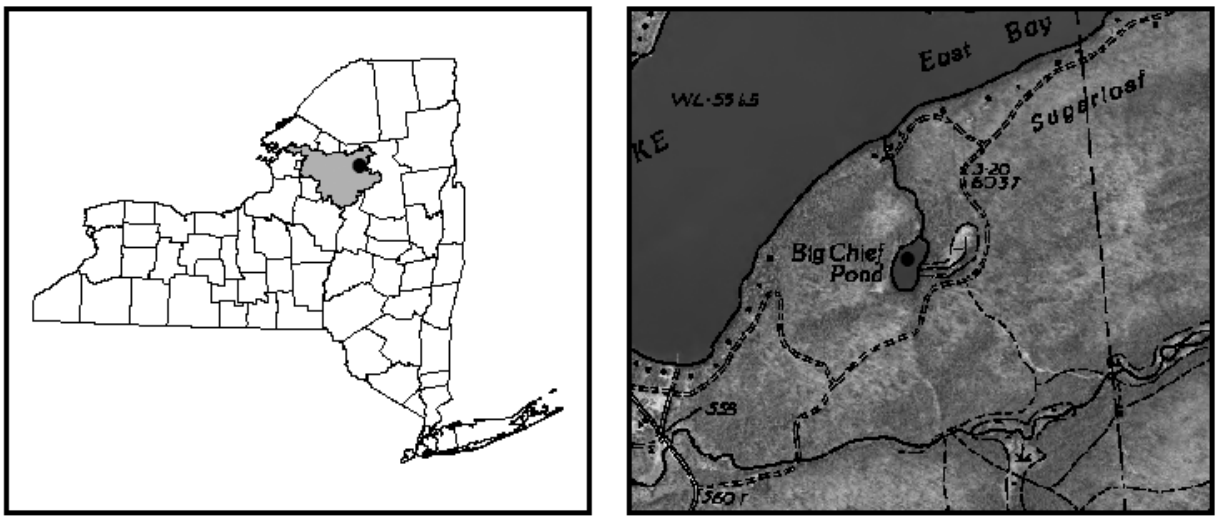
LCI Lake Water Quality Summary

General Information

Lake Name:	**Big Chief Pond**
Location:	Town of Webb, Herkimer County
Basin:	Black River
Size:	~1.6 hectares (~4 acres)
Lake Origins:	Unknown
Tributaries:	None
Watershed Area:	19.5 hectares (48 acres)
Lake Tributary to:	Big Moose Lake via a minor unnamed tributary
Water Quality Classification:	C (best intended use: secondary contact recreation)
Sounding Depth:	11.5 meters (38 feet)
Sampling Coordinates:	43.83043, -74.82912
Sampling Access Point:	Private land
Monitoring Program:	Lake Classification and Inventory (LCI) Survey
Sampling Date:	September 20, 2012
Samplers:	David Newman, NYSDEC Division of Water, Albany Brad Wenskoski, 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

Big Chief Pond is a small pond near the southeastern shoreline of Big Moose Lake, within the Adirondack Park. The land around the pond is owned by a small number of private land owners, with no public access to the pond. There is only one seasonal residence visible from the pond with the rest of the land surrounding the pond and the pond's small watershed being forested or wetlands. The pond is used by the private land owners for boating, fishing and swimming. From 1983 to 1986 Big Chief Pond was monitored by researchers at Cornell, as part of their Extensive Liming Study (ELS). As part of this research agricultural limestone was applied to the pond in the fall of 1983; and the pond was subsequently stocked with brook trout (Schofield et al. 1993, Gloss et al. 1989)

Big Chief Pond was screened (single sample) through a pilot probabilistic (randomly selected) monitoring program run by the NYSDEC Division of Water's Lake Classification and Inventory (LCI) program, in the early fall of 2012. In addition, *The 2004 Black River Basin Waterbody Inventory and Priority Waterbodies List* (DEC 2007), identifies the aquatic life in "*Minor Trib[utaries] to Big Moose Lake*" as *impaired*, due to atmospheric deposition (acid rain) and low pH values (in some cases less than 5.0). The data and observation collected from this monitoring effort indicated that the pond was generally meeting its designated uses, primarily non-contact recreation. Big Chief Pond is not likely to be considered for additional Division of Water monitoring during the summer of 2013.

Based on data from the single sampling event, in late September of 2012, Big Chief Pond can be characterized as *oligotrophic*, or unproductive. The water clarity reading (TSI = 41, typical of *mesotrophic* lakes) was slightly lower than expected, given the phosphorus (TSI = 31, typical of *oligotrophic* lakes) and the chlorophyll *a* reading (TSI = 33, typical of *oligotrophic* lakes). The lower than expected water clarity reading is likely due to the tannic nature of the pond's water. The tannic color of the pond is caused by dissolved organic acids entering the pond from the watershed, and is common for many of the small lakes and ponds in the Black River Basin. The trophic indicators show that baseline nutrient levels do not support high levels of algae production in the pond.

A small number of native water lilies were observed during a visual assessment of the pond. A more thorough plant specific survey would be needed to adequately assess the plant community of the pond, and rule out the existence of any invasive species. The acidic nature of the pond may preclude the survival of many plant species.

Big Chief Pond 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 six meters deep. The thermocline in the pond was at four to five meters in late September. Below this point, anoxic (lack of dissolved oxygen) conditions were observed. The pH readings were around 5.75 at the surface and dropped to 5.2 at the thermocline. pH values of less than 6.0 may *stress* many forms of aquatic life. Conductivity readings indicate soft water, as is typical for Adirondack lakes and ponds, due to the underlying soil layers.

Big Chief Pond appears to be typical of acidic, soft water, highly colored ponds in the Adirondacks. Other waterbodies, with similar water quality characteristics, often do not support a wide variety of fish and plant life, due to the low pH. A fisheries survey would need to be conducted, to look at the impacts of low pH and other parameters on the survival of fish, in the pond.

Chloride levels were below the laboratory detection limit, indicating little to no impacts from road salting and runoff through developed areas. Low chloride readings are commonly reported in waterbodies with highly forested watersheds. The alkalinity levels were also below the laboratories detection limit, indicating the pond has little to no buffering capacity to acidic inputs. This is also common to many Adirondack lakes and ponds, due to low level of carbonates in the underlying soil. Iron levels in the hypolimnion (bottom waters)were above the state's drinking water quality standard, and would likely cause taste and/or odor problems with water withdrawn from the pond's hypolimnion. Elevated levels of iron, in the bottom waters, are often associated with anoxic conditions, allowing iron bound to the bottom sediments to be release into the water column.

Comparison to ELS data

Many of the findings from the fall 2012 DEC monitoring were consistent with the data found during the ELS monitoring in the 1980's. The 2012 water clarity reading was within the range of values seen after lime was applied to the pond (1984-1986), but lower than that seen before the lime was applied (1983). In addition, the temperature profile from 2012 would fall into the "*strongly stratified*" category that Schofield et al (1993) placed the pond in, based on the ELS monitoring data. The 2012 pH level was below that seen in the months immediately following the application of lime to the pond (Gloss et al. 1989), but above those found during the summer of the three years subsequent to the liming. The pre-liming pH level was as low as 4.8 (Schofield et al 1993).

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Big Chief Pond is not classified, nor used as a potable water supply. Data collected through the LCI program are not sufficient to fully evaluate potable water use. These data indicate that bottom water withdrawals may experience taste and odor problems associated with elevated iron levels. The low pH of the water may also cause corrosion problems with plumbling. However, potable water use is not a designated use for Big Chief Pond.

Contact Recreation (Swimming)

Big Chief Pond is not classified for swimming. 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". The land owners indicated that people do swim in the pond. Bacteria data are needed to evaluate the safety of Big Chief Pond for swimming; these are not collected through the LCI. Data collected though the LCI, indicate that swimming should be supported in the pond, assuming low bacteria levels. The water clarity was well above the State Department of Health's guidance value of 1.2 meters to protect the safety of swimmers.

Non-Contact Recreation (Boating and Fishing)
Big Chief Pond is classified for non-contact recreation including boating and fishing. The land owners indicated that the pond is frequently used for both contact and non-contact recreation including non-powered boating and fish. The low pH of the pond may negatively impact fish populations and the lack of oxygen in the bottom waters would not be supportive of cold water fish species.

Aquatic Life
The low pH levels in the pond are not conducive to aquatic life. A biological survey of the pond would be needed to fully evaluate the impacts of low pH and any other stressors to aquatic life.

Aesthetics
These data did not indicate any stressors to the aesthetics of the pond.

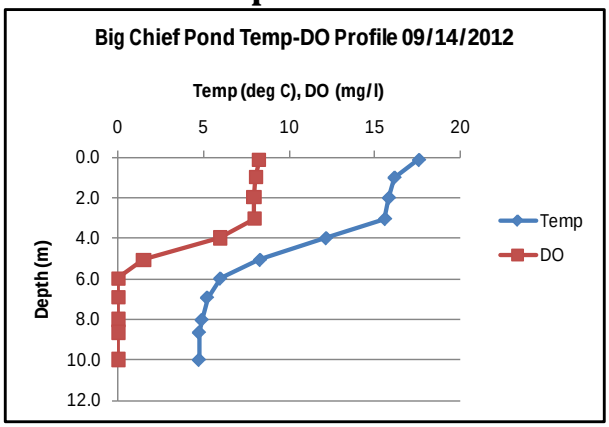
Additional Comments

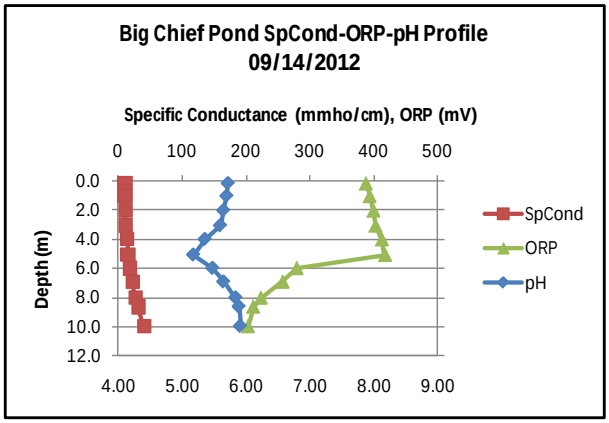
- The apparent slow rise in pH levels, since the 1980's, has been seen in many other lakes and ponds, in the Adirondacks, and has been linked to provisions in the Clean Air Act, that have reduced acidic deposition (Adirondack Lakes Survey Corporation 2012). However, it is not known if the higher pH observed in Big Chief Pond relative to data from previous years represents normal variability or is in response to the regional changes.
- 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.
- "Efforts are underway on a national level to address problems caused by acid rain by reducing pollutant emissions, as required by the Clean Air Act. New York State (and other northeastern states) ha[s] taken legal action against USEPA to accelerate implementation of controls. Monitoring of these waters (waterbodies impacted by acid deposition) will continue, in order to assess changes in water quality resulting from implementation of the Clean Air Act. However, these changes are expected to occur only slowly over time (DEC 2007)".

Aquatic Plant IDs

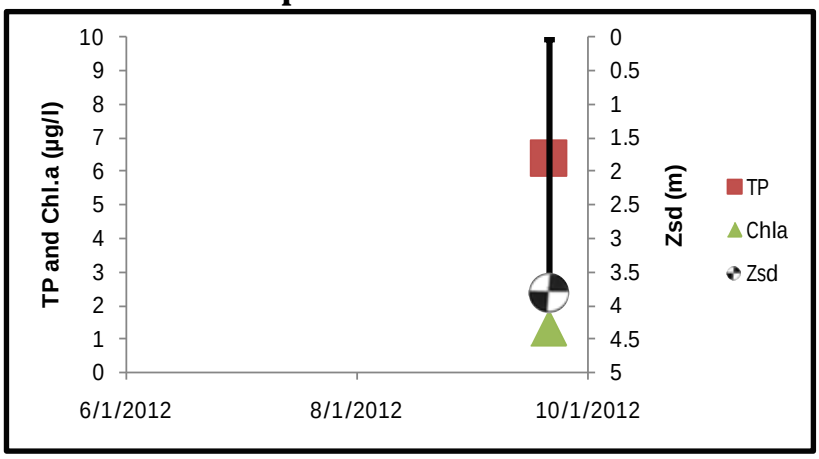
Exotic Plants: None observed
Native Plants: *Nymphaea sp.* (white waterlily)

Time Series: Depth Profiles





Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
SECCHI	meters	3.8	Mesotrophic	Readings does not violate DOH guidance value
TSI-Secchi		40.8	Mesotrophic	No pertinent water quality standards
TP	mg/l	0.0064	Oligotrophic	Reading does not violate DEC guidance values
TSI-TP		30.9	Oligotrophic	No pertinent water quality standards
TSP	mg/l	0.0031	Little available phosphorus	No pertinent water quality standards
NOx	mg/l	0.0248	Low nitrate	Reading does not violate guidance
NH4	mg/l	0.035	Low ammonia	Reading does not violate guidance
TKN	mg/l	0.28	Low organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	104.78	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	1.32	Oligotrophic	No pertinent water quality standards
TSI-CHLA		33.32	Oligotrophic	No pertinent water quality standards
Alkalinity	mg/l	ND	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	42	Highly Colored	No pertinent water quality standards
TOC	mg/l	7.4		No pertinent water quality standards
Ca	mg/l	1.44	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	0.0854		Reading does not violate water quality standards
Mn	mg/l	0.0135		Reading does not violate water quality standards
Mg	mg/l	0.154		Reading does not violate water quality standards
K	mg/l	0.238		No pertinent water quality standards
Na	mg/l	0.582		Reading does not violate water guidance value
Cl	mg/l	ND	Little impact from road salt	Reading does not violate water quality standards
SO4	mg/l	2.2		Reading does not violate water quality standards

Bottom Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
TP-bottom	mg/l	0.0264		No pertinent water quality standards
TSP-bottom	mg/l	0.0192	High % soluble phosphorus	No pertinent water quality standards
NOx-bottom	mg/l	0.0089	No evidence of DO depletion	Reading does not violate water quality standards
NH4-bottom	mg/l	0.923	Evidence of DO depletion	Reading does not violate water quality standards
TKN-bottom	mg/l	1.34		No pertinent water quality standards
Alk-bottom	mg/l	6.6	Poorly Buffered	No pertinent water quality standards
TCOLOR-bottom	ptu	180	Highly Colored	No pertinent water quality standards
TOC-bottom	mg/l	12.5		No pertinent water quality standards
Ca-bottom	mg/l	2.42	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe-bottom	mg/l	3.92	Taste or odor likely	Readings violates class 'A' water quality standards (not applicable to Big Chief Pond)
Mn-bottom	mg/l	0.031		No readings violate water quality standards
Mg-bottom	mg/l	0.229		No readings violate water quality standards
K-bottom	mg/l	0.509		No pertinent water quality standards
Na-bottom	mg/l	0.698		No readings violate water quality standards
Cl-bottom	mg/l	ND		Reading does not violate water quality standards
SO4-bottom	mg/l	ND		Reading does not violate water quality standards
Si-bottom	mg/l	6.26		No pertinent water quality standards
As-bottom	mg/l	ND		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	2	Plants Visible Below Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	1	Could Not Be Nicer	No pertinent water quality standards

References

Adirondack Lake Survey Corporation. 2012. A Long-Term Monitoring Program for Evaluating Changes in Water Quality in Selected Adirondack Waters: Program Summary Report 2011. Available from <http://www.adirondacklakessurvey.org>.

DEC. 2007. The 2004 Black River Basin Waterbody Inventory and Priority Waterbodies List. Available at <http://www.dec.ny.gov/docs/water_pdf/pwlblck07.pdf>.

Gloss, S.P., C.L. Schofield & M.D. Marcus. 1989. Liming and fisheries management guidelines for acidified lakes in the Adirondack Region. U.S. Fish and Wildlife Service, National Ecology Research Center-Leetown Biological Report 80(40.27). xi + 59 pp.

Schofield, C.L., D. Josephson, C. Keleher, & S.P. Gloss. 1993. Thermal stratification of dilute lakes - an evaluation of regulatory processes and biological effects prior to and following base addition. Part II: Effects on brook trout habitat and growth. RWO No. 4, Unit Cooperative Agreement 14-16-0009-1553, U.S. Fish and Wildlife Service, 66 pp.

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 = 1.0 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
Si	= dissolved silica, mg/l Detection limit = 0.01mg/l; no NYS standard or guidance value
As	= arsenic, mg/l Detection limit = 0.001mg/l; NYS standard = 0.01 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