Report on the Health of Thompson Lake
2014

This report is a summary and analysis of findings of water quality monitoring of Thompson Lake from May through September, 2014. Most of the readings, samples and observations were gathered at the deepest point in the lake, situated to the west of Hayes Point in Oxford. The majority of historical water quality information for Thompson Lake is also based on sampling at the Hayes Point deep station.

In addition to the sampling that we conducted, Maine VLMP-certified volunteer lake monitors, Bob Tracy and Ron Armontrout, provided a complete season of Secchi transparency (lake water clarity) readings. This additional information has been very helpful in developing an overview of conditions in the lake during the 2014 monitoring season.

Weather Influences:
Weather conditions can have a strong influence on indicators of lake water quality. Much of the natural variability that is common in lakes from year to year can often be attributed, in part, to overall weather patterns, and sometimes to individual storm events.

Extreme weather events, including heavy rain, strong wind, and abnormally high temperatures associated with climate change may be increasingly frequent in the future. Such events are likely to have a measurable effect on lake systems, including a reduction in the period of ice cover, lower dissolved oxygen concentrations in deep areas during late summer, an increase in nutrient and sediment levels in stormwater runoff from soil erosion in lake watersheds, and more.

Weather during the late winter through early summer typically has a significant bearing on lake water quality during the summer months. Runoff from storm events during this period transports nutrients from watersheds into lakes, and sets the stage for algal growth during the warmest time of the year. The winter of 2014 was colder than recent winters, and cool temperatures persisted into the early summer. Runoff from significant snow pack, combined with frequent rain events during the spring and early summer created the potential for higher algal growth in lakes whose watersheds were significantly altered due to watershed development.

2014 Water Quality Monitoring Summary:
A key indicator of biological productivity in lake systems is water clarity (aka Secchi transparency) Lake clarity is primarily influenced by the concentration of algae in the water. However, suspended sediment particles from eroded soil in the watershed can at times also influence clarity. Although the

clarity of the water in Thompson Lake from May through September, 2014 was significantly below (less clear than) the historical average for the lake, very likely due to early spring and summer storm events and stormwater runoff, other water quality indicators were quite close to average.

During the course of the monitoring season, the distance that one could see down into the water from the lake surface varied from a very high (good) reading of 11.25 meters (~36.5 feet), taken by Ron Armontrout on September 19, to the lowest reading of the season of 6.96 meters, taken by Scott Williams on May 16. The low reading in May was very likely the result of the early season weather and runoff mentioned above, and the exceptionally clear reading in September occurred during the a time of the season when weather conditions were dry and calm. Historical water clarity data for Thompson have shown on many occasions that the lake is very sensitive to heavy rain and runoff, often resulting in measurable negative changes in water clarity. The average for the May through September period was 7.9 meters, which although significantly clearer than the overall average for Maine lakes, was well-below the historical 9.0 meter average for Thompson. The last five years have shown a short-term decline in Thompson's water clarity. However, similar trends have been observed in the lake in the past, followed by recovery, including short-term improvements in lake clarity, as the graphic below illustrates.

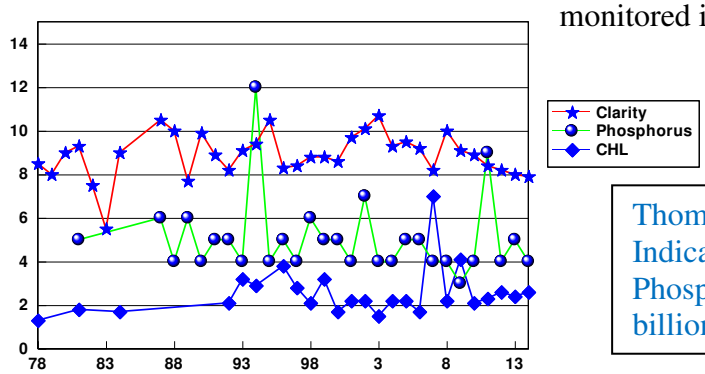
The concentration of the nutrient phosphorus in lake water largely determines the growth of algae in the water, which in turn influences water clarity and oxygen levels. The average concentration of total phosphorus (TP = combined organic and inorganic forms) in the lake in 2014 was 4 parts per billion, compared to the 5 ppb historical average for the lake. During the course of the 5 month monitoring period, TP varied from a very low concentration of 3 ppb in both July and August, to a high of 6 ppb in September.

The average concentration of chlorophyll-a, (CHL) a direct measurement of algae growth in the water was 2.6 ppb – very close to the historical concentration of 2.5 ppb. CHL ranged from a low concentration of 1.2 ppb in August to a high of 3.3 ppb in May.

It is worth noting that while over time there is generally good correlation between water clarity and the concentration of total phosphorus and chlorophyll-a in lake water, the inter-related physical, chemical and biological processes that are represented through the water quality data do not necessarily correlate well when viewed on a monthly basis. During a typical lake monitoring season, the sampling represents an instantaneous "snapshot" of conditions in the lake when the samples and readings were taken. But lake ecosystems are highly variable and dynamic, resulting in what may appear to be a lack of correlation in a short-term view of the data.

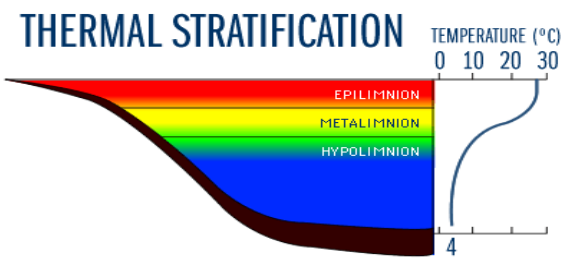
Another factor to be considered when comparing annual averages to historical is that historical averages are continuously changing, as each previous years' data are included in the calculation of the historical numbers.

The chart below illustrates annual averages for each of three primary indicators of lake water quality that have been monitored in Thompson Lake since 1977.



Thompson Lake Water Quality Indicators: Clarity in meters; Total Phosphorus and CHL in parts per billion (ppb)

Dissolved Oxygen:
The amount of oxygen that is dissolved in the water in the deepest area of a lake during the late summer and early fall, until the lake mixes or "turns over" is a critical indicator of overall lake health. Thompson Lake has maintained high levels of dissolved oxygen through the summer/fall period for as long as data have been collected for the lake – even in the deepest spot in the basin near Hayes Point. This characteristic of exceptional water quality is the primary factor that allows coldwater fish to thrive in the lake.



However, water temperature and dissolved oxygen profiles measured throughout the 5 month monitoring period may be showing a slight decline in oxygen in the deepest area of the lake during the month of September. This may be due to the combined influences of increasing lake water temperature, and a lengthening of the period of thermal stratification, during which cold water in the deep area of the lake is isolated from the atmosphere. Additional data will be needed to determine whether or not change is occurring in this indicator of lake health. In late September, 2013, the concentration of dissolved oxygen in the deepest area of the lake had dropped to 7 mg/l (ppm), compared to the early summer readings of nearly 12 ppm. The critical oxygen level for cold water fish species (Trout and Salmon) is ~5-6 parts per million.

The natural water color level for the lake in 2014, a measure of the concentration of humic acids that typically leach from wetland areas in the watershed, was very close to the historical average for the lake, averaging 9 SPU, compared to 10 SPU historical. This indicator of lake health bears close watching in future years. Warming of the lake and its watershed over time may result in the transport of higher amounts of dissolved organic carbon in stormwater runoff, resulting in higher color levels in the lake. This, in turn, could influence thermal stratification patterns, and bring about higher water temperatures in the lake surface.

Conductivity is a measure of the ability of lake water to pass an electrical current. It is a measure of the concentration of ions in the water. As lake watersheds become more developed, and indicators of water quality show evidence of a negative change, conductivity concentration generally increases. The historical conductivity concentration in Thompson Lake is 38 ms/cm, based on eight samples taken since the 1970's. A sample taken in August, 2014 measured 44 ms/cm.

Another factor that has been on lake scientists radar screens for more than a decade is the fact that research strongly suggests that the geochemistry of lake sediments can have a strong bearing on the vulnerability of individual lakes to a decline in water quality. Grant proposals underway through the Maine Volunteer Lake Monitoring Program, the Maine DEP, and VLMP Advisory Board members from the University of Maine will hopefully allow us to look more closely at this influence in lakes throughout Maine.

Gloeotrichia:
We continued to monitor the presence of Gloeotrichia in the lake in 2014. This blue-green algae has often appeared in Thompson historically at low densities during mid to late summer. "Gloeo" colonies

are typically observed relatively close to the water surface, having the appearance of tiny, fuzzy, green-white dots. Gloeotrichia is sometimes described as having the appearance of "tapioca in lake water". It is found in many lake algal communities throughout Maine. However, Gloeo may be increasing in some lakes, and it has been associated with water quality concerns in a small number Maine lakes in recent years. Gloeo is the subject of current research, in an attempt to determine why it may be more prevalent in Maine lakes in recent years, and possible implications for lake ecosystems.

Monthly observation/measurement of Gloeo density in Thompson showed 0 colonies observed until August and September, when the concentration at the monitoring station was positive, but relatively low, consistent with both the timing and density of what has been observed historically in Thompson Lake. Gloeo colonies were somewhat more abundant at the public boat launch on Rte 121 on the August sampling date, ostensibly due to accumulation from the southwest wind, and wave action.

Summary:
Overall, the water in Thompson Lake was less clear than the historical average for the lake in 2014. Phosphorus levels averaged slightly lower than average, and the concentration of algae in the lake was very close to the historical average. Late summer oxygen levels in the deepest area of the lake have been relatively low during the past few years, possibly due to shorter duration of the period of ice cover, warmer water temperatures, and a resulting lengthening of the period of thermal stratification. The September, 2014 oxygen concentration at the deepest area of the monitoring station was not as low as it was at the same time of year in 2013, but any factors that cause the temperature of the lake water to increase, or the period of thermal stratification to be longer, will very likely have a negative effect on late season dissolved oxygen levels in the lake. Thompson Lake very likely remains stratified well into October, and possibly November, depending on annual weather patterns. It is assumed that during oxygen levels in the deepest areas of the lake continue to decline beyond the end of the monitoring period in September until the lake mixes.

Thompson Lake continues to exhibit water quality that is significantly above the average for Maine lakes. The number, and complexity of threats to Maine lakes will very likely continue to grow as climate change exacerbates the effects of everything from watershed development to the breadth of invasive species infestations. TLEA has played a critically important role in protecting the lake for more than four decades. Many of the historical sources of financial and technical support available to lakes are imperiled, and in some cases, no longer exist, as tight budgets continue to force difficult decisions concerning the monitoring and protection of natural resources. The protection of our lakes is ultimately a local issue, and TLEA is well positioned to be the leader in the Thompson Lake watershed community.

Prepared by Scott Willliams