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})**	1.6
Surface Area (Ac.):	154	**Mean Depth (m):**	6.6	**P Retention Coef:**	0.54
Shore Length (m):	5,000	**Volume (m^3):**	4,149,000	**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 2018 305(b) report on the status of N.H. waters, and are based on data collected from 2008-2017. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organization/divisions/water/wmb/swqa/index.htm

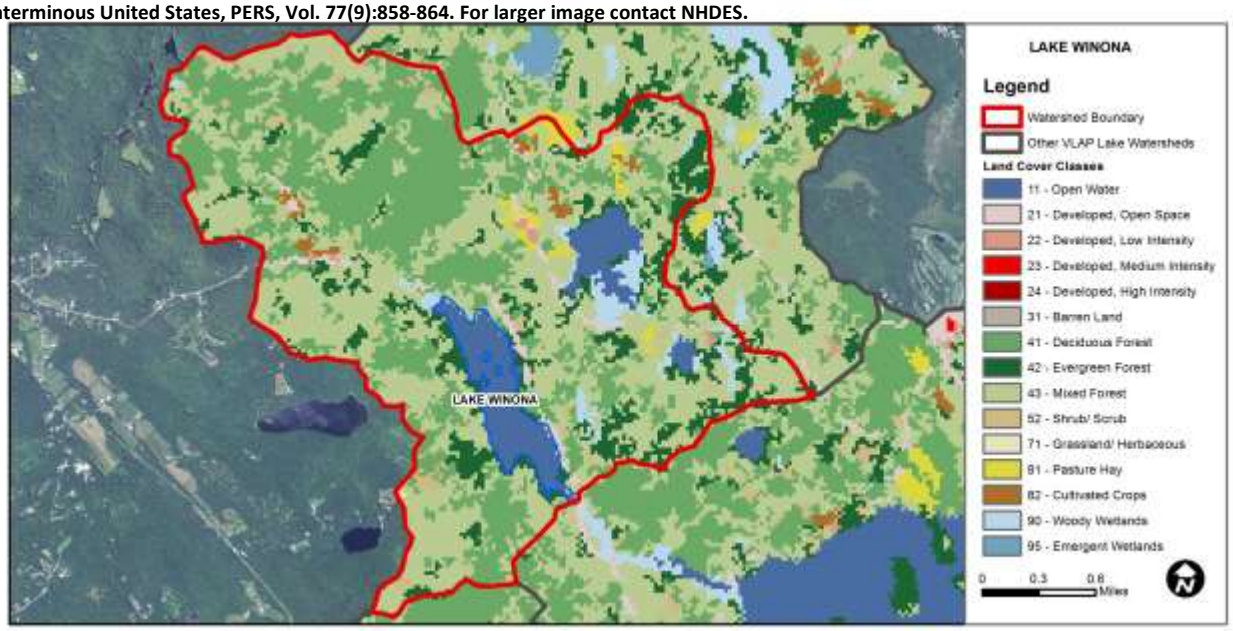
Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Good	Sampling data is better than the water quality standards or thresholds for this parameter.
	pH	Slightly Bad	Data periodically exceed water quality standards or thresholds for this parameter by a small margin.
	Oxygen, Dissolved	Bad	Data periodically exceed water quality standards or thresholds for this parameter by a large margin.
	Dissolved oxygen satura	Slightly Bad	Data periodically exceed water quality standards or thresholds for a given parameter by a small margin.
	Chlorophyll-a	Good	Sampling data is better than the water quality standards or thresholds for this parameter.
Primary Contact Recreation	Escherichia coli	Very Good	All sampling data meet water quality standards or thresholds for this parameter.
	Cyanobacteria hepatoto	Slightly Bad	Cyanobacteria bloom(s).
	Chlorophyll-a	Very Good	All sampling data meet water quality standards or thresholds for this parameter.

BEACH PRIMARY CONTACT ASSESSMENT STATUS

LAKE WAUKEWAN - TOWN BEACH	Escherichia coli	Good	Sampling data commonly meet water quality standards or thresholds for this parameter.

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.



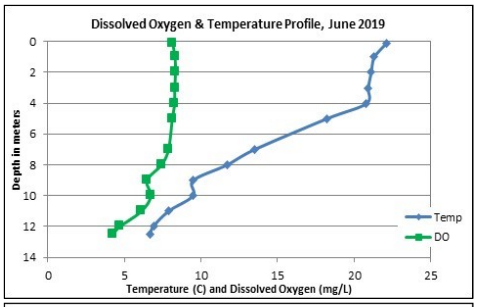
Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	7.09	Barren Land	0	Grassland/Herbaceous	0.04
Developed-Open Space	1.83	Deciduous Forest	30.07	Pasture Hay	1.16
Developed-Low Intensity	0.27	Evergreen Forest	10.89	Cultivated Crops	0.79
Developed-Medium Intensity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

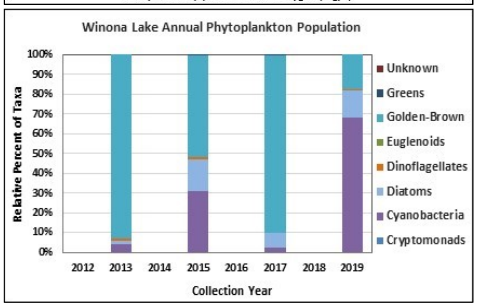
Volunteer Lake Assessment Program Individual Lake Reports
Lake Winona, New Hampton
2019 Data Summary

Recommended Actions: Lake quality was good in June with phosphorus and chlorophyll levels below the thresholds for mesotrophic lakes, however historical data suggest the occurrence of late summer algal/cyanobacteria blooms and phosphorus levels have significantly increased in the Hypolimnion suggesting a thick organic layer on the lake bottom that depletes dissolved oxygen resulting in release of phosphorus bound in the sediments into the water column. This phosphorus is readily available for uptake by algae and cyanobacteria. This highlights the importance of minimizing stormwater runoff, erosion, and sedimentation and deposition of organic material to the lake. Educate lake residents on best practices to dispose of organic material and how to reduce stormwater runoff and shoreline erosion. Identify and catalogue areas prone to erosion and prioritize areas for remediation activities. DES' "NH Homeowner's Guide to Stormwater Management" and UNH Cooperative Extension's "Landscaping at the Water's Edge" are good resources. Consider partnering with NHDES' Soak Up the Rain NH program aimed at helping reduce stormwater runoff from residential properties. Visit www.soaknh.org for more information. Keep up the great work!

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

- **Chlorophyll-a:** Chlorophyll level was low in June, decreased from 2018, and was less than the state median and the threshold for mesotrophic lakes. Historical trend analysis indicates highly variable chlorophyll levels since monitoring began.
- **Conductivity/Chloride:** Epilimnetic (upper water layer), Metalimnetic (middle water layer), Hypolimnetic (lower water layer), Heights Brook, Jean Chutes, North Inlet, and Outlet conductivity levels were slightly greater than the state median, yet not above a level of concern. Epilimnetic chloride levels were also slightly greater than the state median, yet much less than the state chronic chloride standard. However, historical trend analysis indicates significantly increasing (worsening) epilimnetic conductivity levels since monitoring began. Hawkins Pond Inlet conductivity levels remained slightly elevated, but chloride levels were also less than the state standard. York Brook conductivity levels were low.
- **Color:** Apparent color measured in the epilimnion indicates the water was lightly tea colored, or light brown.
- **E. coli:** Hawkins Pond Inlet, Heights Brook, Jean Chutes, Outlet, and York Brook E. coli levels were low and much less than the state standard for surface waters.
- **Total Phosphorus:** Epilimnetic and Metalimnetic phosphorus levels were low in June. Average epilimnetic phosphorus level increased from 2018 but remained less than the state median and the threshold for mesotrophic lakes. Historical trend analysis indicates highly variable epilimnetic phosphorus levels since monitoring began. Hypolimnetic phosphorus level was within a moderate range. Heights Brook, North Inlet, Outlet, and York Brook phosphorus levels were within a low range. Hawkins Pond Inlet phosphorus levels were moderate and within a normal range for that station. Jean Chutes phosphorus levels were slightly elevated during low flow conditions.
- **Transparency:** Transparency measured with (VS) and without (NVS) the viewscope was within an average range for the lake in June, decreased slightly from 2018, and was higher (better) than the state median. Historical trend analysis indicates relatively stable transparency since monitoring began.
- **Turbidity:** Epilimnetic, Metalimnetic, Hypolimnetic, Hawkins Pond Inlet, Heights Brook, Jean Chutes, North Inlet, Outlet, and York Brook turbidity levels were within low to moderate ranges for those stations.
- **pH:** Epilimnetic, Hawkins Pond Inlet, Jean Chutes, North Inlet, Outlet, and York Brook pH levels were within the desirable range 6.5-8.0 units. Historical trend analysis indicates stable epilimnetic pH levels since monitoring began. Metalimnetic, Hypolimnetic and Heights Brook pH levels were slightly less than desirable.





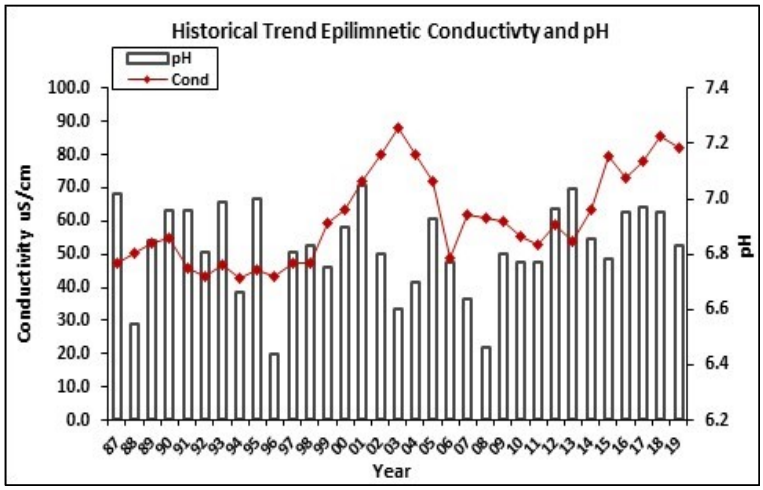
Station Name	Table 1. 2019 Average Water Quality Data for LAKE WINONA - NEW HAMPTON										
	Alk. mg/l	Chlor-a ug/l	Chloride mg/l	Color pcu	Cond. us/cm	E. coli mpn/100ml	Total P mg/l	Trans. m		Turb. ntu	pH
								NVS	VS		
Epilimnion	6.3	2.44	17	40	81.8		8	4.75	5.00	0.58	6.83
Metalimnion					82.4		9			0.83	6.28
Hypolimnion					86.2		15			1.46	6.11
Hawkins Pond Inlet			29		124.6	54	18			0.77	6.79
Heights Brook Inlet			6		51.8	77	10			0.36	6.33
Jean Chutes					100.2	6	26			0.76	6.70
North Inlet			12		68.9		9			1.31	6.47
Outlet			17		83.9	4	11			0.59	6.85
York Brook					22.2	6	3			0.08	6.66

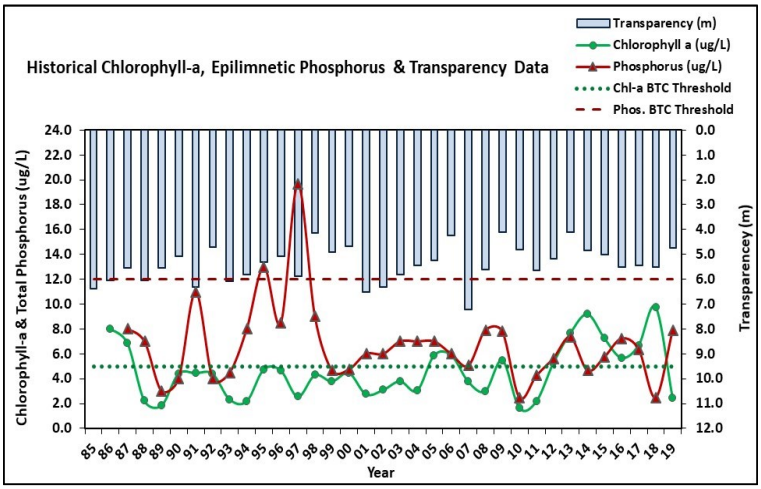
NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.
Chloride: > 230 mg/L (chronic)
E. coli: > 88 cts/100 mL – public beach
E. coli: > 406 cts/100 mL – surface waters
Turbidity: > 10 NTU above natural level
pH: between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

NH Median Values: Median values for specific parameters generated from historic lake monitoring data.
Alkalinity: 4.5 mg/L
Chlorophyll-a: 4.39 ug/L
Conductivity: 42.3 uS/cm
Chloride: 5 mg/L
Total Phosphorus: 11 ug/L
Transparency: 3.3 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 show low variability.	Transparency	Stable	Trend not significant; data moderately variable.
			Phosphorus (epilimnion)	Stable	Trend not significant; data highly variable.





HOW TO READ YOUR VLAP REPORT

MORPHOMETRIC DATA[1]

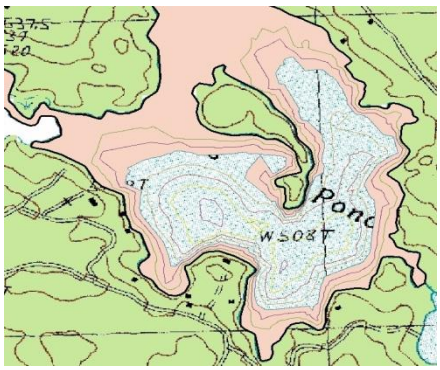
Watershed Area (Ac.):	17,664	**Max. Depth (m):**	11.3	**Flushing Rate (yr^{-1})[2]:**	12.9	**Year**	**Trophic Class**
Surface Area (Ac.):	179	**Mean Depth (m):**	3.7	**P Retention Coef[3]:**	0.37	1992	MESOTROPHIC
Shore Length (m):	4,000	**Volume (m^3):**	2,675,000	**Elevation(ft):**	508	2009	EUTROPHIC

TROPHIC CLASSIFICATION[4]

KNOWN EXOTIC SPECIES[5]

Variable Milfoil

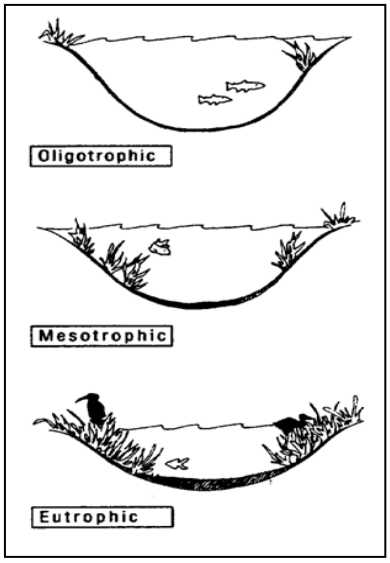
1. LAKE MORPHOMETRY: refers to the size and shape of the lake basin, and can affect the physical, chemical and biological processes of the lake. A lake's morphometry can be best described by a bathymetric map.



2. FLUSHING RATE: refers to the number of times a lake flushes (volume of water equal to the lake's volume passes through the lake) in one year, expressed to the nearest 0.1 times/year. Lakes have low flushing rates compared to rivers and streams, which are constantly replenishing their water volume, which leaves lakes more vulnerable to the accumulation of pollutants and nutrients.

3. PHOSPHORUS RETENTION COEFFICIENT: The phosphorus retention coefficient can be defined as the fraction of inflowing phosphorus that is not lost through outflow and retained within the water body.

4. TROPHIC CLASSIFICATION: generally refers to the biological production, or how aged a lake is. NH uses four indicators to determine a lake's trophic status. Those are dissolved oxygen, chlorophyll-a, transparency, and vascular aquatic plant growth. Oligotrophic lakes tend to be deeper, larger lakes with clear water, rocky or sandy shorelines, low phosphorus enrichment, limited rooted plant growth, low algal growth and adequate dissolved oxygen throughout. Mesotrophic waters are an intermediate category with characteristics between oligotrophic and eutrophic water bodies. Eutrophic waters are smaller, shallower ponds with mucky bottoms, extensive rooted plant growth, and depleted dissolved oxygen in bottom waters; often tea-colored and sometimes murky from planktonic algal growth.



5. EXOTIC SPECIES: plants and/or animals that are not native to a specific region and once introduced, typically have no natural enemies to keep populations in check. In lakes, exotic aquatic plants, such as Variable milfoil, can quickly out-compete native plants for resources and have detrimental effects on the lake ecosystem. Currently, 89 lakes/ponds in NH are infested with an exotic species. For more information on Exotic Species in NH's lakes visit http://des.nh.gov/organization/divisions/water/wmb/exoticspecies/index.htm

Variable milfoil (*Myriophyllum heterophyllum*)

WATERBODY REPORT CARD TABLES

Water Quality Assessment Outcomes

Since the *Clean Water Act* took effect in 1987, it requires that every state submit two surface water quality assessment documents to the EPA every two years. Included in these reports is a list of waters (Section 303d list) that do not meet water quality standards thus, they are impaired or not supporting their designated uses.

Designated Use	Impaired	Parameter	Category
This represents the uses a waterbody (lake, river, estuary) should support. There are seven designated uses: aquatic life, fish consumption, shellfish consumption, drinking water, primary contact recreation, secondary contact recreation, and wildlife.	If data collected for a specific parameter routinely do not meet accepted criteria, then a waterbody is considered to be impaired for that designated use. Alternately, if data meet accepted criteria, the waterbody fully supports the designated use.	The physical, chemical or biological parameter used to assess whether a waterbody supports a specific designated use.	Depicts how well the designated use is supported based on thresholds assigned to the parameter. There are several categories from fully supported to severely impaired. Category ratings of Bad and Slightly Bad indicate the use is impaired. A category rating of Encouraging indicates additional data are needed. Category ratings of Good or Very Good mean data support the use.

Parameter	Thresholds
pH	6.5 – 8.0
Phosphorus (total)	< 8 ug/L Oligotrophic ≤ 12 ug/L Mesotrophic ≤ 28 ug/L Eutrophic
Chlorophyll-a	< 3.3 ug/L Oligotrophic ≤ 5.0 ug/L Mesotrophic ≤ 11.0 ug/L Eutrophic
Dissolved Oxygen	> 6.0 mg/L Class A waters > 5.0 mg/L Class B waters > 75% Sat. Class A & B waters
E. coli	Single sample < 88 cts/100 mL Public beaches Geometric mean < 47 cts/100 mL Public beaches Single sample < 153 cts/100 mL Class A waters Single sample < 406 cts/100 mL Class B waters Geometric mean < 47 cts/100 mL Class A waters Geometric mean < 126 cts/100 mL Class B waters

HOW TO READ YOUR VLAP REPORT

OBSERVATIONS AND RECOMMENDATIONS SECTION

Chlorophyll-a: A photosynthetic pigment found in plants, including algae, and measured to estimate amount of algal growth in a lake system. Elevated chl-a levels indicate excessive algal growth typically caused by too many nutrients (phosphorus).

Conductivity/Chloride: Conductivity measures the ability of water to carry an electrical current. It is determined by the number of ions and minerals present. Chloride ion is naturally occurring in seawater, but less so in freshwaters. NH's soft water has naturally low conductivity and chloride values. Elevated conductivity and chloride may indicate pollution from such sources as road salting, septic systems, wastewater treatment plants, or agriculture runoff.

Color: A visual measure of the color of water. This color is generally caused by decaying organic matter or by naturally occurring metals in the soils, such as iron and manganese. A highly colored lake generally has extensive wetlands along the shore or within the watershed, and often a mucky bottom, conditions often associated with eutrophic waters.

E. coli: *E. coli* is a natural component of the large intestines of humans and other warm-blooded animals. *E. coli* is used as an indicator organism for bacteriological monitoring because it is easily cultured and its presence in the water in defined amounts indicates that fecal matter MAY be present.

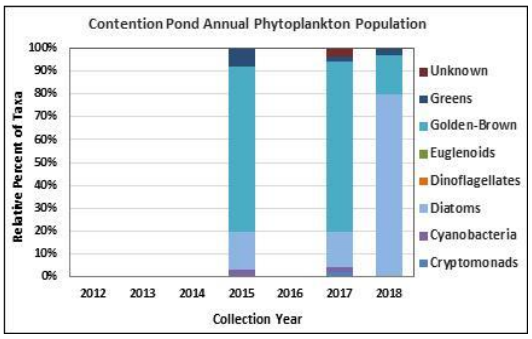
Total Phosphorus: Total phosphorus is a measure of all the phosphorus forms present in the water, including both inorganic and organic forms. In freshwater, it is the limiting nutrient that determines the amount of algal growth that can occur. Too much phosphorus can lead to excessive algal and cyanobacteria populations.

Transparency: Transparency, a measure of water clarity, is affected by the amount of algae, color, and particulate matter within a lake. It is measured using a 20 cm black and white Secchi disk.

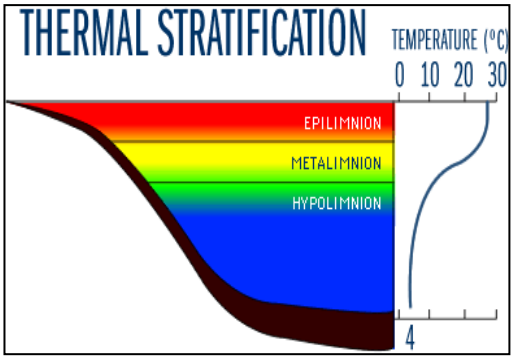
Turbidity: Turbidity in the water is caused by suspended matter (such as clay, silt, and algae) that cause light to be scattered and absorbed, not transmitted in straight lines through water.

pH: pH is a measure of the hydrogen ions in the water or, in general terms, the acidity. New Hampshire lakes historically have slightly acidic pH levels due to acid rain and granite bedrock lacking in minerals that counteract inputs of the acid rain. Lake pH is important to the survival and reproduction of fish and other aquatic life.

PHYTOPLANKTON: Microscopic plants, or algae, form the basis of the lake's food chain. They need sunlight and nutrients to grow and are typically found in the warmer epilimnetic and metalimnetic waters. The type of phytoplankton present in a lake can be used as an indicator of general lake quality and shifts in the dominant algal population over time can be an early warning to shifts in the aquatic ecosystem. Diatoms and golden-brown algae are typically found in the spring and fall, while green algae and cyanobacteria are more common in mid to late summer. An abundance or shift to cyanobacteria dominance over time may indicate excessive phosphorus or that the lake ecology is out of balance. Diatoms and golden-brown algae are typical of NH's less productive lakes. ***Note: Phytoplankton graphics are not included in all lake reports.***



DISSOLVED OXYGEN AND TEMPERATURE PROFILE



Depicts the amount of oxygen dissolved in water at various temperatures from the lake's surface to bottom. Dissolved oxygen (DO) in lake water is used by all forms of aquatic life and can help to assess the "health" of the lake ecosystem. NH's lakes typically mix twice annually; spring and fall. Spring turnover of lake water occurs after ice out as warmer air temperatures heat up surface waters. Eventually, the lake becomes thermally stratified with a layer of warm surface water overlying layers of dense cold water. Eventually three distinct layers form called the epilimnion, metalimnion, and hypolimnion, and waters in these layers do not mix freely during summer months. Layers can be determined by looking at the DO/Temperature profile and graphic. Typically, DO is greater in the epilimnion due to wind and wave action mixing atmospheric oxygen into surface waters, as well as algal growth producing oxygen as a by-product of photosynthesis. As you move into the metalimnion and hypolimnion, DO can decrease to low levels as these layers do not get re-oxygenated and microbial activity utilizes DO to break down organic matter in bottom sediments. When fall arrives and colder air temperatures cool surface waters, fall turnover occurs, mixing the thermal layers until they are a uniform temperature and DO levels recover at deeper depths. Understanding DO and temperature patterns is important to lake management. These patterns reflect and influence lake productivity, physical properties, phosphorus cycling, and fish and aquatic animal populations.

Note: Dissolved oxygen and temperature profiles are not included in all lake reports.

WATER QUALITY TREND ANALYSIS: Understanding how lake water quality has changed over time can identify potential problems and help guide watershed management activities. Statistical analyses are conducted on various parameters where ten or more consecutive years of data are available. Specifically, linear regression analyses are utilized to determine if the annual mean value of a parameter has changed significantly, increased or decreased, over time. A parameter has significantly changed if the significance value is less than 0.05, meaning there is 95% confidence that the values have increased or decreased. If there is not a significant change, then we look at the coefficient of variation to determine how stable or variable are the data. The graphics depict the average annual value for chlorophyll-a, transparency, and epilimnetic total phosphorus, pH and conductivity. A significant increase in chlorophyll-a, total phosphorus and conductivity means that data are degrading or worsening over time; while a significant decrease means the data are improving over time. The opposite holds true for pH and transparency; a significant increase means the data are improving, while a significant decrease means the data are degrading or worsening. Total phosphorus and chlorophyll data are compared with the threshold associated with the lake's best trophic classification (BTC). Values above the thresholds are generally considered poor, while values below the thresholds are considered good (see page 1 for parameter thresholds).