LCI Lake Water Quality Summary

General Information

Lake Name:	**Silver Lake**
Location:	Town Harrison and City of White Plains, Westchester County, New York
Basin:	Atlantic Ocean/Long Island Sound Basin
Size:	15.5 hectares (38 acres)
Lake Origins:	natural
Major Tributaries:	two minor unnamed tributaries
Lake Tributary to?:	Mamaroneck River
Water Quality Classification:	B (best intended use: primary contact recreation)
Sounding Depth:	3.2 meters (10.5 feet)
Sampling Coordinates:	Latitude: 41.04668, Longitude: -73.74500 (July) Latitude: 41.04411, Longitude: -73.75007 (Aug. & Sept.)
Sampling Access Point:	Liberty County Park
Monitoring Program:	Lake Classification and Inventory (LCI) Survey
Sampling Dates:	7/22/09, 8/21/2009, 9/21/2009
Samplers:	Scott Kishbaugh, NYSDEC Division of Water David Newman, NYSDEC Division of Water, Albany Steven Finnemore, 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

Silver Lake is just outside the City of White Plains in Westchester County. Silver Lake Preserve County Park is just to the north of the lake, but does not provide an access point to the lake itself. At the southwestern end of the lake there is a small park owned by the City of White Plains. This small park has a parking area and a boat dock that at one time was used to rent row boats to allow people to paddle around the lake. On the southeastern shore of the lake the Town/Village of Harrison has a recreational area with athletic fields and swimming pool as well as a small boat dock. However, access to the lake surface is limited, and the boat docks are no longer available for public usage. The lake's watershed consists of a mix of land uses including urban and suburban housing, recreation fields, and forest.

The pond was included in the New York State DEC Division of Water's 2009 intensive (monthly sampling) Lake Classification and Inventory (LCI) survey of the Atlantic Ocean/ Long Island Sound (AO/LIS) basin. Inclusion in the survey was based on a "Needs Verification" listing in The 2000 AO/LIS Waterbody Inventory and Priority Waterbodies List (WIPWL). The WIPWL states, "Public bathing, recreational uses and aesthetics in Silver Lake may be limited by excessive aquatic vegetation. Lake nutrient loads from urban runoff and lawn fertilizing are possible sources of nutrients that exacerbate weed growth. (DEC/DOW, Region 3, 1996)."

Silver Lake can generally be characterized as *eutrophic*, or highly productive. The average water clarity reading (TSI = 70, typical of *eutrophic* lakes) was expected given the average phosphorus reading (TSI = 69, typical of *eutrophic* lakes), and the average chlorophyll *a* reading (TSI = 64, typical of *eutrophic* lakes). These data along with visual observation indicate that algal blooms were occurring during the August and September sampling events and that baseline nutrients can and do support persistent algal blooms in the lake.

Algal greenness was apparent to the casual observer during the August and September sampling events. An algal bloom was also visible at the south end of the lake during the July sample. Three different species of rooted aquatic plants were found at the lake and included the floating leaf species *Nuphar sp.* (spadderdock) which occurs at the shallow northern end of the lake in dense stands. *Elodea canadensis* (common waterweed), and *Najas sp* (unidentified naiad) were also found in low densities in the main body of the lake.

Water samples were collected to evaluate the potential presence of harmful algal blooms—cyanobacteria that might trigger the release of algal toxins or taste and odor compounds. The samples from Silver Lake were run through a phycocyanin detector and recorded readings of 187 phycocyanin units. Any sampling results above 100 units may be associated with the presence of more than 1.0 µg/l of microcystis-LR, corresponding to the World Health Organization (WHO) guidance to protect drinking water supplies (it is not yet known what phycocyanin readings might result in microcystis-LR readings above 5-10 µg/l, the guidance to protect contact recreation). The results from these detectors can be highly variable, and should only be used as an indication of a potential problem.

Like most shallow lakes, Silver Lake does not exhibit thermal stratification, in which depth zones (warm water on top, cold water on the bottom during the summer) are established. Temperature and dissolved oxygen readings were comparable throughout the water column. pH readings indicate alkaline water, and conductivity readings indicate hard water (high ionic

strength). The former is typical of lakes exhibiting high algae levels, and the latter is typical of lakes in watersheds with high amounts of development.

Silver Lake appears to be typical of weakly colored, hardwater, alkaline 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.

Phosphorus, iron, manganese, and sodium levels were above the state guidance values. Chloride levels were also elevated, suggesting significant impacts from road salting and/or storm water inputs from developed areas. It is not known if any of these issues result in ecological impacts to the lake.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Silver 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. Surface water withdrawals may be impacted by elevated algae levels, high nutrient levels, and elevated, sodium, iron and manganese levels.

Contact Recreation (Swimming)

Silver Lake is classified for contact recreation- swimming and bathing. It is not likely that people currently swim in the lake, given the lack of public or private access to the shoreline. Bacteria data are needed to evaluate the safety to Silver Lake for swimming-these are not collected though the LCI. The data collected through the LCI show that the water clarity was consistently below the New York State Department of Health's standard of 1.2 meters to protect the safety of swimmers.

Some species of cyanobacteria can produce toxins, such as microcystis-LR, and others can be implicated in taste and odor problems. While the presence of cyanobacteria does not necessarily indicate water quality problems or the presence of harmful algal blooms, it may warrant additional investigation.

Non-Contact Recreation (Boating and Fishing)

These data did not indicate any impacts to non-contact recreation, although the presence of algal blooms during the summer may deter individuals from participating in non-contact recreation. Shallow lakes with similar water quality characteristics tend to see a shift in the fish community from bass, bluegill and perch, to less desirable carp and bullhead.

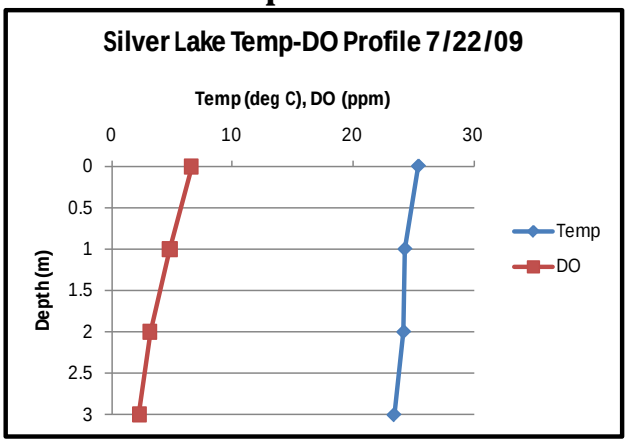
Aquatic Life

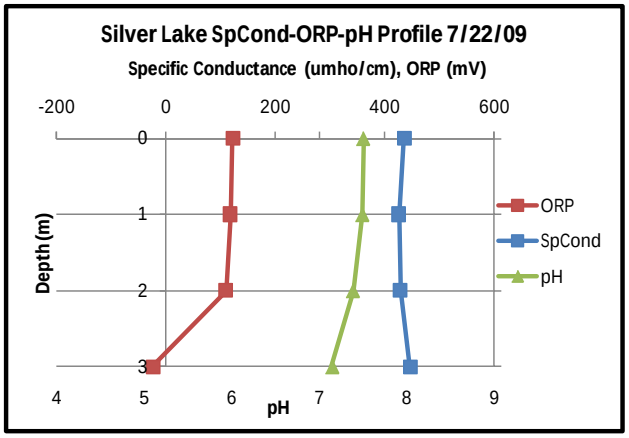
The low water clarity readings will limit the growth of native vegetation in the lake to all but the shallow fringes of the lake. The algal blooms may also cause anoxic (devoid of oxygen) conditions which may lead to fish kills.

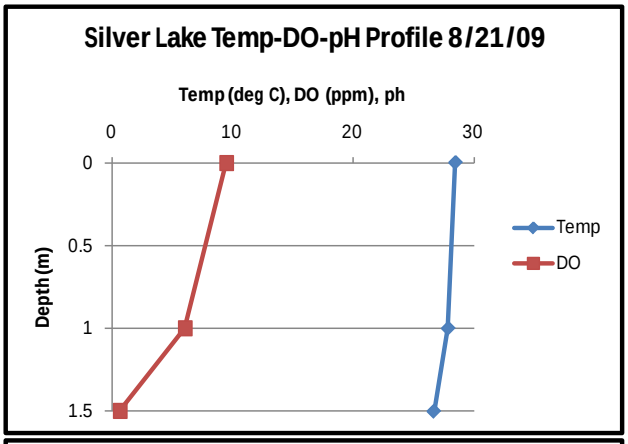
Aesthetics
The presence of algal blooms during the summer months detracts from the aesthetic appeal of the lake.

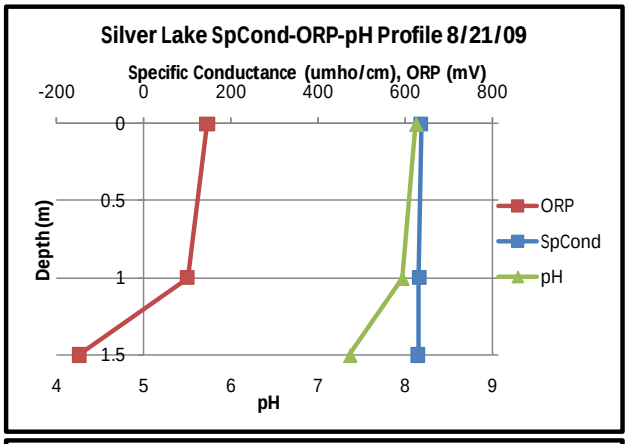
Additional Comments
1. Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of any new invaders, given the escalating problems with exotic aquatic weeds.
2. Algae identification would determine if the lake may suffer from harmful algal blooms (HABs) and/or the production of algal toxins. This may be conducted through future generations of the LCI, and HAB evaluations may be conducted by NYSDOH (as part of an ongoing 5 year CDC study) on samples collected in Silver Lake in 2009. In the interim, if any algal blooms are suspected at Silver Lake in the future, the Westchester County Health Department should be notified to conduct additional investigations to determine if restrictions on drinking or swimming in lake water may be appropriate.
3. Shallow lakes like Silver Lake may have alternative stable states, with one being clear water with large population of native aquatic vegetation, and the other being a state dominated by algae with reduced water clarity, and a lack of native vegetation. Consulting the current literature on the topic of "alternative stable states in shallow lakes" will provide additional information on the topic as well as outline some management recommendations.

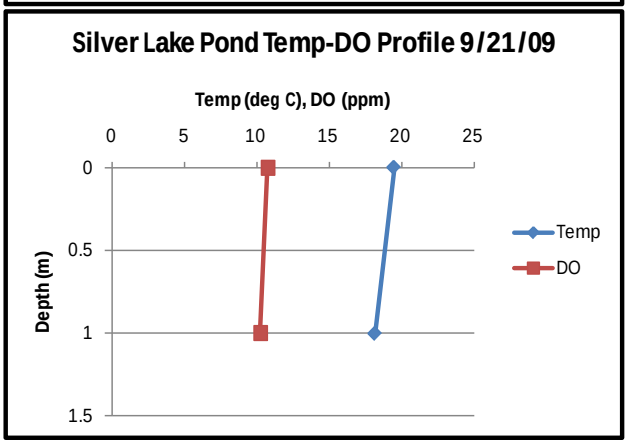
Aquatic Plant IDs
Exotic Plants:	None Observed
Native Plants:	*Nuphar sp.* (spadderdock)
	Elodea canadensis (common waterweed)
	Najas sp (unidentified naiad)

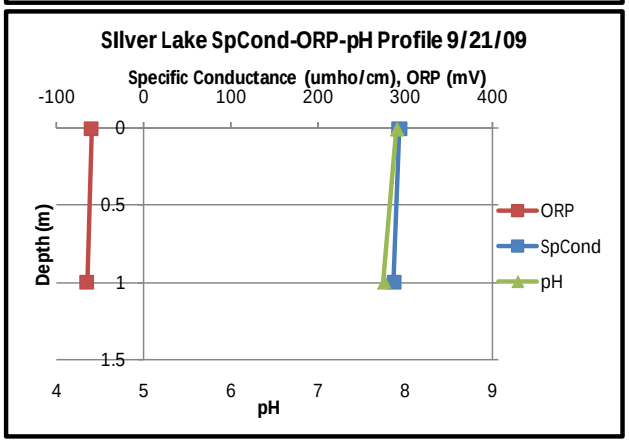
Time Series: Depth Profiles




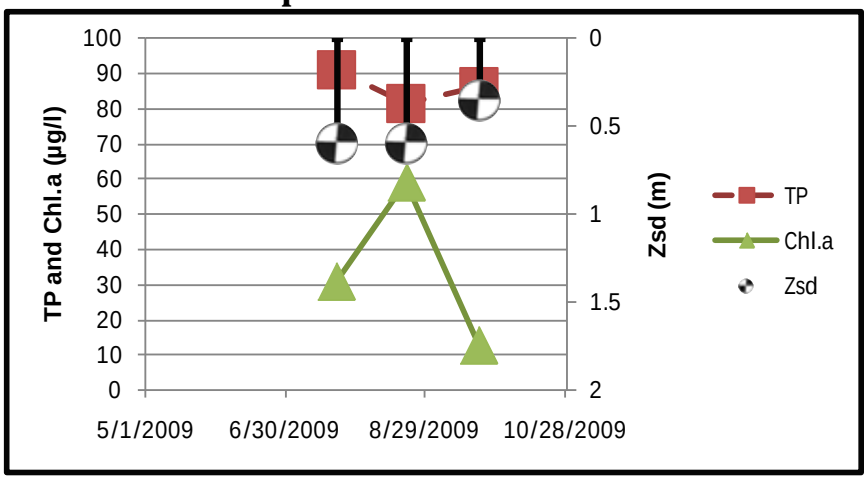








Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	3	0.35	0.52	0.6	Eutrophic	100% of readings violate DOH guidelines
TSI-Secchi			75.1	69.4	67.4	Eutrophic	No pertinent water quality standards
TP	mg/l	3	0.0816	0.0863	0.091	Eutrophic	100% of readings violate DOH guidelines
TSI-TP			67.6	68.4	69.2	Eutrophic	No pertinent water quality standards
TSP	mg/l	3	0.0076	0.0148	0.0193	Little available phosphorus	No pertinent water quality standards
NOx	mg/l	3	ND	0.0072*	0.0181	Low nitrate	No readings violate DOH guidance value
NH4	mg/l	3	0.032	0.057	0.092	Low ammonia	No readings violate DOH guidance value
TKN	mg/l	3	1.41	1.54	1.66	Elevated organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	3	34.53	39.56	42.43	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	3	12.8	34.37	59.3	Eutrophic	No pertinent water quality standards
TSI-CHLA			55.6	65.3	70.7	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	3	75	77.5	81.6	Moderately Buffered	No pertinent water quality standards
TCOLOR	ptu	3	10	16.7	20	Weakly Colored	No pertinent water quality standards
TOC	mg/l	3	7	8.9	10.2		No pertinent water quality standards
Ca	mg/l	3	30.3	30.8	31.4	Strongly Supports Zebra Mussels	No pertinent water quality standards
Fe	mg/l	3	0.536	0.676	0.905	Taste or odor likely	100% of readings violate DOH guidelines
Mn	mg/l	3	0.156	0.2433	0.403	May have some taste/odor	33% of readings violate DOH guidelines
Mg	mg/l	3	9.05	9.24	9.42		No readings violate DOH guidance value
K	mg/l	3	4.18	4.28	4.47		No pertinent water quality standards
Na	mg/l	3	34.4	36.5	38		100% of readings violate DOH guidelines
Cl	mg/l	3	75.1	78	81.1	Significant road salt runoff	No readings violate DOH guidance value
SO4	mg/l	3	9.5	11.27	12.8		No readings violate DOH guidance value

***** The nitrate average was calculated with non-detects being treated as equal to half the detection limit or 0.001 mg/l.

Lake Perception

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
WQ Assessment	1-5, 1 best	3	4	4	4	High Algae Levels	No pertinent water quality standards
Weed Assessment	1-5, 1 best	3	1	1.67	2	Plants Visible Below Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	3	4	4	4	Substantially Impaired	No pertinent water quality standards

Legend Information

General Legend Information

Surface Samples = integrated sample collected in the first 2 meters of surface water
N = number of samples
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

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

References

NYSDEC. 2002. The 2000 Atlantic Ocean/ Long Island Sound Basin Waterbody Inventory and Priority Waterbodies List. NYSDEC, Albany, NY. Available online at http://www.dec.ny.gov/docs/water_pdf/pwlatlv202.pdf.