Sources of Information and Explanation of Data

The sources of the data or the methodologies for computing the data that is presented in the scanned Lake Trophic Survey reports are explained here in the order presented in the reports. In addition, generalized explanations of the data are provided to assist the reader in understanding a particular lake of interest.

I. Lake Trophic Data

The first two pages on each lake presents the trophic data and trophic classification for the lake. Following is the explanatory information for this data.

A. Morphometric Data

1. Lake: The name of the lake, pond, or reservoir, as given in the New Hampshire State Planning Project publication (NHSPP, 1964). Alternate names are provided in the 'Comments' section on the second page.

2. Town: The municipality, in which the largest part of the waterbody is located, from NHSPP, 1964.

3. County: The county in which the water body (or largest portion) is located, from NHSPP, 1964.

4. River Basin: The major river basin in which the water body is located, from Newell (1963, 1970, 1972) or determined from topographic maps. Five major river basins are used: Androscoggin, Saco, Connecticut, Merrimack and Coastal.

5. Latitude: The latitude of the deep spot of the lake as determined in the field by GPS or in the office from a USGS topographic map.

6. Longitude: The longitude of the deep spot of the lake as determined in the field by GPS or in the office from a USGS topographic map.

7. Elevation: The elevation of the water body above sea level, to the nearest 1 foot, from the NHDES *Official List of Public Waters in New Hampshire* (NHDES, 1994). Elevation influences trophic state primarily by its association with temperature, precipitation, and the length of the growing season. Higher altitude lakes also tend to have smaller watersheds, resulting in a greater percentage of their water input coming from direct precipitation. They are, therefore, more susceptible to acid precipitation effects than low elevation lakes.

8. Shore Length: The length of the shoreline to the nearest 100 meters, from NHSSP, 1964. The value includes the shoreline length of islands over five acres in area. If not available, the shore length was determined by tracing the outline of the lake from an appropriate USGS topographic map on a digitizing tablet.

9. Watershed Area: The area of the watershed to the nearest 0.1 hectare, from Cowing and Lash (1975). If not available, it was determined planimetrically from the appropriate USGS topographic map. If the area was determined by this agency, the value includes the area of the lake. Generally, the size of the watershed determines the volume of runoff entering a lake, thereby affecting the flushing rate.

10. % Watershed Ponded: The total area of all the lakes and ponds in the watershed above the lake being considered, divided by the area of the watershed (minus the area of the lake being considered), and expressed to the nearest 0.1%. Lakes are generally considered to be phosphorus traps, sedimenting a percentage of the incoming phosphorus. If a lake has one or more upstream lakes in its watershed, these upstream lakes will retain a portion of the phosphorus loading to the downstream lake. The greater the percent watershed ponded of a lake, the smaller the expected concentration of phosphorus from surface runoff, assuming all other factors are equal. Dillon (1975a) considers this parameter when calculating the phosphorus export from watersheds, although Kirchner (1975) found that this parameter accounted for only 1% of the variation in phosphorus export.

11. Lake Area: The surface area of the lake to the nearest 0.01 hectares, from NHDES, 1991. Many of the areas were originally determined in 1934 (NHSPB, 1934) by planimetering available USGS topographic maps. Naturally the accuracy of the data cannot exceed the accuracy of the maps available at that time, and cannot reflect changes that have occurred since that time.

12. Maximum Depth: The greatest depth, to the nearest 0.1 meter, found in the lake during the current survey or in previous surveys, either from the sounding chart or from the temperature/oxygen profile. Between 1986 and 2000, only depths recorded during the current survey were listed in an attempt to provide a means of following trends in sedimentation. In practice, however, we often are not able to complete a comprehensive depth sounding effort and thus may not find the deep spot in any given survey. The year 2001 was the first year since 1985 that we include historical depth readings when listing the maximum depth.

13. Mean Depth: Determined by dividing the lake volume (m^3) by the lake surface area (m^2) and recorded to the nearest 0.1 meter. Rawson (1955) found that mean depth was the primary factor in separating oligotrophic and eutrophic lakes. It is the most significant feature affecting the summer thermal stratification, and thus the ability of nutrient rich bottom waters to reach the surface layers. It also affects the percentage of lake water in the photic zone for phytoplankton growth, and the amount of sediment in the photic zone for rooted macrophyte growth.

14. Volume: The volume of water in a lake, given to the nearest $500m^3$. The areas of the depth contours of a lake's bathymetric chart were determined with a planimeter. The volume between two successive contours was calculated by:

$$1/3\ h(A_1 + A_2 + \sqrt{A_1 A_2})$$

where h is the contour interval (m) and A_1 and A_2 are the areas of the two contours (m^2). The volume below the bottom contour was computed using $1/3\ h_N A_N$ where A_N is the area of the bottom contour and h_N is the distance between the bottom contour and the maximum depth. The total lake volume is the sum of the successive contour volumes. Volume affects the trophic status largely by determining the lake's ability to dilute incoming water, thereby reducing nutrient concentrations.

15. Relative Depth: A ratio of the maximum depth to the mean diameter of a lake, expressed as a percentage to the nearest 0.1%. It is calculated by: (maximum depth x 50 x $\sqrt{\pi}$) / $\sqrt{A}$, where A is the lake area. The value is a measure of the extent of shallow water, which is important both for the likely abundance of rooted macrophytes, and for the potential of mixing sediment nutrients into the overlying water by wind, waves, and motor boat activity. The smaller the ratio the greater the extent of shallow water. This value is sometimes referred to as the "bottom slope".

16. Shore Configuration: A ratio of the length of the shoreline divided by the circumference of a circle having an area equal to the area of the lake, recorded to the nearest 0.01. It was called "development of shoreline" by Hutchinson (1957) and is defined as: shore length/$2\sqrt{\pi A}$. This is a measure of the irregularity of the shoreline. A value of one is a lake that is a perfect circle. As the ratio increases, there is an increase in contact between land and water, generally resulting in greater the potential for rooted macrophyte growth and for enrichment from nearshore development.

17. Areal Water Load: The total volume of water entering a lake in a year (m^3/yr), divided by the lake surface area (m^2), and expressed to the nearest 0.01 m/yr. The total water inflow was estimated by adding the annual runoff from the drainage area to the input directly to the lake from precipitation minus evaporation. In other words, the yearly water input was:

$$A_d \cdot r + A_o (P_r - E_v)$$

where A_d is the area of the drainage basin (minus the lake area) (m^2), r is the average annual areal runoff (m/yr), A_o is the lake area (m^2), P_r is the average annual precipitation (m/yr), and E_v is the average annual evaporation (m/yr). The methodology for doing these calculations is described by Dillon (1975a), and the data for annual runoff, precipitation, and evaporation were obtained from Randall (1996). It is cautioned that this method is only an estimate, and that the actual measurement of the water budget is greatly preferred. This value is used in many phosphorus-loading models relating phosphorus inputs to in-lake phosphorus and algal concentrations.

18. Flushing Rate: The number of times a lake flushes (i.e., a volume of water equal to the lake's volume passes through the lake) in one year, expressed to the nearest 0.1 times/year. It is calculated by dividing the total volume of water entering a lake in a year (as estimated in #17 above) by the lake volume. The reciprocal of the flushing rate is called the "water renewal

time" or the "hydraulic detention time", and is the number of years required to completely replace the water volume of a lake by incoming water, assuming complete mixing. Areal water load, flushing rate, and hydraulic detention time all influence the trophic state of a lake by determining the duration that incoming nutrients are available for algal growth under the quiescent conditions of a lake. The importance of flushing rate to trophic level was pointed out by Dillon (1975b) and was incorporated by Vollenweider (1975, 1976) in his revised model relating phosphorus loadings to trophic conditions. A rapid flushing rate is also advantageous in the recovery of a lake that has undergone nutrient diversion.

19. Phosphorus Retention Coefficient: The fraction of the inflowing phosphorus that is not lost through the outflow, i.e., it is added to the sediment each year. It is recorded here to the nearest 0.01. It is determined empirically by its various relationships to the areal water load or the flushing rate (Larsen and Mercier, 1976). For this study, the relationship developed by Kirchner and Dillon (1975) was used:

$$R = .426e^{(-.271qs)} + .574e^{(-.00949qs)}$$

where q_s is the areal water load. The greater the R, the greater the amount of phosphorus retained by the lake, some of which may later be made available for plant growth.

20. Lake Type: The type of water body, from NHDES, 1991. Three types are listed: natural, natural raised by damming, and artificial.

B. Biological Data

The winter and summer biological data is presented in this section of the Lake Trophic Data sheet, with the summer data reflecting the trophic state of the lake. Phytoplankton are microscopic algae that are found suspended in the water column. The dominant phytoplankton listed are from the population of net plankton as collected with an 80u mesh plankton net. The phytoplankton abundance is no longer counted, but historically was determined from a whole-water composite sample of the epilimnion, as enumerated by the Utermohl method using an inverted microscope. This analysis was terminated in 1994 due to the loss of federal Clean Lakes funds. Colonies, filaments and single cells are all counted as a single standard unit in both procedures. Chlorophyll-a is a measure of the total amount of planktonic algae in the water, as measured in the epilimnion composite sample. Zooplankton are microscopic invertebrate animals that are found suspended in the water column. Rotifers and microcrustacea are the two most common groups of freshwater zooplankton. Vascular plant abundance is a subjective evaluation of the abundance of rooted (mostly) plants in the pond as a whole as described by seven abundance terms (see summer field procedures). Secchi disk is a measure of the clarity of the water. In general, the water clarity is inversely related to chlorophyll: as the algae level increases, the water clarity decreases. The exception is when shoreland erosion occurs and the water clarity is reduced by suspended silt particles rather than algal cells.

In general, the genera of dominant aquatic plants and animals observed in these surveys are found in a range of lake types, and are therefore poor indicators of trophic state as

individuals. However, the amount of algae, as measured by chlorophyll-a, is an excellent trophic state indicator. The number of zooplankton can be a trophic state indicator, but there is a wide range of numbers within each trophic category for New Hampshire lakes, as evidenced by the large overlap in the numbers defining the categories. The table below presents classifications for some of the biological parameters.

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Cholorophyll-a (ug/L)	0-4	4-15	>15
Rotifers (cells/L)	0-100	25-250	>100
Microcrustacea (cells/L)	0-100	25-200	>50
Secchi Disk (m)	>4.0	1.8-4.0	<1.8
Zooplankton	0-200	50-500	>250

In addition to the above data, other biological data provide insights into trophic conditions. Blue-green algae, such as *Anabaena, Anacystis,* or *Aphanizomenon*, as the dominant phytoplankton usually indicate high nutrient levels. Conversely, phytoplankton dominated by diatoms (e.g., *Asterionella, Tabellaria*) often indicate oligotrophic conditions. Dominant phytoplankton representing a large percentage of the total phytoplankton population indicates low species diversity. This generally means that conditions are not favorable for most algae growth, either because of extremely low (very oligotrophic) or extremely high (very eutrophic) nutrient levels.

The presence of rooted vascular plants is usually dependent on substrate type, water depth, and wind or wave action. Since they can generally obtain their nutrient requirements through their roots in the mud, the plants do not indicate in-lake nutrient levels (i.e., trophic state). Abundant rooted plant growth, however, usually indicates a mucky bottom and shallow water, conditions often associated with a eutrophic lake. *Eriocaulon* (pipewort) is the one vascular aquatic plant that is often found in clear water in sandy bottoms.

To provide an understanding of how a particular lake compares to other New Hampshire lakes, the following table summarizes key biological parmeters using the most recent summer data for all the state's lakes surveyed since 1975.

Parameter	# of Lakes	Minimum	Maximum	Mean	Median
Chlorophyll-a (ug/L)	776	0.19	143.80	7.16	4.58
Rotifers (cells/L)	633	<1	13,516	-	78
Microcrustacea (cells/L)	633	<1	1584	-	65
Secchi Disk (m)*	663	0.40	13.0	3.7	3.2
Zooplankton (cells/L)	633	<1	13,807	-	182

*doesn't include 'visible on bottom' readings

The amount of dissolved oxygen in the bottom waters of a thermally stratified lake in the summer is indirectly related to trophic state. The bottom oxygen is used up by decomposing organic matter, including that which is currently being produced in the sun-lit surface waters and settling to the bottom, that which is carried into the lake by wind or tributaries, and that which is already in bottom muds from previous years. The extent of oxygen depletion is a measure of both the amount of organic matter (oxygen demand) and the volume of the bottom (hypolimnetic) water (oxygen availability).

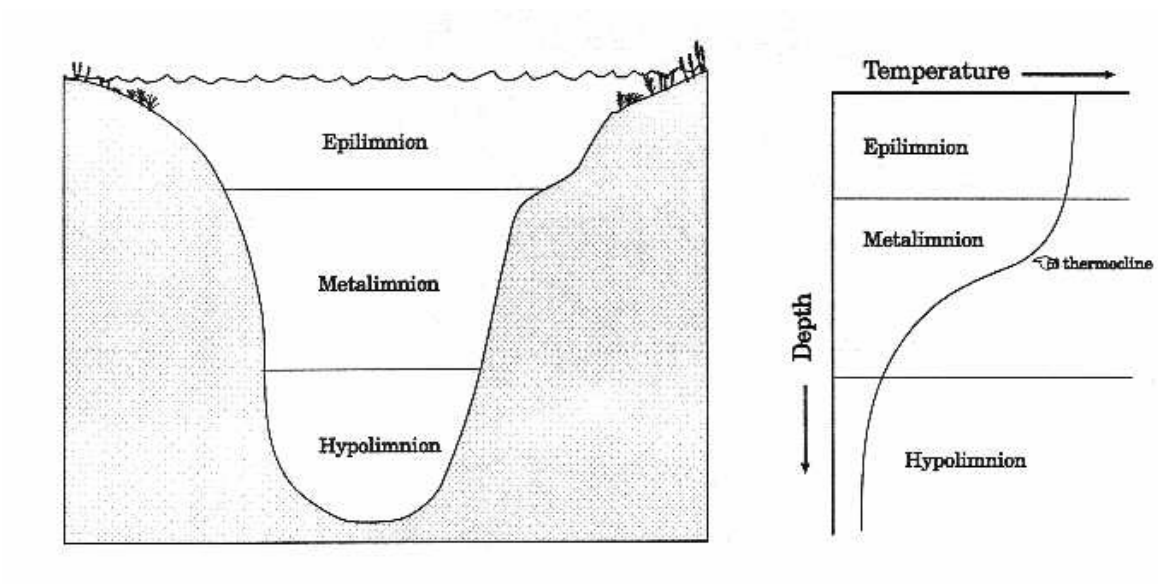
The *E. coli* bacteria level is not a measure of trophic status. It is used as an indicator of human sewage but elevated numbers can occur in the presence of ducks, beaver or any other warm-blooded animal. Waters with *E. coli* levels of less than 406 are considered suitable for swimming, except at public beaches where, because of the proximity of many people, the value should be less that 88. Somewhat higher levels are not considered hazardous unless shown to be caused by human sewage.

C. Summer Thermal Stratification

If a lake is sufficiently deep, it will thermally stratify during the summer, with a warm, well-mixed surface layer, a cold, undisturbed bottom layer, and a transitional layer in between, exhibiting a rapid decrease in temperature with depth. The figure below depicts these thermal layers.

Figure 1

Diagrammatic Sketch Depicting Thermal Stratification of Temperate Lakes in Summer



Although the term thermocline is often used interchangeably with metalimnion, it specifically refers to the plane of maximum temperature decrease. Diagrammatically, this is the point of inflection, or where the temperature profile curve goes from concave

upward to concave downward (mathematically, it is where the second derivative is equal to zero).

For the purposes of this report, "stratified" means a thermocline is present (a hypolimnion may or may not be present); "weakly stratified" means there is a several degree temperature difference (generally 5° C or more) between surface and bottom waters but there is no thermocline; and "not stratified" means that water temperatures are essentially the same from top to bottom.

Thermal stratification by itself is not a trophic state indicator. However, because it impedes mixing between the surface and bottom waters, it does not allow the hypolimnion to be replenished with dissolved oxygen from the surface. In general, given two hypolimnions of equal size, the one with the least dissolved oxygen is found in the more productive (more eutrophic) lake.

D. Chemical Data

The winter and summer chemical data is presented in this portion of the lake trophic data sheet. A blank space denotes that no sample was collected. Phosphorus is the only chemical parameter that directly relates to trophic status, with the following classifications.

Total Phosphorus (mg/L):	<0.010	Oligotrophic
	0.10-0.20	Mesotrophic
	>0.020	Eutrophic

Table 1 on the following page lists the laboratory procedures used, and Table 2 portrays the range, mean, and median values of the chemical parameters for the most recent data on lakes surveyed since 1976. By using this table, a value for a particular lake can be compared to an average value for many New Hampshire lakes. Table 3 provides descriptive terms for various concentrations of some of the key chemical parameters as well as two biological parameters. These are general categories and may not be directly related to water quality criteria.

1. pH: A measure of the hydrogen ions in the water or, in general terms, the acidity. New Hampshire lakes historically have had pH values in the mid to upper sixes in most cases. As the pH decreases to between 5 and 6, many fish and other aquatic organisms become stressed, and some species disappear. Little or no fish life remains when the pH falls much below 5.

2. Alkalinity: A measure of the buffering capacity of a lake to neutralize acid inputs. This value is now often referred to as A.N.C., or the 'acid neutralizing capacity' of a lake. New Hampshire has historically had low alkaline waters because of a granitic bedrock. There is some evidence that alkalinity has decreased in recent years. If the buffering capacity of a lake is lost, conditions for aquatic life would be dramatically and adversely altered by acid rain inputs.

3. Nitrite + Nitrate Nitrogen: A measure of the major inorganic species of nitrogen found in lake waters, and often used as a nitrogen source by algae. The detectable limit of the analytical method used is 0.05 mg/L, a level which can still support algal growth. The combined nitrite (NO_2) plus nitrate (NO_3) nitrogen were measured and reported as one value prior to 1987 and after 1991. For the period 1987 through 1991, nitrate was analyzed on a Dionex analyzer and only nitrate nitrogen was reported. In New Hampshire lakes, nitrite nitrogen is extremely low so that $NO_2 + NO_3$ is essentially the same as NO_3.

4. Total Kjeldahl Nitrogen: A measure of inorganic ammonia nitrogen and total organic nitrogen. Higher values generally indicate more eutrophic conditions.

Table 1

Laboratory Methods

Parameter	Method
pH	Electrometric
Alkalinity	Titration, electrometric, Gran plot
Specific conductance	Wheatstone bridge type meter
Apparent color	Colorimetric, platinum-cobalt, unfiltered
Total phosphorus	Colorimetric, persulfate digestion, manual
Total Kjeldahl nitrogen	Autoanalyzer with block digester
Nitrite + Nitrate nitrogen	Lachat colorimetry, automated cadmium reduction
Sulfate	Dionex analyzer – ion chromatography
Chloride	Lachat colorimetry, automated ferric cyanide
Calcium	Atomic absorption, direct aspiration
Magnesium	Atomic absorption, direct aspiration
Sodium	Atomic absorption, direct aspiration
Potassium	Atomic absorption, direct aspiration
Chlorophyll-a	Spectrophotometric, trichromatic

Table 2

Chemical Characteristics of New Hampshire Lakes and Ponds
Summer Epilimnetic Values*

Parameter*	# of Lakes/Stns.	Minimum	Maximum	Mean	Median
pH (units)	780	4.3	9.3	**6.5	6.6
Alkalinity	781	-3	85.9	6.6	4.9
Nitrite + nitrate nitrogen	722	<0.02	1.51	-	<0.05
Total Kjeldahl nitrogen	652	<0.10	2.40	-	0.35
Total Phosphorus	772	<0.001	0.121	-	0.012
Conductivity (umhos/cm)	768	13.1	696	59.4	40.0
Color (units)	759	<5	250	-	28
Magnesium	767	0.05	5.38	0.69	0.54
Calcium	768	<1	33	-	2.6
Sodium	763	<1	108	-	3.1
Potassium	764	<0.4	4.4	-	0.5
Chloride	742	<2	198	-	4
Sulfate	590	<1	21	-	4
CSI (units)	735	-0.5	7.2	3.6	3.5

**mg/L unless indicated otherwise*
*** average pH reading; not average of hydrogen ion concentration*

Table 3
Water Quality Evaluations

pH (units)

<5	critical (toxic to most fish)
5-6	endangered (toxic to some aquatic organisms)
>6	satisfactory (generally not toxic to biota)

alkalinity (mg/L)

<0	acidified
0 – 2.5	highly vulnerable
2.5 – 10	vulnerable
>10	satisfactory

total phosphorus (mg/L)

<0.010	ideal
0.11-0.20	average
0.21-0.40	more than desirable
>0.040	excessive

color (units)

0-25	clear
25-40	light tea color
40-80	tea color
>80	highly colored

chlorophyll-a (ug/L)

< 4	excellent
4 – 8	satisfactory
8 – 16	more than desirable
>16	nuisance amounts

Secchi disk transparency (feet)

<4	poor
4-15	good
>15	exceptional

5. Total Phosphorus: A measure of all the phosphorus forms present in the water, including both inorganic and organic forms. It, along with nitrogen, is a plant nutrient that determines the amount of a algae growth that can occur. Phosphorus directly relates to trophic state, with values less than 0.010 mg/L generally indicative of oligotrophic waters, values greater than 0.020 mg/L indicative of eutrophic waters, and mesotrophic conditions existing between these two values.

6. Specific Conductance: A measure of the ability of water to conduct an electric current. It is determined primarily by the number of ionic particles present. The soft waters of New Hampshire have traditionally had low conductivity values, and the lakes most sensitive to acid rain tend to group at the low end of the scale.

7. 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.

8. Magnesium, Calcium, Sodium, and Potassium: A measure of the four major cations present in water. Calcium levels are sometimes used to predict the sensitivity of waters to acid rain: Adirondack lakes containing less than 2.5 mg/L calcium are considered to be sensitive (Glass, et. al. 1982).

9. Chloride: The chloride content in New Hampshire lakes is naturally low, generally < 2 mg/L remote from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs.

10. Sulfate: Sulfate is generally not related to trophic status and is naturally low in New Hampshire lakes. A trend of increasing sulfate in a pond that is otherwise undisturbed by man may be an indication of acid rain deposition.

11. TN:TP: The ratio of total nitrogen to total phosphorus. Total nitrogen is the sum of nitrite, nitrate and total Kjeldahl nitrogen. This ratio is used to determine which plant nutrient determines the amount of algae growth (i.e., is the limiting nutrient) when other factors such as light and temperature are sufficient for growth. A value less than 15 indicates nitrogen is limiting; a value greater than 15 suggests phosphorus is limiting (Porcella and Bishop, 1975).

12. Calcite Saturation Index: A measure of the sensitivity of a lake to acid deposition, with increasing CSI values denoting increasing sensitivity to acid inputs. Kooiker (1980) grouped Vermont lakes as follows:

CSI > 4	–	very vulnerable to acid deposition
CSI = 3 to 4	–	moderate vulnerability to acid deposition
CSI < 3	–	low vulnerability to acid deposition

The index was calculated as follows:

$$CSI = -\log_{10} Ca/40{,}000 - \log_{10} alkalinity/50{,}000 - pH + 2$$

E. Trophic Classification

The system used to trophically classify New Hampshire lakes and ponds is outlined on the following page. The system 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 trophic points assigned under each of the four criteria are presented in this section, 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 (see Table 4).

II. Bathymetric Chart

Bathymetric charts indicate water depths in lakes by showing depth contour intervals. Historically, lakes were sounded by recording depths from a continuously recording fathometer (Humminbird LCR 3000 or Sonar 600) onto a lake outline map while completing numerous intersecting transects across the lake. The appropriate depth contours were drawn by hand in the office. Beginning in 2002, depth soundings were electronically recorded by a GPS-based fathometer that records locational information (latitude/longitude) as well as water depth. The data was downloaded into a computer and transferred to an Arcinfo-based program that automatically draws the depth contours. The contour lines may appear more jagged than the free-hand drawn contours of the past but should be more accurate. A computer program was developed to automatically calculate volume and related metrics from the depth contours. Existing bathymetric charts were used when available, and are so noted. The charts are rough approximations of depth contours and should not be used as navigational charts.

III. Field Data Sheet

This sheet provides temperature and dissolved oxygen values with depth at the deep spot of the lake. Dissolved oxygen (DO) depletion in the bottom waters of a stratified lake reflects trophic status to the extent that a more productive (more eutrophic) lake produces more organic matter in the surface waters where sunlight is available. This material ‘rains’ down into the bottom waters upon death, and uses up oxygen during decomposition. Dissolved oxygen depletions can also be caused by the decomposition of materials produced outside the lake (e.g., leaves, pine needles, sediment) and transported to the lake by wind or runoff. This portion of the DO deficit is not indicative of lake trophic state. Organic materials historically deposited in the lake sediment, including both in-lake and outside the lake sources, also contribute to the DO demand in the bottom waters.

The DO/temperature data also determines the suitability of the water for salmonoid fish and, if present, the depth at which they may be located. Trout and salmon generally require temperatures less than 21°C (70°F), and prefer temperatures in the 10 to 15°C (50 to 60°F) range or lower. They must also have dissolved oxygen levels above 4 mg/L.

TABLE -4

TROPHIC CLASSIFICATION SYSTEM FOR NEW HAMPSHIRE LAKES AND PONDS

Trophic Points

1. Summer Bottom Dissolved Oxygen:

a. D.O. >4mg/L 0
b. D.O. = 1 to 4 mg/L & hypolimnion volume ≤10% lake volume 1
c. D.O. = 1 to 4 mg/L & hypolimnion volume >10% lake volume 2
d. D.O. <1mg/L in <1/3 hypo. volume & hypo. volume ≤10% lake volume 3
e. D.O. <1mg/L in ≥1/3 hypo. volume & hypo. volume ≤10% lake volume 4
f. D.O. <1mg/L in <1/3 hypo. volume & hypo. volume >10% lake volume.....5
g. D.O. <1mg/L in ≥1/3 hypo. volume & hypo. volume >10% lake volume 6

2. Summer Secchi Disk Transparency:

a. > 7m 0
b. > 5m – 7m 1
c. > 3m – 5m 2
d. >2m – 3m 3
e. >1m – 2m 4
f. >0.5 – 1m.....5
g. ≤0.5m 6

3. Aquatic Vascular Plant Abundance:

a. Sparse 0
b. Scattered.....1
c. Scattered/Common 2
d. Common.....3
e. Common/Abundant 4
f. Abundant 5
g. Very Abundant.....6

4. Summer Epilimnetic Chlorophyll-a (mg/m^3):

a. <4 0
b. 4 - <8 1
c. 8 - <12 2
d. 12 - <18 3
e. 18 - <24 4
f. 24 - <32.....5
g. ≥32 6

Trophic Classification	Trophic Points Stratified	*Unstratified
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.

The Secchi disk value indicates the depth at which an eight-centimeter diameter black and white disk just disappears from view. The greater the value, the more oligotrophic the lake.

IV. Aquatic Plant Survey

The final two data sheets for each lake provide information on the type, location, and abundance of the major growths of aquatic vascular plants in the lake. The first sheet is a lake outline map with letters indicating the location of specific growths; the second provides a key identifying the plants, and an abundance rating for each of the plants observed and for the lake as a whole. The abundance rating is a subjective evaluation of the abundance of the plants in the lake as a whole, using the following terms and descriptions.

Abundance	Description
Sparse	Few emergent plants observed; submerged plants not obvious
Scattered	Several small patches or one to two large patches or much of the shoreline with a sparsely growing plant; submerged plants not obvious
Scattered/Common	Intermediate between Scattered and Common
Common	Plants around most of the shoreline but not a problem to navigation or several large patches of plants
Common/Abundant	Intermediate between Common and Abundant
Abundant	Plants around the entire shoreline and with large patches in several areas; submerged plants generally visible wherever bottom is visible
Very Abundant	At least ½ of the surface with emergent or floating leaf plants or submerged plants thick throughout the pond; navigation and swimming is impaired in areas due to physical presence of plants

Plant growth is generally dependent on substrate type and water depth, and does not necessarily indicate water quality. However, an abundance of aquatic plants is generally associated with eutrophic conditions.