Volunteer Lake Assessment Program Individual Lake Reports

WINONA, LAKE, NEW HAMPTON, NH

MORPHOMETRIC DATA

Watershed Area (Ac.):	3,328	**Max. Depth (m):**	14.6	**Flushing Rate (yr^1)**	2.1
Surface Area (Ac.):	154	**Mean Depth (m):**	5.2	**P Retention Coef:**	0.54
Shore Length (m):	5,000	**Volume (m^3):**	3,161,000	**Elevation (ft):**	540

TROPHIC CLASSIFICATION

Year	Trophic class
1987	MESOTROPHIC
2005	MESOTROPHIC

KNOWN EXOTIC SPECIES

The Waterbody Report Card tables are generated from the DRAFT 2014 305(b) report on the status of N.H. waters, and are based on data collected from 2004-2013. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organizations/divisions/water/wmb/swqa/index.htm

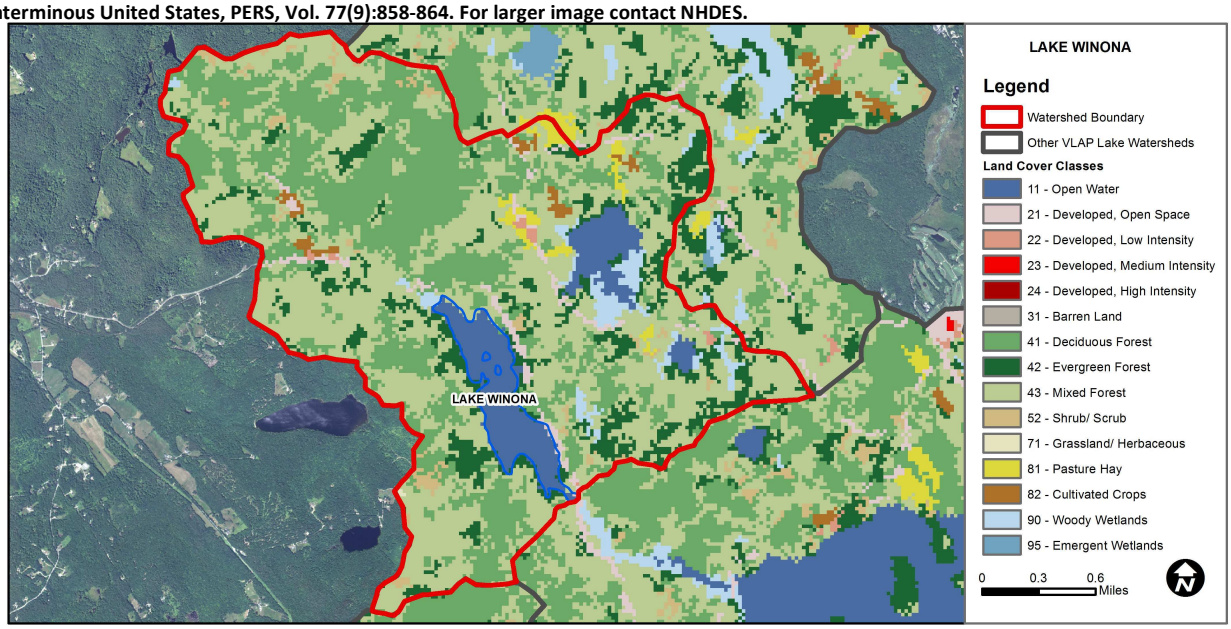
Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Good	The calculated median is from 5 or more samples and is < indicator and > 1/2 indicator and the chlorophyll a indicator is okay.
	pH	Slightly Bad	>10% of samples exceed criteria by a small margin (minimum of 2 exceedances).
	Oxygen, Dissolved	Bad	There are >10% of samples (minimum of 2), exceeding criteria with one or more samples considered large exceedance.
	Dissolved oxygen satura	Slightly Bad	There are >10% of samples (minimum of 2), exceeding criteria.
	Chlorophyll-a	Good	The calculated median is from 5 or more samples and is < indicator and > 1/2 indicator.
Primary Contact Recreation	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.
	Chlorophyll-a	Very Good	There are a total of at least 10 samples with 0 exceedances of indicator.

BEACH PRIMARY CONTACT ASSESSMENT STATUS

LAKE WAUKEWAN - TOWN BEACH	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.

WATERSHED LAND USE SUMMARY

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PERS, Vol. 77(9):858-864. For larger image contact NHDES.



Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	7.09	Barren Land	0	Grassland/Herbaceous	0.04
Developed-Open Space	1.83	Deciduous Forest	30.07	Pasture Hay	1.16
Developed-Low Intensity	0.27	Evergreen Forest	10.89	Cultivated Crops	0.79
Developed-Medium Intensity	0	Mixed Forest	43.84	Woody Wetlands	2.3
Developed-High Intensity	0	Shrub-Scrub	1.58	Emergent Wetlands	0

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Winona Lake, New Hampton

2014 Data Summary

Observations and Recommendations (*Refer to Table 1 and Historical Deep Spot Data Graphics*)

- **Chlorophyll-a:** Chlorophyll levels were elevated in July and approached levels indicative of an algal bloom. Chlorophyll levels had decreased by September however remained slightly elevated. Average chlorophyll levels were the highest measured since monitoring began and have increased steadily since 2010. Historical trend analysis indicates highly variable chlorophyll levels since monitoring began.
- **Conductivity/Chloride:** Deep spot, Heights Bk., North Inlet, and Outlet conductivity and chloride levels were slightly greater than the state medians. Historical trend analysis indicates significantly increasing (worsening) epilimnetic (upper water layer) conductivity since monitoring began. York Bk. conductivity levels remained low. Hawkins Pond Inlet conductivity levels were slightly greater than the state median in June and July and then increased in September when tributary flows were low concentrating minerals in the stream. Conductivity levels were measured upstream of Hawkins Pond Inlet, above and below the Outlet of Hawkins Pond. Conductivity and chloride levels were slightly elevated but lower than those measured downstream at Hawkins Pond Inlet.
- **E. coli:** Tributary E. coli levels were low on each sampling event and much less than the state standards for public beaches and surface waters.
- **Total Phosphorus:** Epilimnetic (upper water layer), metalimnetic (middle water layer) and hypolimnetic (lower water layer) phosphorus levels were very low in June, and epilimnetic and metalimnetic phosphorus levels remained stable and low in July and September and were much less than the state median. Historical trend analysis indicates highly variable epilimnetic phosphorus levels since monitoring began. Hypolimnetic phosphorus levels increased gradually in July and again in September, and turbidity also increased. This suggests the potential for internal phosphorus loading. When hypolimnetic dissolved oxygen levels decrease to below 1.0 mg/L, phosphorus normally bound in bottom sediment may be released into the water column. North Inlet and Outlet phosphorus levels were low on each sampling event. Heights Bk. and Hawkins Pond Inlet phosphorus levels increased in July following a significant rain event, but were low in June and September. Hawkins Pond Above and Below Outlet phosphorus levels were low in September.
- **Transparency:** Transparency was good in June and then decreased in July and September likely due to the elevated algal growth and a significant storm event prior to the July sampling event. However, average transparency remained better than the state median and improved from 2013. Historical trend analysis indicates relatively stable transparency with moderate variability between years.
- **Turbidity:** Epilimnetic and metalimnetic turbidity levels remained relatively low, however there was a small spike in metalimnetic turbidity in July, possibly due to algal growth. Hypolimnetic turbidity was low in June and then increased in July and September corresponding with decreased dissolved oxygen levels and the release of phosphorus and other organic compounds from bottom sediments. Heights Bk. turbidity was slightly elevated on each sampling event and laboratory checklists note organic material in the samples. North Inlet turbidity was slightly elevated in June and organic matter was noted in the sample as well. Hawkins Pond Inlet turbidity was slightly elevated in July following a significant storm event. Outlet turbidity was low on each sampling event.
- **pH:** Epilimnetic and metalimnetic pH levels were within desirable range 6.5—8.0 units however hypolimnetic pH was less than desirable, and deep spot pH has fluctuated below the desirable range historically. Historical trend analysis indicates relatively stable epilimnetic pH since monitoring began.
- **Recommended Actions:** The increase in chlorophyll levels since 2010 is concerning. The increased frequency and intensity of storm events and the resulting high water levels may be promoting spikes in algal growth. This may have occurred in July as a 2-3 inch rain event occurred 48 hours prior to sampling resulting in high water levels and elevated algal growth as measured by chlorophyll. The algae quickly take up the phosphorus made available from stormwater runoff and high water levels, which may be why algal growth is elevated but phosphorus levels measured in epilimnetic waters remains low. This highlights the importance of better managing stormwater runoff and water levels. Continue bracket sampling and conduct stormwater sampling of Hawkins Pond Inlet to identify areas of erosion. Keep up the great work!

Table 1. 2014 Average Water Quality Data for LAKE WINONA

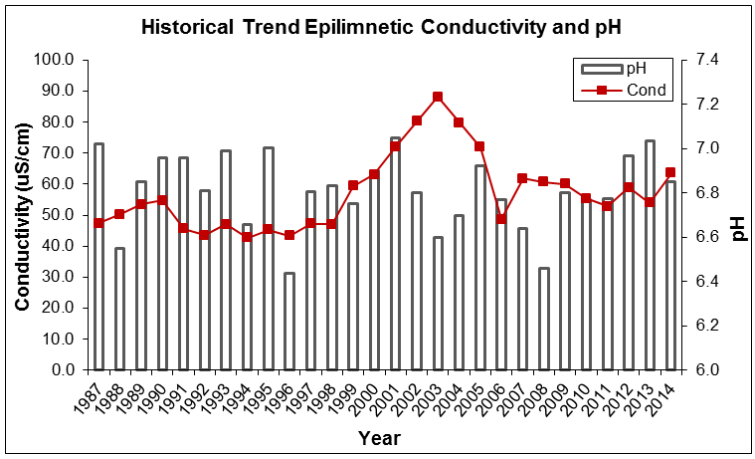
Station Name	Alk. mg/l	Chlor-a ug/l	Chloride mg/l	Cond. uS/cm	E. Coli #/100ml	Total P ug/l	Trans. m NVS	Trans. m VS	Turb. ntu	pH
Epilimnion	6.67	9.19	10	63.7		5	4.83	5.82	0.67	6.85
Metalimnion				62.9		5			0.85	6.78
Hypolimnion				63.3		12			4.85	6.47
Hawkins Outlet Above			17	87.1	10	5			0.45	6.71
Hawkins Outlet Below				89.7	10	9			1.87	6.88
Hawkins Pond Inlet			18	92.3	33	9			0.99	6.86
Heights Brook Inlet			7	61.5	13	13			2.48	6.52
North Cove East					10					
North Cove West					10					
North Inlet			11	64.1	23	7			1.32	6.81
Outlet			11	64.3		6			0.61	6.74
York Brook				25.5	10	6			0.15	6.75

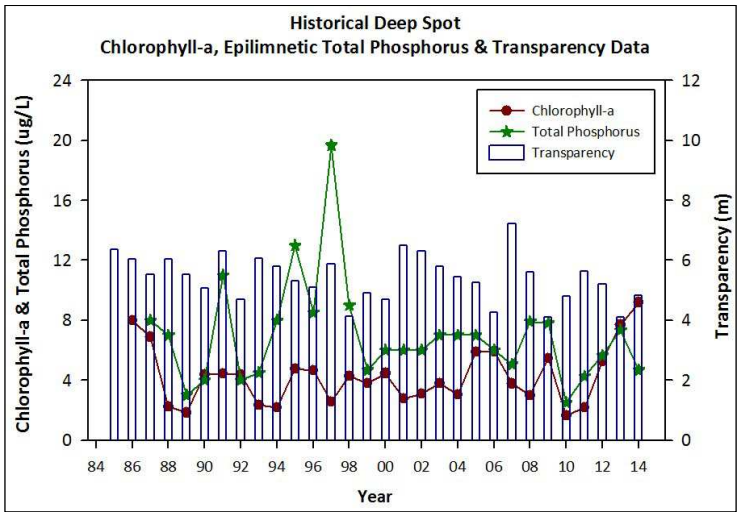
NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.
Chloride: > 230 mg/L (chronic)
E. coli: > 88 cts/100 mL – public beach
E. coli: > 406 cts/100 mL – surface waters
Turbidity: > 10 NTU above natural level
pH: between 6.5-8.0 (unless naturally occurring)

NH Median Values: Median values for specific parameters generated from historic lake monitoring data.
Alkalinity: 4.9 mg/L
Chlorophyll-a: 4.58 mg/m^3
Conductivity: 40.0 uS/cm
Chloride: 4 mg/L
Total Phosphorus: 12 ug/L
Transparency: 3.2 m
pH: 6.6

Historical Water Quality Trend Analysis

Parameter	Trend	Explanation	Parameter	Trend	Explanation
Conductivity	Worsening	Data significantly increasing.	Chlorophyll-a	Stable	Trend not significant; data highly variable.
pH (epilimnion)	Stable	Trend not significant; data moderately variable.	Transparency	Stable	Trend not significant; data moderately variable.
			Phosphorus (epilimnion)	Stable	Trend not significant; data highly variable.





This report was generated by the NH DES Volunteer Lake Assessment Program (VLAP). For more information contact VLAP at (603) 271-2658 or sara.steiner@des.nh.gov