nymphaea sp. (white water lily)
Nuphar lutea (yellow water lily)
Utricularia vulgaris (common bladderwort)
Utricularia gemniscapa (hiddenfruit bladderwort)
Potamogeton natans (broad-leaved pondweed)
Potamogeton epihydrus (ribbonleaf pondweed)
Sagittaria sp. (arrowhead)
Najas flexilis (slender naiad)
Fontinalis sp. (aquatic moss).

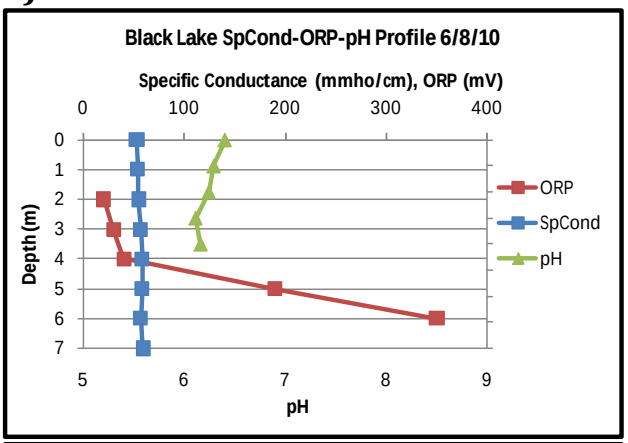
Time Series: Depth Profiles

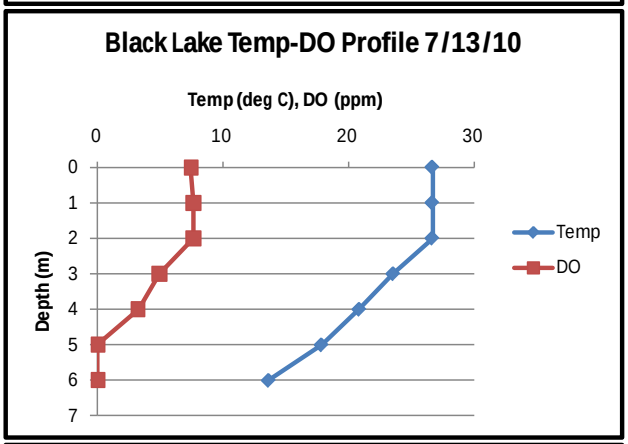


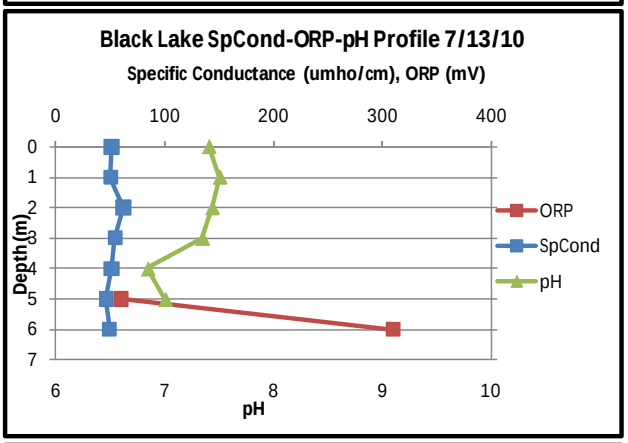


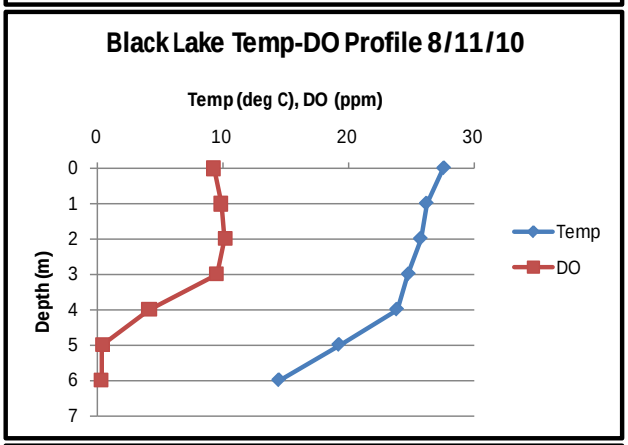
Time Series: Depth Profiles (continued)

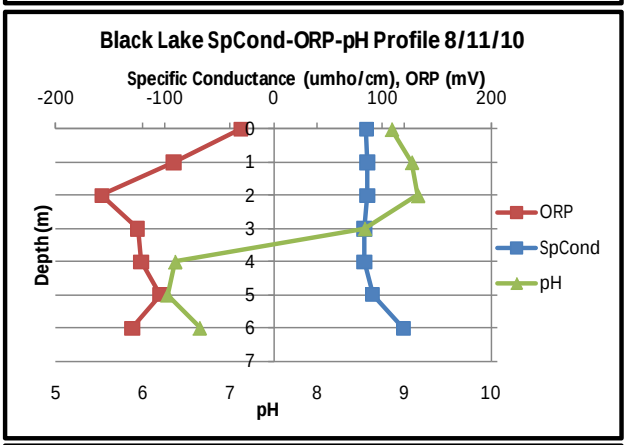


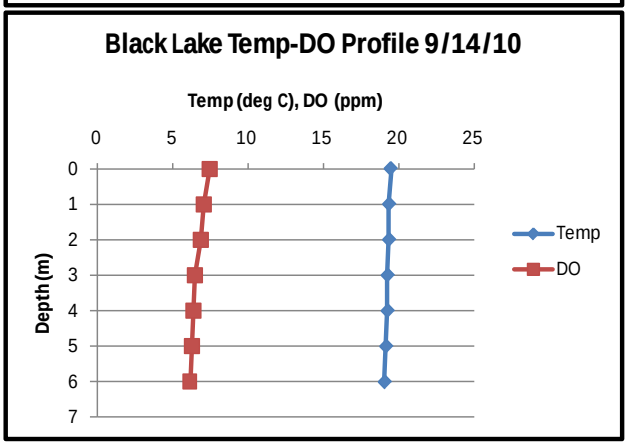


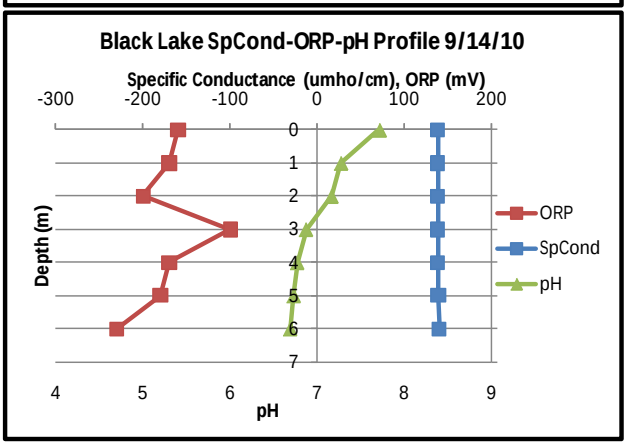




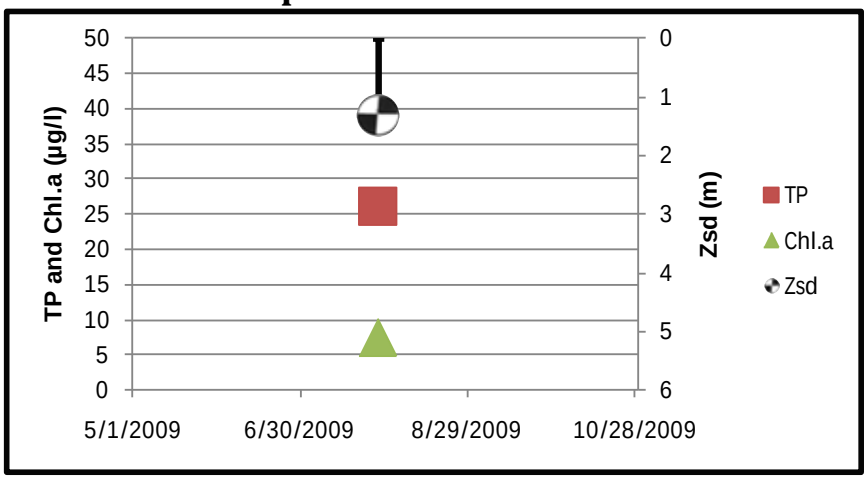




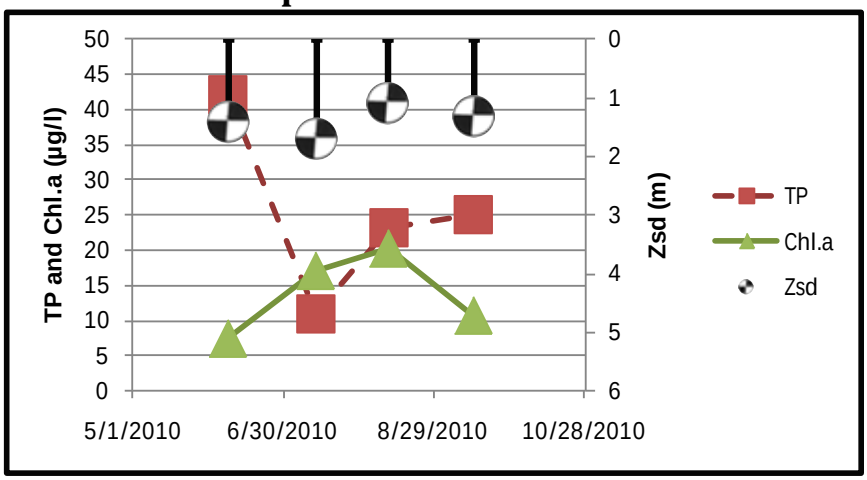




Time Series: Trophic Indicators 2009



Time Series: Trophic Indicators 2010



WQ Sampling Results

Lake Perception

	UNITS	N	MIN	AVG	MAX	Scientific Classification
WQ Assessment	1-5, 1 best	5	2	2.8	3	Definite Algal Greenness
Weed Assessment	1-5, 1 best	5	2	2.6	3	Plants Grow to Lake Surface
Recreational Assessment	1-5, 1 best	5	2	2.2	3	Excellent for Most Uses

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	5	1.1	1.4	1.7	Eutrophic	20% of readings violate DOH guidelines
TSI-Secchi			58.6	55.2	52.4	Eutrophic	No pertinent water quality standards
TP	mg/l	5	0.0109	0.025	0.042	Eutrophic	80% of readings violate DOH guidelines
TSI-TP			38.6	50.5	58.0	Eutrophic	No pertinent water quality standards
TSP	mg/l	5	0.0058	0.0092	0.0155	High % soluble Phosphorus	No pertinent water quality standards
NOx	mg/l	5	ND	0.0075*	0.0193	Low nitrate	No readings violate DOH guidance value
NH4	mg/l	5	ND	0.011*	0.032	Low ammonia	No readings violate DOH guidance value
TKN	mg/l	5	0.36	0.59	0.86	Intermediate organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	5	31.21	60.11	98.76	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	5	7.4	12.6	20.3	Eutrophic	No pertinent water quality standards
TSI-CHLA			50.2	54.6	60.1	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	5	7.0	7.7	8.1	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	5	30	31	35	Slightly Colored	No pertinent water quality standards
TOC	mg/l	5	5.9	6.7	7.8		No pertinent water quality standards
Ca	mg/l	5	3.79	4.168	4.45	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	5	0.1894	0.188	0.277		No readings violate DOH guidance value
Mn	mg/l	5	0.0546	0.28108	1.0	May have some taste/odor	20% of readings violate DOH guidelines
Mg	mg/l	5	0.0435	0.9747	1.3		No readings violate DOH guidance value
K	mg/l	5	1.01	1.07	1.15		No pertinent water quality standards
Na	mg/l	5	8.382	8.19	9.16		No readings violate DOH guidance value
Cl	mg/l	5	13.8	13.43	15.3	Moderate road salt runoff	No readings violate DOH guidance value
SO4	mg/l	5	4.08	4.03	4.3		No readings violate DOH guidance value

* Non-detect (ND) values were set to half the detection limit for calculating the average

Bottom Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
TP-bottom	mg/l	4	0.0266	0.0347	0.0474		No pertinent water quality standards
TSP-bottom	mg/l	4	0.0083	0.0093	0.0102	High % soluble phosphorus	No pertinent water quality standards
NOx-bottom	mg/l	4	ND	0.0032*	0.0058	No evidence of DO depletion	No readings violate DOH guidance value
NH4-bottom	mg/l	4	0.040	0.188	0.376	Evidence of DO depletion	No readings violate DOH guidance value
TKN-bottom	mg/l	4	0.40	0.62	0.89		No pertinent water quality standards
Alk-bottom	mg/l	4	8.1	11.7	15.8	Poorly Buffered	No pertinent water quality standards
TCOLOR-bottom	ptu	4	30	61.3	100	Highly Colored	No pertinent water quality standards
TOC-bottom	mg/l	4	6.7	7.8	8.7		No pertinent water quality standards
Ca-bottom	mg/l	4	4.26	4.8	5.41		Minimally Supports Zebra Mussels
Fe-bottom	mg/l	4	0.532	2.448	4.37	Taste or odor likely	100% of readings violate DOH guidelines
Mn-bottom	mg/l	4	0.45	1.24	2.00	Taste or odor likely	100% of readings violate DOH guidelines
Mg-bottom	mg/l	4	1.18	1.46	1.97		No readings violate DOH guidance value
K-bottom	mg/l	4	1.07	1.19	1.97		No pertinent water quality standards
Na-bottom	mg/l	4	7.47	8.0	8.7		No readings violate DOH guidance value
Cl-bottom	mg/l	4	12	12.9	14.5		No readings violate DOH guidance value
SO4-bottom	mg/l	4	2.6	3.29	4.2		No readings violate DOH guidance value
As-bottom	mg/l	3	ND	1.08*	1.2	Threat to deep potable water intakes	No readings violate guidance values

* Non-detect (ND) values were set to half the detection limit for calculating the average

Legend Information

General Legend Information

Surface Samples = integrated sample collected in the first 2 meters of surface water
Bottom Samples = grab sample collected from a depth of approximately 1 meter from the lake bottom
SECCHI = Secchi disk water transparency or clarity - measured in meters (m)
TSI-SECCHI = Trophic State Index calculated from Secchi, = 60 – 14.41*ln(Secchi)

Laboratory Parameters

ND = Non-Detect, the level of the analyte in question is at or below the laboratory's detection limit
TP = total phosphorus- milligrams per liter (mg/l)
Detection limit = 0.003 mg/l; NYS Guidance Value = 0.020 mg/l
TSI-TP = Trophic State Index calculated from TP, = 14.42*ln(TP*1000) + 4.15
TSP = total soluble phosphorus, mg/l
Detection limit = 0.003 mg/l; no NYS standard or guidance value

NOx	= nitrate + nitrite nitrogen, mg/l Detection limit = 0.01 mg/l; NYS WQ standard = 10 mg/l
NH4	= total ammonia, mg/l Detection limit = 0.01 mg/l; NYS WQ standard = 2 mg/l
TKN	= total Kjeldahl nitrogen (= organic nitrogen + ammonia), mg/l Detection limit = 0.01 mg/l; no NYS standard or guidance value
TN/TP	= Nitrogen to Phosphorus ratio (molar ratio), = (TKN + NOx)*2.2/TP > 30 suggests phosphorus limitation, < 10 suggests nitrogen limitation
CHLA	= chlorophyll *a*, micrograms per liter (µg/l) or parts per billion (ppb) Detection limit = 2 µg/l; no NYS standard or guidance value
TSI-CHLA	= Trophic State Index calculated from CHLA, = 9.81*ln(CHLA) + 30.6
ALKALINITY	= total alkalinity in mg/l as calcium carbonate Detection limit = 10 mg/l; no NYS standard or guidance value
TCOLOR	= true (filtered or centrifuged) color, platinum color units (ptu) Detection limit = 5 ptu; no NYS standard or guidance value
TOC	= total organic carbon, mg/l Detection limit = 1 mg/l; no NYS standard or guidance value
Ca	= calcium, mg/l Detection limit = 1 mg/l; no NYS standard or guidance value
Fe	= iron, mg/l Detection limit = 0.1 mg/l; NYS standard = 0.3 mg/l
Mn	= manganese, mg/l Detection limit = 0.01 mg/l; NYS standard = 0.3 mg/l
Mg	= magnesium, mg/l Detection limit = 2 mg/l; NYS standard = 35 mg/l
K	= potassium, mg/l Detection limit = 2 mg/l; no NYS standard or guidance value
Na	= sodium, mg/l Detection limit = 2 mg/l; NYS standard = 20 mg/l
Cl	= chloride, mg/l Detection limit = 2 mg/l; NYS standard = 250 mg/l
SO4	= sulfate, mg/l Detection limit = 2 mg/l; NYS standard = 250 mg/l
As	=arsenic, mg/l Detection limit = 0.236 µg/l; NYS standard = 10 µg/l

Field Parameters

Depth	= water depth, meters
Temp	= water temperature, degrees Celsius
D.O.	= dissolved oxygen, in milligrams per liter (mg/l) or parts per million (ppm) NYS standard = 4 mg/l; 5 mg/l for salmonids
pH	= powers of hydrogen, standard pH units (S.U.) Detection limit = 1 S.U.; NYS standard = 6.5 and 8.5
SpCond	= specific conductance, corrected to 25ºC, micromho per centimeter (µmho/cm) Detection limit = 1 µmho/cm; no NYS standard or guidance value
ORP	= Oxygen Reduction Potential, millivolts (MV) Detection limit = -250 mV; no NYS standard or guidance value

Lake Assessment

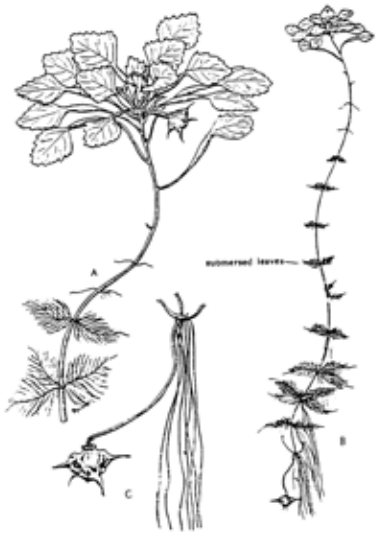
WQ Assessment	**= water quality assessment**, 5 point scale, 1= crystal clear, 2 = not quite crystal clear, 3 = definite algae greenness, 4 = high algae levels, 5 = severely high algae levels
Weed Assessment	**= weed coverage/density assessment**, 5 point scale, 1 = no plants visible, 2 = plants below surface, 3 = plants at surface, 4 = plants dense at surface, 5 = plants cover surface
Recreational Assessment	**= swimming/aesthetic assessment**, 5 point scale; 1 = could not be nicer, 2 = excellent, 3= slightly impaired, 4 = substantially impaired, 5 = lake not usable

Fact Sheet: Water Chestnut

Scientific Name: *Trapa natans*

ECOLOGICAL VALUE: like all floating plants, *Trapa* harbor aquatic insects, and there is some evidence that water chestnut also provide an excellent habitat for small fish. However, for the most part, *Trapa* does not possess great ecological value. It is a poor food producer and shelter for most aquatic organisms. The nuts are not utilized by wildlife, and infestations are detrimental to water flow.

DEGREE OF NUISANCE: *Trapa* is a non-native plant to New York, and, as such, can dominate a plant community when introduced. In some areas of the state, it constitutes a major nuisance, affecting recreational use and aesthetic enjoyment of the water. In other areas, it remains less of a problem, due at least to some degree to the vigilent control (usually by hand-pulling) exerted once a bed is located. At present, it is far more common in major navigable rivers (such as the Mohawk and Hudson Rivers) or major lakes (such as Lake Champlain) than in small inland lakes



DISTRIBUTION IN UNITED STATES: it is locally abundant, sometimes forming large floating mats, in the soft mud of lakes, ponds, and sluggish river tributaries in most of the New England and Atlantic States, ranging from Massachusetts to western Vermont, eastern New York, Maryland, and Virginia

DISTRIBUTION IN NEW YORK: this plant is limited primarily to lakes hydrologically connected to Lake Champlain and the Hudson River, although increasingly appearing in other lakes in these drainage basins and throughout eastern New York to Oneida Lake (along the Barge Canal and the Mohawk River). It has been identified in Long Island. As noted above, however, it is still more frequently found in rivers than in lakes.

COMMENTS: *Trapa* is one of the four major nuisance exotic plants in New York State. It was introduced to North America around 1874, and one of the first documented introductions in the United States was in Collins Lake in Schenectady in 1884. It is an annual, overwintering by seeds, and forming a rosette of flowers by early summer. The flowers produce sharp horned nuts that can inflict painful wounds at bathing beaches. As a non-native plant, it often outcompetes other vegetation, forming impenetrable mats that hinder transportation and fishing. As such, it has been the subject of extensive aquatic vegetation control strategies. The importation, transportation or cultivation of this plant is prohibited by state and federal law. One species of this genus is found in New York.

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000