

ENVIRONMENTAL Fact Sheet



29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

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Layman's Guide for Measuring a Lake's Trophic Status

The trophic status of a lake or pond is a general concept that seeks to quantify the productivity of a waterbody. Productivity can be determined by several factors, and consequently multiple methods exist for determining a lake's trophic status. Despite different methodologies, determining trophic status is a useful way to classify and describe individual waterbodies.

Trophic Status of New Hampshire Lakes*		
Class	Number of Lakes	Area of Lakes
Oligotrophic	25.6%	67.0%
Mesotrophic	50.1%	26.5%
Eutrophic	21.6%	6.0%
Not classified/ Other	2.7%	0.5%

*Only includes waterbodies sampled under NHDES's Lake Trophic Survey Program, 1975 - 2013

Categories

Oligotrophic: Larger, deeper lakes with clear water, rocky or sandy shorelines, low phosphorus enrichment, limited rooted plant growth, low algal growth, and adequate dissolved oxygen throughout. Low productivity.

Mesotrophic: An intermediate category with characteristics between the other two groups. Medium productivity.

Eutrophic: Smaller, shallower ponds with mucky bottoms, extensive rooted plant growth and depleted dissolved oxygen in the bottom waters; often tea-colored and sometimes murky from planktonic algal growth. High productivity.

Indicators

Many different indicators have been used by scientists to describe trophic state. A few of the more commonly used indicators are presented below, along with ranges of values that depict the three trophic categories for New Hampshire lakes. Values for the first three indicators are from the lake nutrient criteria first developed for use in the 2010 assessment of lake quality. The values are more restrictive than generally accepted values for lakes worldwide. A given lake may fall into more than one trophic category, depending on the indicator used.

1. Total Phosphorus

In New Hampshire lakes, phosphorus is the limiting nutrient that controls aquatic plant growth. Phosphorus values in New Hampshire lakes range from less than 0.001 mg/L to 0.121 mg/L, with a median value of 0.012 mg/L.

<u>Phosphorus (mg/L)</u>	<u>Trophic Category</u>
< 0.008	oligotrophic
0.008 - 0.012	mesotrophic
> 0.012	eutrophic

2. Water Clarity

The water clarity or Secchi disk transparency is a measure of the depth one can see into a lake. It ranges from less than a foot to over 40 feet in New Hampshire lakes with a median value of 10 feet.



<u>Water Clarity (ft.)</u>	<u>Trophic Category</u>
> 14	oligotrophic
10 - 14	mesotrophic
< 10	eutrophic

3. Chlorophyll-*a*

Chlorophyll-*a* is a measure of the amount of planktonic algae in the water. Chlorophyll values in New Hampshire lakes range from less than one to over 100 ug/L with a median value of 4.6 ug/L.

<u>Chlorophyll (ug/L)</u>	<u>Trophic Category</u>
< 3.3	oligotrophic
3.3 – 5.0	mesotrophic
> 5	eutrophic

4. Rooted Plant Growth

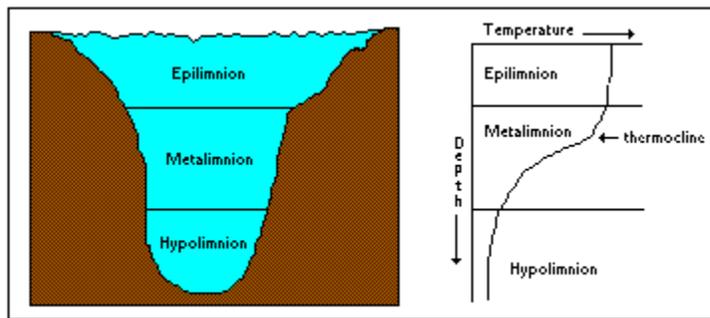
In general, rooted plant growth is more reflective of substrate type, water depth and wind and wave action than it is of in-lake nutrient levels. Most rooted plants obtain most of their nutrient requirements from the sediment and not directly from the water. However, to the extent that shallow, weedy, mucky-bottomed lakes are considered eutrophic, rooted plant growth can be used as a trophic indicator. A subjective evaluation of the amount of plant growth is used for the evaluation below.

<u>Plant Growth</u>	<u>Trophic Category</u>
Sparse to scattered plant growth around the shore with perhaps a few small patches	oligotrophic
Plants present along most of the shoreline with some thick patches	mesotrophic
Floating or emergent plants covering over 1/3 the surface area and/or submerged plants over most of the visible bottom	eutrophic

5. Dissolved Oxygen

This criterion can be used only for lakes that are deep enough to develop a cold bottom layer of water (hypolimnion) during the summer. The extent of dissolved oxygen depletion in the hypolimnion is a measure of decomposing organic matter in the bottom waters and in the sediments, and represents an indirect measure of the biological production in the lake.

<u>Dissolved Oxygen (mg/L)</u>	<u>Trophic Category</u>
> 1 throughout the lake	oligotrophic
< 1 in less than half of the hypolimnion volume	mesotrophic
< 1 in more than half of the hypolimnion volume	eutrophic



Thermal Stratification of Deep N.H. Lakes in Summer

Changing Trophic State

Lakes generally change trophic state very slowly, gradually becoming more eutrophic over time, where time is measured in thousands of years. This process is called natural eutrophication. Often the process is greatly accelerated due to human activity (called cultural eutrophication). Cultural eutrophication can be controlled by managing human activity within the watershed and on the lake. Watershed controls that reduce phosphorus runoff and erosion into a lake will help protect the lake and slow its movement toward a more eutrophic state. For lake protection tips, see <http://des.nh.gov/organization/commissioner/pip/factsheets/bb/documents/bb-9.pdf>.

How does NHDES determine trophic status?

NHDES considers dissolved oxygen concentration, water clarity (Secchi disk transparency), aquatic plant abundance, and chlorophyll-*a* concentration when determining trophic status. The trophic classification for New Hampshire's lakes and ponds was revised in 1989, and the 1988-sampled lakes were the first to be classified under the new system. The purpose of the revision was to provide for equal points under each attribute and to reduce the impact of the bottom dissolved oxygen criterion. Unlike in the previous system, the extent of oxygen depletion is evaluated in the new system. The method was once again modified and updated in 2013 to refine the point scale associated with aquatic macrophyte abundance.

The trophic points assigned under each of the four criteria are listed below, as well as the total points and classifications. Lakes with no hypolimnion are not rated under the bottom dissolved oxygen criterion. The protocol for rating lakes under Secchi disk transparency when the disk is visible on the bottom (V.O.B.) is to select the next higher rating unless field data sheet comments suggest otherwise. For example, a 2.2 V.O.B. reading would receive two trophic points under the 3 to 5 meter category in the ranking shown below.

This rating will be calculated using a mean of the data collected on the three separate sample dates.

TROPIC CLASSIFICATION SYSTEM FOR NEW HAMPSHIRE LAKES AND PONDS

Trophic Points

- 1. Summer Bottom Dissolved Oxygen:**
 - a. D.O. >4mg/L0
 - b. D.O. = 1 to 4 mg/L & hypolimnion volume ≤10% lake volume1
 - c. D.O. = 1 to 4 mg/L & hypolimnion volume >10% lake volume2
 - d. D.O. <1mg/L in <1/3 hypo. volume & hypo. volume ≤10% lake volume3
 - e. D.O. <1mg/L in ≥1/3 hypo. volume & hypo. volume ≤10% lake volume4
 - f. D.O. <1mg/L in <1/3 hypo. volume & hypo. volume >10% lake volume5
 - g. D.O. <1mg/L in ≥1/3 hypo. volume & hypo. volume >10% lake volume6

- 2. Summer Secchi Disk Transparency:**
 - a. > 7m0
 - b. > 5m – 7m1
 - c. > 3m – 5m2
 - d. >2m – 3m3
 - e. >1m – 2m4
 - f. >0.5 – 1m5
 - g. ≤0.5m6

- 3. Aquatic Vascular Plant Abundance:**
 - a. Sparse0
 - b. Scattered.....1
 - c. Scattered/Common2
 - d. Common.....3
 - e. Common/Abundant4
 - f. Abundant5
 - g. Very Abundant.....6

- 4. Summer Epilimnetic Chlorophyll-a (mg/m³):**
 - a. <40
 - b. 4 - <8.....1
 - c. 8 - <122
 - d. 12 - <18.....3
 - e. 18 - <244
 - f. 24 - <32.....5
 - g. ≥326

<u>Trophic Classification</u>	<u>Trophic Points</u> <u>Stratified</u>	<u>*Unstratified</u>
Oligotrophic	0-6	0-4
Mesotrophic	7-12	5-9
Eutrophic	13-24	10-18

*Lakes without hypolimnions are not evaluated by the bottom dissolved oxygen criterion.

For More Information

For more information about lake water quality, please visit the NHDES web page at http://des.nh.gov/organization/divisions/water/wmb/lakes/lake_water.htm.