

LCI Lake Water Quality Summary

General Information

Lake Name: Rainbow Lake

Location: Town of East Otto, Cattaraugus County, NY

Basin: Lake Erie

Size: 28 hectares (70 acres)

Lake Origins: Earthen dam built in 1964

Major Tributaries: spring fed

Watershed Area: 0.6 Square Miles

Lake Tributary to: East Otto Creek/South Branch Cattaraugus Creek

Water Quality Classification: C(T) (best intended use: primary contact recreation)
(T) waters shall be suitable for trout survival

Sounding Depth: 4.1 meters (13.5 feet)

Sampling Coordinates: 42.35233, -78.69767

Sampling Access Point: Private land (Allegheny Mountain Resort)

Monitoring Program: Lake Classification and Inventory (LCI) Survey

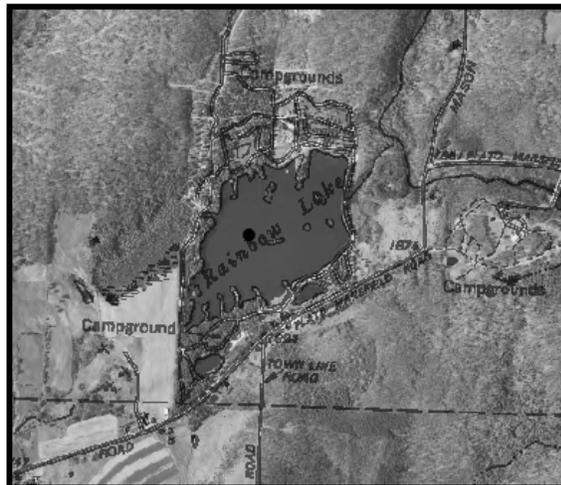
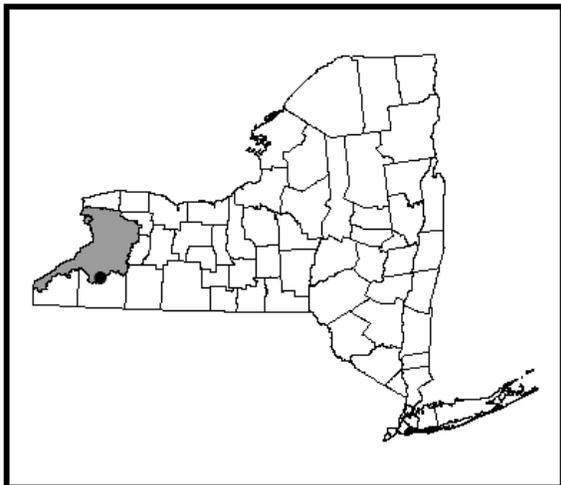
Sampling Date: 8/4/2010, 6/8, 7/7, 8/4 & 9/14/2011

Samplers: David Newman & Scott Kishbaugh NYSDEC Division of Water, Albany
Bill Murray, Brian Hourigan, Richard Rink & Tom Wantuck NYSDEC Division of Water, Buffalo

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Lake Map

(sampling location marked with a circle)



Background and Lake Assessment

Rainbow Lake is a 70 acre spring fed waterbody that was created for recreational purposes in the 1960's. Rainbow Lake is in the headwaters of East Otto Creek/South Branch of Cattaraugus Creek in the town of East Otto. The lake and the land that surrounds it are owned and maintained by Allegheny Mountain Resort at Rainbow Lake, which is a 500 unit campground for recreational vehicles (RVs). The shoreline of the lake is predominately manicured grass, with some treed camp sites along the western portion of the lake. The larger watershed has a mix of land cover, including forest, agriculture, and the RV Park. The lake is predominately used for catch and release fishing and non-powered boating by visitors to the Allegheny Mountain Resort. The lake has been used in the past for swimming, but swimming in the lake has not been allowed by the resort for the past few years due to bacteria concerns related to large numbers of waterfowl on the lake. In 2010, staff at the RV Park indicated that the park had been in a state of disrepair and recently came under new management and that the resort was looking to improve conditions of the RV Park, including the lake and some of the smaller ponds on the property.

Rainbow Lake was included in the 2010 NYS DEC Division of Water's Lake Classification and Inventory Survey (LCI) screening program. Inclusion in the LCI was based on a *Minor Impacts* listing in The Niagara River/Lake Erie Basin Waterbody Inventory and Priority Waterbodies List (WI/PWL) (NYS DEC 2010), due to high nutrient levels, algal growth and reduced clarity. The sampling in 2010 showed that the lake had slightly elevated phosphorus and chlorophyll *a* (algae) levels. To determine if these conditions were typical for the lake, additional monitoring was conducted during the summer of 2011.

Rainbow Lake can be characterized as *eutrophic*, or highly productive. The average water clarity reading (TSI = 50, typical of *eutrophic* waterbodies) was in the expected range given the total phosphorus reading (TSI = 51, typical of *eutrophic* waterbodies), and the chlorophyll *a* reading (TSI = 52, typical of *eutrophic* waterbodies). These data indicated that elevated nutrient levels are fueling primary production in the form of algae, which is reducing the water clarity in the lake. The water clarity and phosphorus readings in August of 2010 were within the range of values seen in 2011, while the chlorophyll *a* reading in August of 2010 was above the range of values seen in 2011. This indicates that algae levels in 2010 may have been atypical for the lake.

In August of 2010 and throughout the summer of 2011, the water color was described by the samplers as having a slight to moderate algal greenness. The water clarity reading averaged around 2 meters, with all readings at or above 1.2 meters, the criteria used to establish new swimming beaches (and therefore the presumed minimum standard to protect the safety of swimmers). Four native submergent aquatic plants were found to be growing in small quantities in the lake, below levels that would impact recreational uses of the lake.

Like most New York State Lakes that are less than 6 meters deep, Rainbow Lake does not exhibit thermal stratification during the summer. The shallowness of the lake with the relatively large surface area allows the wind to mix the lake's water preventing stratification. pH readings indicate slightly alkaline waters with conductivity readings indicating soft water (low ionic strength).

Rainbow Lake appears to be typical of shallow, softwater, uncolored, alkaline lakes. Other lakes with similar water quality characteristics often support warmwater fisheries. As indicated on the Allegany Mountain Resort's website and confirmed by conversations with individuals staying at the resort, the lake supports populations of bass, perch, bluegill, crappie, bullhead and catfish. Summer water temperatures in the lake are outside the optimum range for coldwater fish like trout, therefore the lake is unlikely to support sustainable populations of coldwater fish species.

Total phosphorus levels in the lake were above the state's guidance value during all of the monitoring events. In addition, the iron level in August of 2011 was found to be above the state's drinking water standard, which may result in taste or odor issues. All of the other water quality parameters analyzed through the LCI were within water quality standards and/or guidance values, and do not indicate any water quality problems.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Rainbow Lake is not classified to be used for potable water. Although the LCI data are not sufficient to evaluate potable water use, these data suggest that "unofficial" surface water withdrawals may be *stressed* by elevated iron levels in the water column, contributing to potential taste and/or odor problems.

Contact Recreation (Swimming)

Rainbow Lake is not classified for contact recreation, although swimming has been supported in the past at a swimming beach at the RV Park. Allegany Mountain Resort did not allow swimming at their beach during the summer of 2010 or 2011 due to bacteria concerns related to waterfowl. Future operation of the swimming beach would need to meet New York State Department of Health's Rules and Regulations regarding *Bathing Beaches*"(see reference below). The New York State Water Quality Classification of *Class C* states that "water quality shall be suitable for primary contact recreation, although other factors may limit the use for this purpose". Bacteria data are needed to evaluate the safety of Rainbow Lake for swimming; however, these are not collected through the LCI. The data collected through the LCI indicate total phosphorus and water clarity levels *threaten* the use of the lake for swimming.

Non-Contact Recreation (Boating and Fishing)

Rainbow Lake is classified for non-contact recreational uses, including boating and fishing. The lake is currently used by people staying at the Allegany Mountain Resort for boating and catch and release fishing. Sampling staff most often assessed the recreational potential of the lake as "excellent for most uses".

Aquatic Life

No direct impacts to aquatic life were observed in the lake.

Aesthetics

These data indicate that the high chlorophyll *a* levels may occasionally *stress* the aesthetics of the lake.

Additional Comments

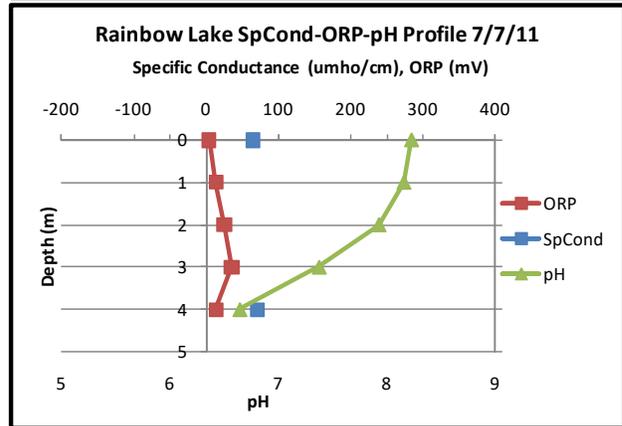
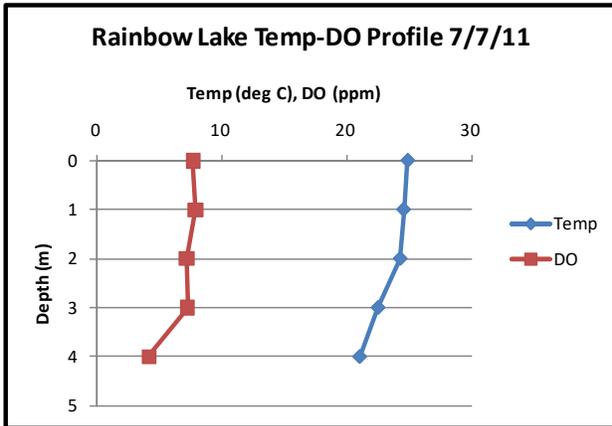
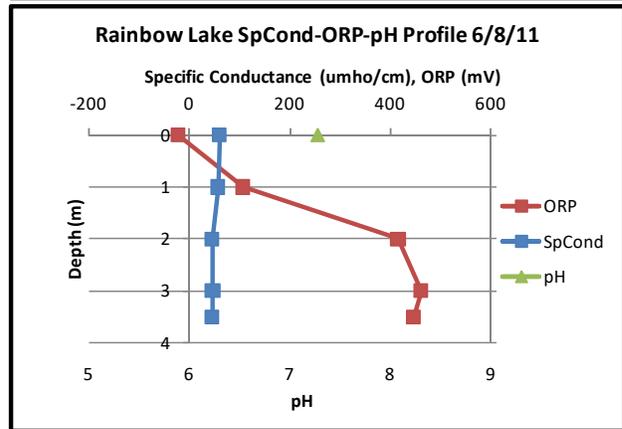
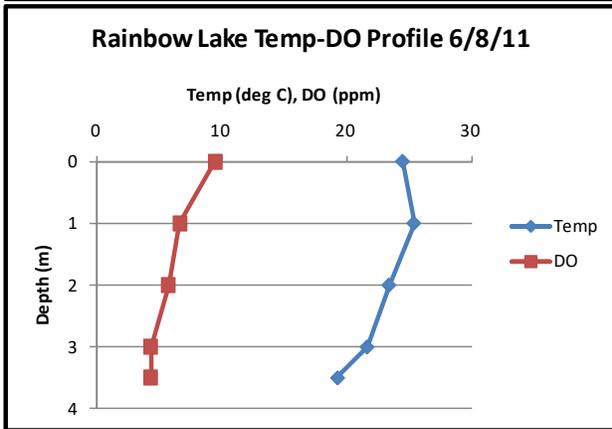
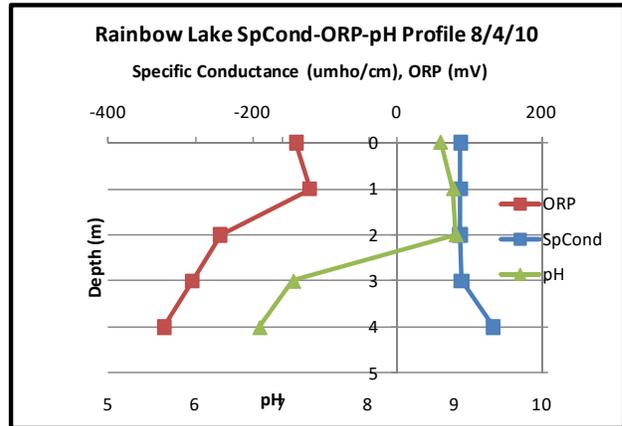
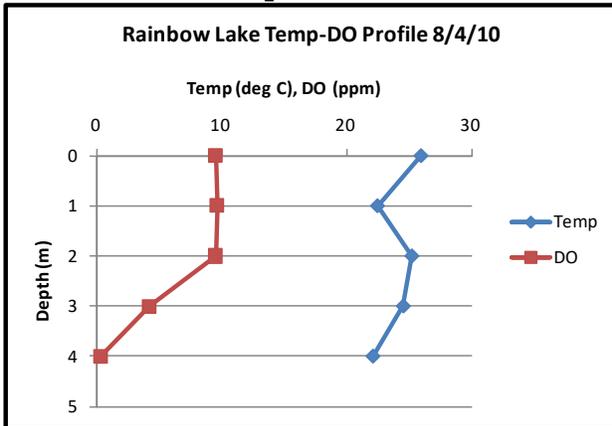
- Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of any new invaders, given the escalating problems with exotic aquatic weeds. Assuring that boats are cleaned and dried before being brought from other waterbodies will help limit the potential of inadvertent introductions.
- Allegany Mountain Resort has been working to reduce Canada Geese populations at the lake through depredation management activities on the resort's property. Staff at the resort indicated that they were still having problems related to geese during the summer of 2011 and attributed it to nest located on adjacent properties that they were not able to treat. Treating eggs/nest should be continued in subsequent years with attempts to reach out to surrounding landowners to secure permission to conduct management activities on their properties may assist in reducing geese populations. In addition incorporation of other non-lethal management activities may also help in reducing geese numbers. Additional information on Canada Geese management can be found at <http://www.dec.ny.gov/animals/7003.html>, <https://epermits.fws.gov/eRCGR/geSI.aspx>, and http://www.aphis.usda.gov/wildlife_damage/downloads/canada_goose.pdf.
- The elevated phosphorus levels in the lake can be attributed to a variety of sources but may be related to failing and/or improperly sited septic systems. Cornell University Cooperative Extension has compiled a large volume of information on the septic systems, which can be accessed at <http://waterquality.cce.cornell.edu/septic.htm>.

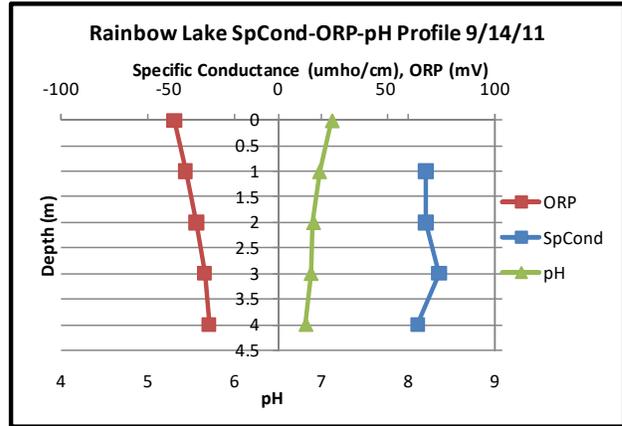
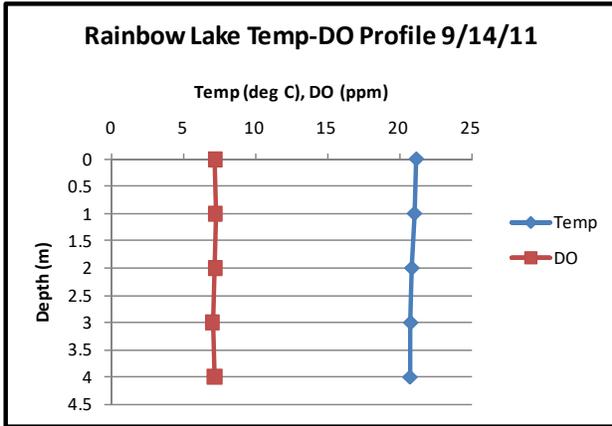
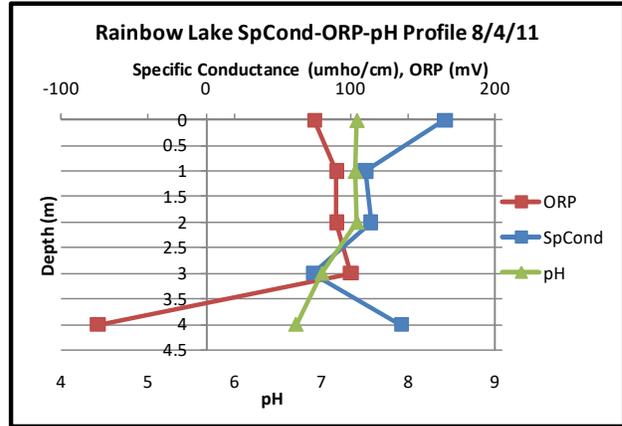
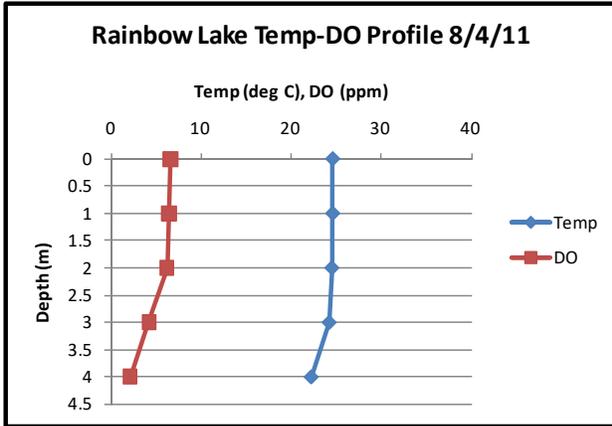
Aquatic Plant IDs

Exotic Plants: None observed

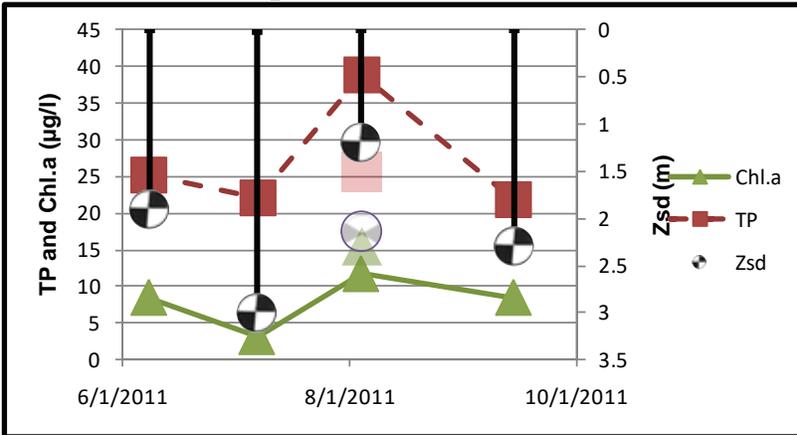
Native Plants: *Nitella sp.* (stonewort)
 Elodea canadensis (common waterweed)
 Potamogeton pusillus (lesser pondweed)
 Najas guadalupensis (southern water nymph)

Time Series: Depth Profiles





Time Series: Trophic Indicators



* Transparent symbols represent the August 4, 2010 readings

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	5	1.2	2.106	3	Mesotrophic	No readings violate DOH guidance value
TSI-Secchi			44.2	49.9	57.4	Mesotrophic	No pertinent water quality standards
TP	mg/l	5	0.0218	0.02672	0.0389	Eutrophic	100% of readings violate water quality standards
TSI-TP			48.6	51.2	56.9	Eutrophic	No pertinent water quality standards
TSP	mg/l	5	0.0093	0.01112	0.014	High % soluble Phosphorus	No pertinent water quality standards
NOx	mg/l	5	0.0052	0.00876	0.0131	Low nitrate	No readings violate water quality standards
NH4	mg/l	5	0.005	0.02275	0.046	Low ammonia	No readings violate water quality standards
TKN	mg/l	5	0.45	0.55	0.66	Intermediate organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	5	37.06	46.57	57.17	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	5	3.2	9.48	15.5	Eutrophic	No pertinent water quality standards
TSI-CHLA			42.03	51.5	57.49	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	5	26.6	29.18	30	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	5	10	14.2	17	Uncolored	No pertinent water quality standards
TOC	mg/l	5	4.3	4.9	5.4		No pertinent water quality standards
Ca	mg/l	5	8.65	10.278	11.4	Minimally Supports Zebra Mussels	No pertinent water quality standards
Fe	mg/l	5	0.175	0.2642	0.53	May have some taste/odor	20% of readings violate water quality standards
Mn	mg/l	5	0.03	0.05096	0.107		No readings violate water quality standards
Mg	mg/l	5	1.35	1.506	1.64		No readings violate water quality standards
K	mg/l	5	0.353	0.7696	0.996		No pertinent water quality standards
Na	mg/l	5	0.497	2.9054	3.81		No readings violate water quality standards
Cl	mg/l	5	4.5	4.84	5	Minor road salt runoff	No readings violate water quality standards
SO4	mg/l	5	2.3	3.18	3.7		No readings violate water quality standards

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

Lake Perception

	UNITS	N	MIN	AVG	MAX	Scientific Classification
WQ Assessment	1-5, 1 best	4	2	3	4	Definite Algal Greenness
Weed Assessment	1-5, 1 best	4	1	1.8	3	Plants Grow to Lake Surface
Recreational Assessment	1-5, 1 best	4	1	2	3	Excellent for Most Uses

References

New York State Department of Health. 2010. Part 6, Subpart 6-2 Bathing Beaches. Available from http://www.health.state.ny.us/regulations/nycrr/title_10/part_6/subpart_6-2.htm.

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, = $60 - 14.41 * \ln(\text{Secchi})$

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, = $14.42 * \ln(\text{TP} * 1000) + 4.15$
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), = $(\text{TKN} + \text{NOx}) * 2.2 / \text{TP}$ > 30 suggests phosphorus limitation, < 10 suggests nitrogen limitation
CHLA	= chlorophyll <i>a</i> , micrograms per liter ($\mu\text{g/l}$) or parts per billion (ppb) Detection limit = 2 $\mu\text{g/l}$; no NYS standard or guidance value
TSI-CHLA	= Trophic State Index calculated from CHLA, = $9.81 * \ln(\text{CHLA}) + 30.6$
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

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)

pH NYS standard = 4 mg/l; 5 mg/l for salmonids
= 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 25°C, micromho per centimeter ($\mu\text{mho/cm}$)
Detection limit = 1 $\mu\text{mho/cm}$; 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