

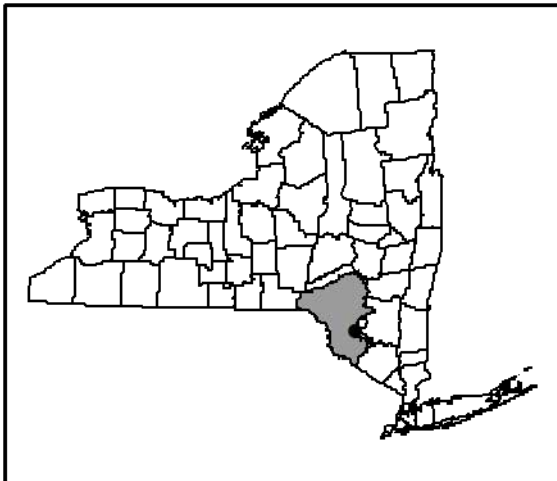
LCI Lake Water Quality Summary

General Information

Lake Name:	Alta (Echo) Lake
Location:	South Fallsburg, Town of Fallsburg, Sullivan County, NY
Basin:	Delaware River Basin
Size:	25.9 hectares (= 64 acres)
Lake Origins:	natural
Major Tributaries:	unnamed minor tributary
Lake Tributary to?:	Sheldrake Stream via Conklin Pond
Water Quality Classification:	B (best intended use: primary contact recreation)
Sounding Depth:	8.5 meters (= 28 feet)
Sampling Coordinates:	Latitude: 41.72809, Longitude: -74.64545
Sampling Access Point:	Tarry Brae Municipal Golf Course (Town of Fallsburg)
Monitoring Program:	Lake Classification and Inventory (LCI) Survey
Sampling Date:	July 28, 2009
Samplers:	Scott Kishbaugh, NYSDEC Division of Water, Albany Dan Hayes, NYSDEC Division of Water, Albany
Contact Information:	Scott Kishbaugh, NYSDEC Division of Water sakishba@gw.dec.state.ny.us ; 518-402-8282

Lake Map

(sampling location marked with a circle)



Background and Lake Assessment

Echo Lake, officially named Alta Lake, is an approximately 65 acre waterbody in South Fallsburg, New York. The lake is on the western side of the Tarry Brae Golf Course, which is owned and managed by the town of Fallsburg. There are very few homes around the lake with the majority of the shoreline being forested. The lake has a relatively small, almost completely forested watershed, with the golf course and a few homes being the only developments. The lake is currently only used for passive recreation by golfers who enjoy the scenic beauty of the lake as a backdrop for one of the golf course's greens.

Echo Lake was included in the NYSDEC Division of Water's 2009 Lake Classification Inventory (LCI) survey in the Delaware River Basin. Inclusion in the LCI's screening year (single sample) was based on a lack of water quality information from the lake in the Division of Water's database. There were some water quality issues related to elevated phosphorus and algae levels, but due to the lack of known recreational uses for the lake, the lake will not be a candidate for additional monitoring during the summer of 2010.

Echo Lake can generally be characterized as *mesoeutrophic*, or moderately to highly productive. The water clarity reading (TSI = 50, typical of *mesoeutrophic* lakes) was lower than expected given the phosphorus reading (TSI = 43, typical of *mesotrophic* lakes), but was in the expected range given the chlorophyll *a* reading (TSI = 53, typical of *mesoeutrophic* lakes). These data suggest that baseline nutrient levels do not support persistent algae blooms, but there may tend to be slightly elevated algae levels in the lake during the summer.

The lake water appeared to have a brownish tint which was typical for other lakes in the area and may come from weak or organic acids (tannins) that enter the lake through the watershed. Several native plant species were observed in the lake and included: *Nuphar sp.* (yellow water lily), *Utricularia purpurea* (purple bladderwort), *Elodea canadensis* (common waterweed), *Najas flexilis* (Naiad), and leafy liverworts. Water lilies, common waterweed and naiad are common throughout the Delaware River Basin. A more thorough plants specific survey would be need to completely rule out the existence of invasive plant species.

Echo 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 great than six meters in depth. The thermocline in the lake was in the three to five meter depth range. The entire hypolimnion (bottom waters) was anoxic (devoid of oxygen) at depths below four meters. This is typical of lakes with high chlorophyll *a* (algae) levels and was common among other lakes sampled in the area. pH readings indicate acidic waters, with the surface reading falling below the state's lower water quality standard. Conductivity readings indicate soft water, which was typical of other lakes sampled in the Delaware River.

The lake appears to be typical of soft water, weakly colored, acidic 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 refugia necessary to protect any salmonids or aquatic life susceptible to high summer temperatures. It is not known if these coldwater fish have historically been supported in the lake.

Deep water total phosphorus reading and ammonia levels were elevated, which is typical of other lakes experiencing oxygen deficits. Iron and manganese levels were also elevated in the bottom waters, with both exceeding the state's drinking water standards. Elevated iron and manganese are also common in lakes experiencing oxygen deficits in the bottom waters. Chloride and other ion levels were low and indicate only minor impacts due to road salting and/ or runoff from developed areas. This is common among lakes in highly forested watersheds.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Echo 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 waters may require substantial treatment due to elevated phosphorus and algae levels. Deep water intakes of lake water would require substantial treatment to serve as a potable water supply, due to the high levels of iron and manganese.

Contact Recreation (Swimming)

Echo Lake is classified for contact recreation- swimming and bathing. There were no indications that people do swim in the lake. Bacteria data are needed to evaluate the safety of Echo Lake for swimming; however, these are not collected through the LCI. The water clarity reading was above the New York State Department of Health's standard of 1.2 meters for protecting the safety of swimmers. Increases in algae levels may drop the water clarity reading below the state minimum to protect the safety of swimmers.

Non-Contact Recreation (Boating and Fishing)

There were no indications that the lake is used for non-contact recreation; however, there were no water quality indicators that would suggest impacts to boating and fishing.

Aquatic Life

The anoxic conditions in the bottom waters will stress aquatic life susceptible to high summer temperature. Additional biological studies would be needed to fully evaluate any other stressors to aquatic life in the lake.

Aesthetics

Algae levels may at times give the lake a greenish color; however, it is unlikely this would affect the passive recreational uses 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.
- Ensuring the golf course adheres to best management practices in regards to fertilizers and pesticide use will help reduce any impacts the golf course may have on nutrient and algae levels in the lake. The Pennsylvania Department of Environmental Protection

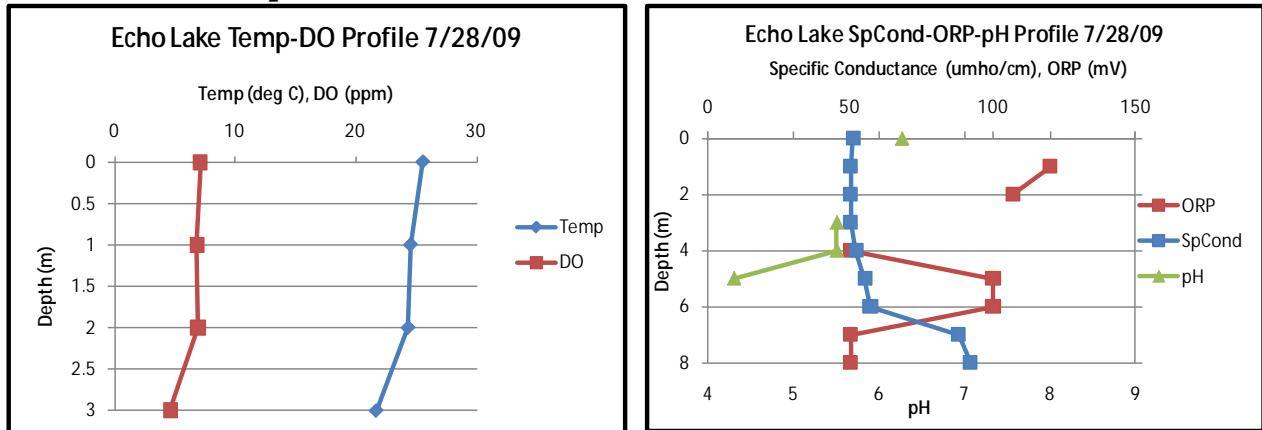
funded the creation of a handbook on Best Management Practices for Golf Courses that can be found online at

http://www.pecpa.org/files/downloads/Golf_BMP_Handbook_3.pdf

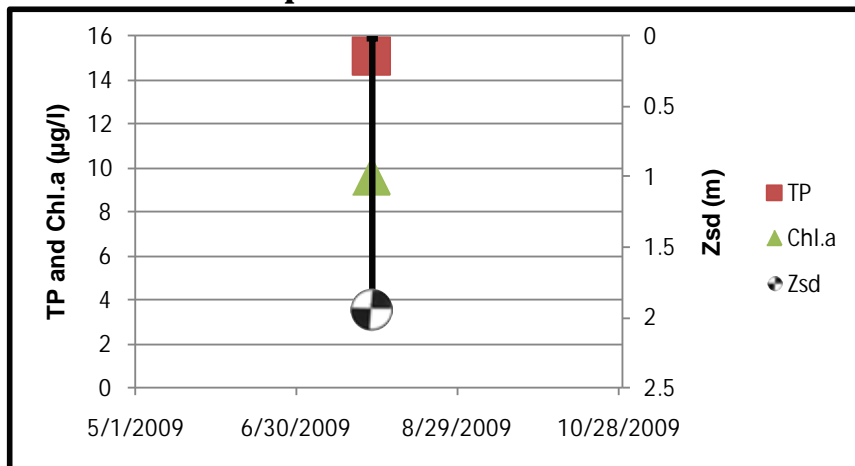
Aquatic Plant IDs

Exotic Plants: None observed
 Native Plants: *Nuphar sp.* (yellow water lily)
Utricularia purpurea (purple bladderwort)
Elodea canadensis (common waterweed)
Najas flexilis (Naiad)
 (leafy liverwort)

Time Series: Depth Profile



Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
SECCHI	meters	1.95	Eutrophic	Readings does not violate DOH guidance value
TSI-Secchi		50.4	Eutrophic	No pertinent water quality standards
TP	mg/l	0.0151	Mesotrophic	Readings does not violate DEC guidance values
TSI-TP		43.3	Mesotrophic	No pertinent water quality standards
TSP	mg/l	0.0283	High % soluble Phosphorus	No pertinent water quality standards
NOx	mg/l	0.0023	Low nitrate	Reading does not violate guidance
NH4	mg/l	0.024	Low ammonia	Reading does not violate guidance
TKN	mg/l	0.39	Low organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	57.16	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	9.6	Eutrophic	No pertinent water quality standards
TSI-CHLA		52.8	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	4.5	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	30	Weakly Colored	No pertinent water quality standards
TOC	mg/l	6.6		No pertinent water quality standards
Ca	mg/l	3.26	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	0.15		Reading does not violate water quality standards
Mn	mg/l	0.0577		Reading does not violate water quality standards
Mg	mg/l	0.768		Reading does not violate water quality standards
K	mg/l	0.459		No pertinent water quality standards
Na	mg/l	5.28		Reading does not violate water quality standards
Cl	mg/l	8.9	Minor road salt runoff	Readings does not violate water quality standards
SO4	mg/l	4		Readings does not violate water quality standards

Bottom Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
TP-bottom	mg/l	0.0543	Elevated deepwater phosphorus	No pertinent water quality standards
TSP-bottom	mg/l	0.0125	Little available phosphorus	No pertinent water quality standards
NOx-bottom	mg/l	ND	No evidence of DO depletion	Reading does not violate water quality standards
NH4-bottom	mg/l	0.368	Evidence of DO depletion	Readings does not violate water quality standards
TKN-bottom	mg/l	0.92		No pertinent water quality standards
Alk-bottom	mg/l	12	Poorly Buffered	No pertinent water quality standards
TCOLOR-bottom	ptu	150	Highly Colored	No pertinent water quality standards
TOC-bottom	mg/l	8.3		No pertinent water quality standards
Ca-bottom	mg/l	4.62	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe-bottom	mg/l	6.69	Taste or odor likely	Reading violates water quality standards

Bottom Samples (continued)

	UNITS	Reading	Scientific Classification	Regulatory Comments
Mn-bottom	mg/l	1.97	Taste or odor likely	Reading violates water quality standards
Mg-bottom	mg/l	0.901		Reading does not violate water quality standards
K-bottom	mg/l	0.668		
Na-bottom	mg/l	5.51		Reading does not violate water quality standards
Cl-bottom	mg/l	8.8		Readings does not violate water quality standards
SO4-bottom	mg/l	2.5		Readings does not violate water quality standards

Lake Perception

	UNITS	Reading	Scientific Classification	Regulatory Comments
WQ Assessment	1-5, 1 best	3	Definite Algal Greenness	No pertinent water quality standards
Weed Assessment	1-5, 1 best	2	Plants Visible Below Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	2	Excellent for Most Uses	No pertinent water quality standards

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 a, micrograms per liter (µg/l) or parts per billion (ppb)

TSI-CHLA	Detection limit = 2 µg/l; no NYS standard or guidance value
ALKALINITY	= Trophic State Index calculated from CHLA, = $9.81 * \ln(\text{CHLA}) + 30.6$ = total alkalinity in mg/l as calcium carbonate
TCOLOR	Detection limit = 10 mg/l; no NYS standard or guidance value = true (filtered or centrifuged) color, platinum color units (ptu)
TOC	Detection limit = 5 ptu; no NYS standard or guidance value = total organic carbon, mg/l
Ca	Detection limit = 1 mg/l; no NYS standard or guidance value = calcium, mg/l
Fe	Detection limit = 1 mg/l; no NYS standard or guidance value = iron, mg/l
Mn	Detection limit = 0.1 mg/l; NYS standard = 0.3 mg/l = manganese, mg/l
Mg	Detection limit = 0.01 mg/l; NYS standard = 0.3 mg/l = magnesium, mg/l
K	Detection limit = 2 mg/l; NYS standard = 35 mg/l = potassium, mg/l
Na	Detection limit = 2 mg/l; no NYS standard or guidance value = sodium, mg/l
Cl	Detection limit = 2 mg/l; NYS standard = 20 mg/l = chloride, mg/l
SO4	Detection limit = 2 mg/l; NYS standard = 250 mg/l = sulfate, 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) 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 25°C, 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