LCI Lake Water Quality Summary

General Information

Lake Name: Tennanah Lake

Location: Tennanah Lake, Town of Fremont, Sullivan County
Basin: Delaware River Basin
Size: 67.3 hectares (= 166 acres)
Lake Origins: natural
Major Tributaries: minor unnamed tributary
Lake Tributary to?: Trout Brook
Water Quality Classification: B (best intended use: primary contact recreation)

Sounding Depth: 17.7 meters (= 58 feet)
Sampling Coordinates: Latitude: 41.89058, Longitude: -74.97911
Sampling Access Point: private land (Tennanah Lake Tax Payers Association)

Monitoring Program: Lake Classification and Inventory (LCI) Survey
Sampling Date: 7/30/09
Samplers: David Newman, NYSDEC Division of Water, Albany
Steven Finnemore, NYSDEC Division of Water, Albany

Contact Information: David Newman, NYSDEC Division of Water
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Lake Map
(sampling location marked with a circle)

Background and Lake Assessment

Tennanah Lake is a 166 acre waterbody in northwestern Sullivan County. The lake is privately owned and managed by the Tennanah Lake Tax Payers Association. The majority of the shoreline line of the lake is developed residentially with both year round and seasonal use dwellings. The southeastern end of the lake has a bog-like plant community with the rest of the lake being open water. The lake is used for boating (non-motorized, motorized, and personal watercraft), fishing, and swimming.

The lake was screened (single sampling event) in NYSDEC Division of Water's 2009 Lake Classification Inventory Survey (LCI), due to the lack of historical water quality data in the Division's water quality database. Tennanah Lake is not a candidate for intensive (monthly sampling) for 2010 due to the moderate to high water quality found during the screening year sampling session.

Tennanah Lake can be generally characterized as a *mesotrophic*, or moderately productive. The water clarity (TSI = 46, typical of *mesotrophic* lakes) was slightly lower than expected given the phosphorus reading (TSI = 38, at the high end of *oligotrophic* lakes), but is higher than expected given the chlorophyll *a* reading (TSI = 51, at the low end of *eutrophic* lakes). These data indicate that baseline nutrient levels do not support persistent algal blooms in the lake.

The lake water was observed to be almost crystal clear with just some hints of yellow and brown. The yellow can probably be attributed to the elevated algae levels as measured by the slightly elevated chlorophyll *a* reading. The brown or tan color to the lake was typical of other lakes in the region and is due to natural tannins in the water that come from weak organic acids found in the watershed. At the bog-like section in the southeastern section of the lake there are a large number of native plant species, while most of the rest of the lake was devoid of rooted aquatic plants. The only plant identified by the DEC was common bladderwort, a common species found in softwater lakes.

Tennanah 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 in the lake was around 7 meters in late July. The entire hypolimnion (bottom waters) was anoxic (devoid of oxygen) at depths below 8 meters. pH readings indicate neutral surface water, with the readings dropping off as depth increases. Conductivity readings indicate soft water (low ionic strength). Both indicators are typical of other lakes sampled in the Delaware River Basin. The oxygen reduction potential (ORP) readings were well below zero in the hypolimnion, indicating persistent oxygen deficits.

The lake appears to be typical of softwater, weakly colored, neutral to slightly 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. Deepwater fisheries may also be affected by elevated deepwater ammonia readings. It is not known if these coldwater fish have historically been supported in the lake.

Nitrate and phosphorus levels were low in both the surface and bottom waters. Ammonia, iron and manganese readings were elevated in the bottom waters, typical of other persistently anoxic lakes. Chloride levels were elevated, indicating impacts from road salting and or stormwater runoff through developed areas. It is not known if this results in any ecological impacts.

Aquatic life cannot be fully evaluated though the LCI. Deepwater oxygen and ammonia levels are not supportive of aquatic life, although it is not known if aquatic life would otherwise be found in the deeper waters.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Tennanah 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 the lake water would require substantial treatment to serve as a potable water supply. Deepwater intake quality would be compromised by elevated ammonia, iron and manganese levels.

Contact Recreation (Swimming)

Tennanah Lake is classified for contact recreation- swimming and bathing. It is believed that this use is currently supported. Bacteria data are needed to evaluate the safety to Tennanah Lake for swimming- these are not collected though the LCI. The data collected through the LCI do not indicate any issues that would prevent the lake from being used for swimming. The water clarity is well above the DOH guidance value of 1.2 meters.

Non-Contact Recreation (Boating and Fishing)

Boating (motorized, non motorized and personal water craft) is presently supported on the lake. Angling should also continue to be a supported use.

Aquatic Life

The anoxic conditions and elevated ammonia levels observed will stress some aquatic life. Additional biological studies would be needed to evaluate any other aquatic life impacts.

Aesthetics

These data indicate that there is no impact to the aesthetics of the lake. There is, however, some concern with the amount and types of boat traffic on the lake impacting some lake shore residents' enjoyment of the lake.

Additional Comments

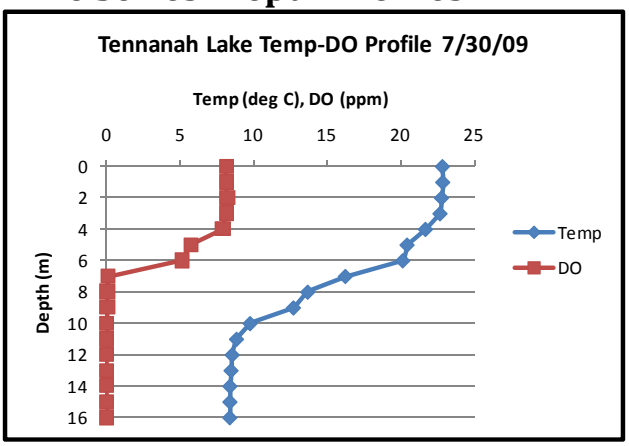
1. Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of invasive plants. Education of lake users to the risk of invasive species and proper cleaning and inspection of boats brought to the lake from other waterbodies will go a long way to help limit the importation of exotic species to the lake.
2. Lake residents should work together to address increasing concerns about boat traffic, including over-use of jet skis. This can be done through establishing lake zoning—times or parts of the lake for specific uses.

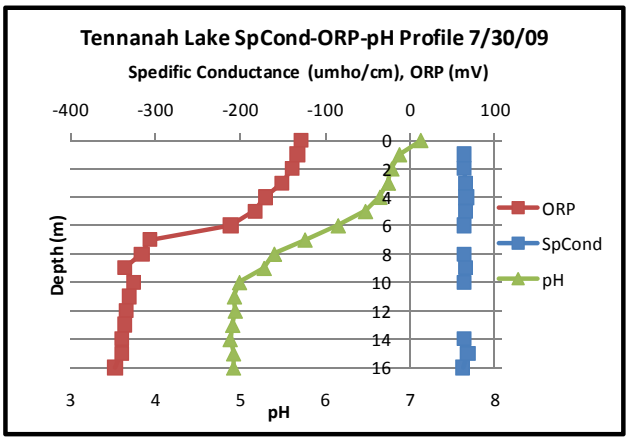
3. Lake residents have expressed an interested in participating in the NY Citizens Statewide Lake Assessment Program (CSLAP), a volunteer lake monitoring program conducted jointly by the DEC and the NY Federation of Lake Associations (FOLA). More information about the program, including an application form, can be found at www.nysfola.org.

Aquatic Plant IDs

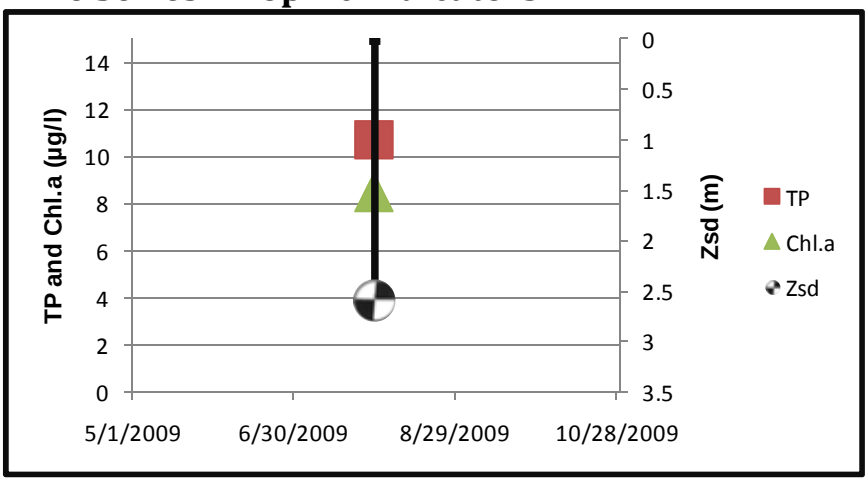
Exotic Plants: None
Native Plants: *Utricularia vulgaris* (Common bladderwort)

Time Series: Depth Profiles





Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
SECCHI	meters	2.6	Mesotrophic	Readings does not violate DOH guidance value
TSI-Secchi		46.2	Mesotrophic	No pertinent water quality standards
TP	mg/l	0.0107	Mesotrophic	Readings does not violate DEC guidance values
TSI-TP		38.3	Oligotrophic	No pertinent water quality standards
TSP	mg/l	0.0044	Little available phosphorus	No pertinent water quality standards
NOx	mg/l	0.0039	Low nitrate	Reading does not violate guidance
NH4	mg/l	0.011	Low ammonia	Reading does not violate guidance
TKN	mg/l	0.33	Low organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	68.65	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	8.5	Eutrophic	No pertinent water quality standards
TSI-CHLA		51.6	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	10.7	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	10	Uncolored	No pertinent water quality standards
TOC	mg/l	3.6		No pertinent water quality standards
Ca	mg/l	6.52	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	0.0468		Reading does not violate water quality standards
Mn	mg/l	0.027		Reading does not violate water quality standards
Mg	mg/l	0.732		Reading does not violate water quality standards
K	mg/l	0.395		No pertinent water quality standards
Na	mg/l	7.43		Reading does not violate water quality standards
Cl	mg/l	14.1	Moderate road salt runoff	Reading does not violate water quality standards
SO4	mg/l	3.9		Reading does not violate water quality standards

Bottom Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
TP-bottom	mg/l	0.0559	Elevated deepwater phosphorus	No pertinent water quality standards
TSP-bottom	mg/l	0.0276	High % soluble phosphorus	No pertinent water quality standards
NOx-bottom	mg/l	0.0062	No evidence of DO depletion	Reading does not violate water quality standards
NH4-bottom	mg/l	0.593	Evidence of DO depletion	Reading does not violate water quality standards
TKN-bottom	mg/l	0.96		No pertinent water quality standards
Alk-bottom	mg/l	20.9	Poorly Buffered	No pertinent water quality standards
TCOLOR-bottom	ptu	35	Highly Colored	No pertinent water quality standards
TOC-bottom	mg/l	3.9		No pertinent water quality standards
Ca-bottom	mg/l	7.67	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe-bottom	mg/l	1.89	Taste or odor likely	Reading violates water quality standards

Bottom Samples (continued)

	UNITS	Reading	Scientific Classification	Regulatory Comments
Mn-bottom	mg/l	1.06	Taste or odor likely	Reading violates water quality standards
Mg-bottom	mg/l	0.789		Reading does not violate water quality standards
K-bottom	mg/l	0.829		No pertinent water quality standards
Na-bottom	mg/l	7.24		Reading does not violate water quality standards
Cl-bottom	mg/l	13.3		Reading does not violate water quality standards
SO4-bottom	mg/l	3.2	May have rotten egg odor	Reading does not violate water quality standards
As-bottom	mg/l	ND	No evidence of potable water threats	Reading does not violate water quality standards

Lake Perception

	UNITS	Reading	Scientific Classification	Regulatory Comments
WQ Assessment	1-5, 1 best	2	Not Quite Crystal Clear	No pertinent water quality standards
Weed Assessment	1-5, 1 best	3	Plants Grow to Lake Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	1	Could Not Be Nicer	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(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 = 3.2 mg/l; NYS standard = 10 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 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