Lake Water Quality Monitoring Reports

The Lake Water Quality Monitoring Reports contain summaries for variables most often used to measure the water quality of lakes and ponds in Maine. These variables are relatively inexpensive to measure and are easily monitored by volunteers in the Volunteer Lake Monitoring Program and staff of the Department of Environmental Protection. Reported minimum and maximum values are from the entire dataset for each lake.

General Lake Information

The top of the lake report displays the lake name, MIDAS number (lake ID) and sampling station. The "data period" notes which years were in the statewide dataset when the report was generated. If a lake did not have data collected in the most recent year, the most recent data in its report may be older than the year indicated by "data period."

Listed next is town, county, Maine DeLorme Atlas Map number, True Basin number and flushing rate for the lake. The term "true basin" is different from "sampling station" and is used to define areas within a lake that are separated by shallow reefs or shoals and therefore function as separate lakes. There are approximately 50 lakes in the state that have more than 1 True Basin. Flushing rate is the number of years the volume of water in a lake is replaced. For example, a lake with a flushing rate of 2 flushes twice per year. A lake with a flushing rate of 0.5 flushes once every two years. The next row of data contains information about the depth, size, volume and watershed area of the lake.

Secchi Disk Transparency Graphs

Secchi Disk Transparency (SDT) is a measure of the water clarity, or transparency, of the lake. All Secchi disk readings are in meters (1 meter (m) = 3.28 feet). Factors which reduce clarity are algae, zooplankton, water color and silt. Since algae are generally the most abundant of these, measuring transparency indirectly measures algal production. SDT readings can be used to track changes in water quality over time. Transparency values in Maine have varied from 0.2 m (8 inches) to 21.3 m (70 ft), with the current overall average being 5.4 m (17.7 ft). Unless a lake is highly colored (see explanation of water *Color* below) or some other factor is interfering, a transparency of less than 2 m (6.6 ft) indicates excessive nutrients that have resulted in an algal bloom. In Maine, the average SDT readings are related to algal productivity using the following guidelines: Productive = 4 m (13 ft) or less; Moderately Productive = 4 - 8 m (13 - 26 ft); Unproductive = 8 m (26 ft) or greater.

Usually two transparency graphs are displayed in the report. The first graph represents the average SDT readings for each year data are available. The Secchi disk symbols indicate the average SDT value for each monitoring year, and the tick marks represent the minimum and maximum Secchi disk readings for that year. This graph allows tracking of water quality over many years. The second graph is provided only if data were collected the previous year and illustrates the seasonal variation that can occur during the monitored months.

Water Chemistry and Trophic State Parameters

Two tables are displayed in this section of the report. The first contains data averages for each year the lake was monitored. The second contains Overall Summary Values; columns labelled with Avg contain overall averages of all yearly averages; columns labelled either *Min* or *Max* contain lowest (minimum) or highest (maximum) values on record.

COLOR (Color in table): The amount of "color" in a lake refers to the concentration of natural dissolved organic acids such as tannins and lignins which give the water a tea color. Color is measured by comparing a sample of the lake water to Standard Platinum Units (SPU). Colored lakes (>30 SPU) can show reduced transparency readings and increased phosphorus values due to the color. This does not mean the lakes produce more algae. The color simply reduces the transparency such that the reading is not a good measure of algal biomass. Chlorophyll *a* (Chl-*a*) is the best indicator of productivity in colored lakes and should be used if possible. The lake reports display "True Color" data, which is the color of the lake water after all particulates (including algae cells) have been filtered out. True Color ranges from 0 to 197 SPU in Maine lakes, with an average of 20.7 SPU.

ALKALINITY (Alk): Alkalinity is a measure of the capacity of water to neutralize acids. This can also be described as the *buffering capacity* of the water. Alkalinity in lakes is primarily governed by watershed geology, and is affected by the presence of naturally available bicarbonate, carbonate and hydroxide ions. Epilimnetic alkalinity in Maine lakes varies from 0 milligrams per liter (mg/L) to 190.0 mg/L, with an average of 11.7 mg/L.

Epilimnion: the warmer top layer of water in a stratified lake which rests on top of cooler bottom waters. The epilimnion is the section of the lake that usually receives the most light, wind activity and mixing, and contains most of the biological organisms living in the lake. Many water samples are taken from the epilimnion because of its importance to the biota and productivity of the lake.

pH (pH): The pH of a lake reflects how acidic or basic the water is and helps determine which plant and animal species may be present in the lake. The measure of the acidity of water is based on a scale of 1-14, with a value of 7 indicating neutral acidity. A one unit change in pH represents a 10 fold change in the concentration of hydrogen (H+) ions, which determine the acidity of water. The pH of acidic waters is below 7; basic waters have pH values above 7. Epilimnetic pH varies from 4.23 to 9.51 in Maine, with an average of 6.44.

SPECIFIC CONDUCTIVITY (SpCon): Specific Conductivity measures the ability of water to carry an electrical current and is directly related to the dissolved ions (charged particles) present in water. Specific Conductivity is measured in microSiemens per centimeter (µS/cm). Epilimnetic specific conductivity varies from 2.0 µS/cm to 5,886.8 µS/cm in Maine, with an average of 51.1 µS/cm. 95% of Maine lakes have epilimnetic specific conductivity values below 95.3 µS/cm. Fishery biologists can use specific conductivity values to calculate fish yield estimates. Specific conductivity will increase if there is an increase of pollutants entering the lake or pond; stormwater runoff from urban or residential areas and roadways is the most common pollutant in Maine lakes that can raise specific conductivity values.

TOTAL PHOSPHORUS (µg/L or ppb): Total Phosphorus (TP) is one of the major nutrients needed for plant growth. It is generally present in small amounts and is usually the nutrient limiting the plant/algae growth in lakes. It is

measured in micrograms per liter (µg/L), which is equivalent to parts per billion (ppb). As phosphorus increases, generally the amount of algae in a lake also increases. Epilimnetic TP varies from 1.0 ppb to 426 ppb in Maine lakes with an average of 11.2 ppb. Phosphorus is sampled in various ways, each of which are noted with the following codes: EC= Epilimnetic Core sample, a mixed sample from the warmer surface layer or epilimnion; SG = Surface Grab, sample taken at the water's surface; BG = Bottom Grab, sample taken near the bottom of lake (bottom grab results that are higher than epilimnion or surface results can indicate that internal recycling of phosphorus is occurring), PG = Samples taken at regular depth intervals from the surface to the bottom and the values averaged.

SECCHI DISK TRANSPARENCY (m) (SDT): See above for description of Secchi Disk Data. Min = minimum or lowest Secchi disk depth reading recorded for that year; Avg = average of monthly averages of Secchi disk reading for that year; Max = maximum or deepest Secchi disk reading taken for that year; n = number of months with readings taken in each year; b = number of times Secchi disk was observed touching the bottom of the lake per year.

CHLOROPHYLL-a (µg/L or ppb): Chlorophyll-*a* (Chl-*a*) is a measurement of the green pigment found in all plants including microscopic plants such as algae. It is measured in micrograms per liter (µg/L), which is equivalent to parts per billion (ppb). Chl-*a* is used as an estimate of algal biomass; the higher the Chl-*a* value, the higher the amount of algae in the lake. Epilimnetic Chl-*a* varies from 0.30 ppb to 220 ppb, with an average of 5.7 ppb. Min = minimum or lowest Chl-*a* recorded for that year; Avg = average Chl-*a* reading for that year; Max = maximum or highest Chl-*a* reading taken for that year.

Most Recent Late Summer Temperature and Dissolved Oxygen Profiles

Dissolved Oxygen (DO) is the measure of the amount of oxygen dissolved in the water. Organisms living in lakes use the oxygen dissolved in the water to breathe. Low DO conditions can severely reduce the diversity and populations of aquatic organisms. Water with less than 1 part per million (ppm) of oxygen is considered anoxic (no oxygen present); less than 5 ppm of oxygen is generally considered so stressful that most coldwater fish will avoid these areas. More than 5 ppm is needed for fish to grow and reproduce such that the population is sustainable. Anoxic conditions can also promote phosphorus release from lake sediments.

Temperature is the measure of heat in the water and can affect the lake's chemistry and biology. For example, the amount of oxygen water can hold is directly related to the temperature of the water. The higher the temperature, the less dissolved oxygen the water can hold. Oxygen will naturally decline during the summer months as water temperatures rise. Lakes deeper than 25-30 feet can also stratify, with warm water above cooler deep water, restricting circulation in the lake. This can contribute to oxygen loss in the lower waters. Temperature can also control the kinds of plants and animals found in lakes. Certain species of fish, insects and algae will predominate during the cooler temperatures of the spring and fall, yet disappear during the warmer temperatures of summer. For instance, salmonid fish (such as trout and salmon) generally prefer temperatures below 18°C (65°F) but can tolerate slightly higher temperatures for short periods of time. Conversely, other more tolerant species will predominate during the more stressful summer months.

The *Late Summer Temperature and Dissolved Oxygen Profiles* table present most recent oxygen and temperature data obtained during the lake's most stressed open water period, which for Maine is August and September. If a

lake is going to experience low-oxygen conditions, it will be during these months. Up to the eight most recent profile surveys are included in the report. The sampling date is noted in the first row of the table, with the corresponding measurements in the two columns below each date. Depth (m) = Depth in meters (1 m= 3.28 ft) of each reading; TEMP = Temperature in degrees Celsius (°C); DO = Dissolved oxygen readings in milligrams per liter (mg/L).

The Recent temperature and dissolved oxygen profile plots below the DO/TEMP data table graph profile data for up to four of the most recent profile sampling events. Depth is on the y-axis (vertical) of the graphs, so that the surface of the lake (Depth = 0 m) is at the top of the graph and the deeper water is represented on the bottom of the graphs. The blue line represents dissolved oxygen; the red dashed line represents temperature values. The values on the x-axis (horizontal) are for both dissolved oxygen (mg/L) and temperature (°C). For deeper lakes that stratify, the temperature curve will bend to the left (closer to 0°C) as depth increases, indicating cooler water on the bottom of the lake. If anoxic conditions are present, the blue dissolved oxygen curve will also bend to the left as depth increases, indicating lower dissolved oxygen in deeper water.