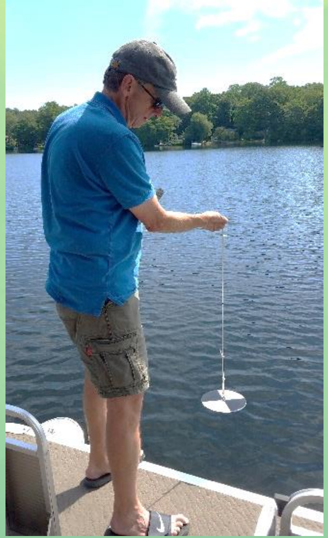
Lake Hayward Lake Quality Improvement Committee (LQIC)

Water Sample Nutrient Testing Summary Report

Summer 2019

As part of the response to recent algae blooms, LQIC created a team of volunteers to gather data to improve our understanding of the lake. Lake chemistry and biology is constantly changing over the year, and also year-to-year. Last year, the Deep-Water Team sampled the deepest part of the lake on or about the 1st and 16th of every month from July through October. The Deep-Water Team was guided by a limnologist (lake scientist) with Northeast Aquatic Research.

Deep Water Sampling Methods



Secchi Disk – This measures the clarity of the water by lowering a black and white Secchi Disk into the water until it can no longer be seen

Dissolved Oxygen Monitor –It measures the temperature, dissolved oxygen and percent oxygen saturation at various depths.

Van Dorn Sampler – This allows us to take actual water samples at any depth for laboratory analysis.

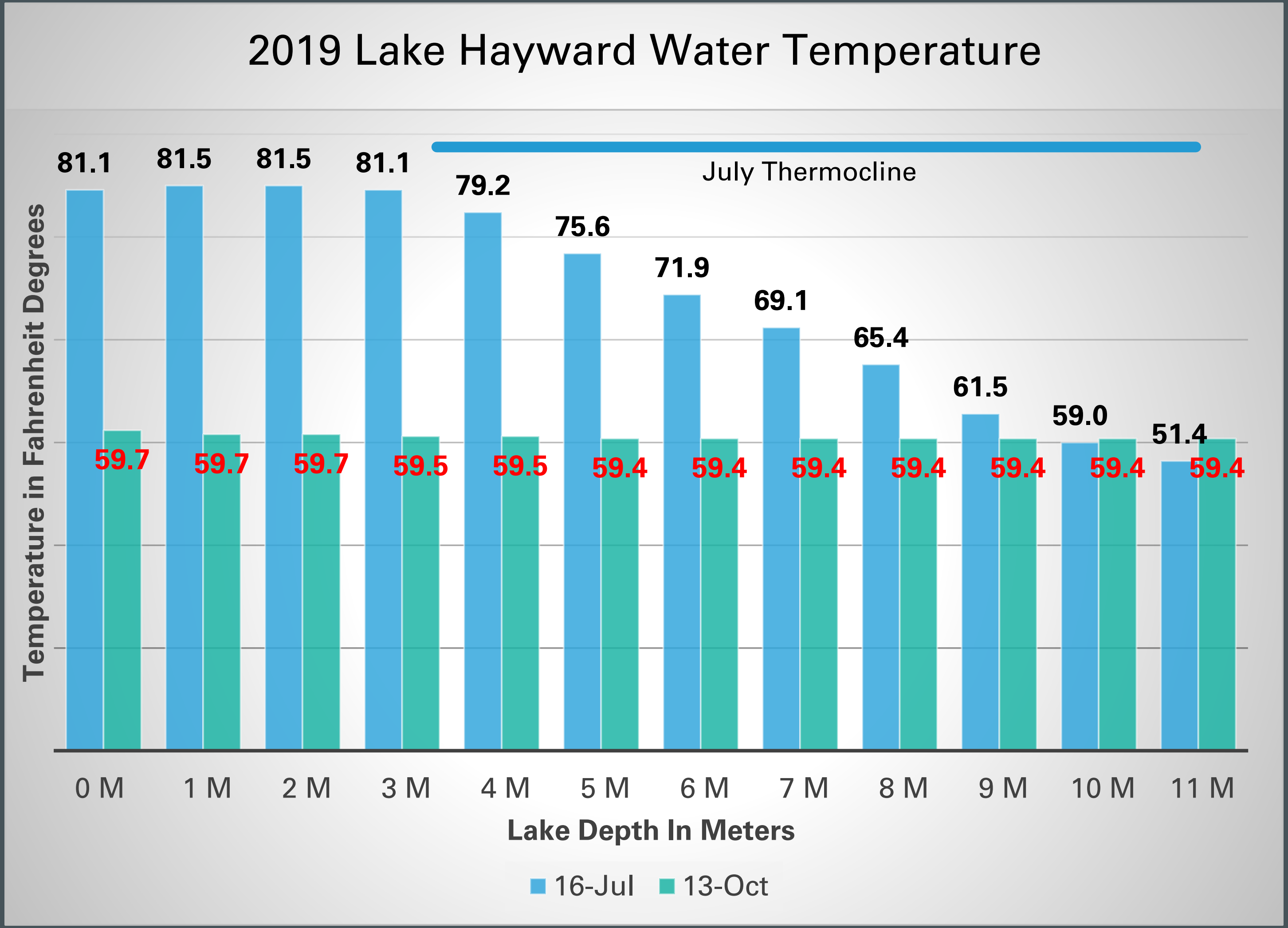
Algae Straw – Used to take a direct sample of algae in the top 10-feet of the lake

TEMPERATURE, THERMOCLINE, AND LAKE 'TURN OVER

The water temperature in Lake Hayward goes through a very interesting cycle each summer. Most of us are familiar when we dive a little deeper into the lake, we sense that the water is a little cooler. What may be less known is the fact that the water temperature on the surface of the lake and bottom of the lake merge together in the fall.

Where there is a significant difference in water temperature (see July data in chart), a **Thermocline**, or the zone of rapid temperature change, is created. A thermocline isolates the top and bottom waters because the density difference between warm water at the surface and cold water at the bottom of the lake resists mixing.

In the fall, '**Lake Turnover**' occurs (see October data in chart). Lake turnover simply means that the water temperature becomes uniform from top of the lake to the bottom and that there is no longer a thermocline. As the thermocline goes away, the water density at all depths becomes constant and the surface and bottom waters can readily mix.



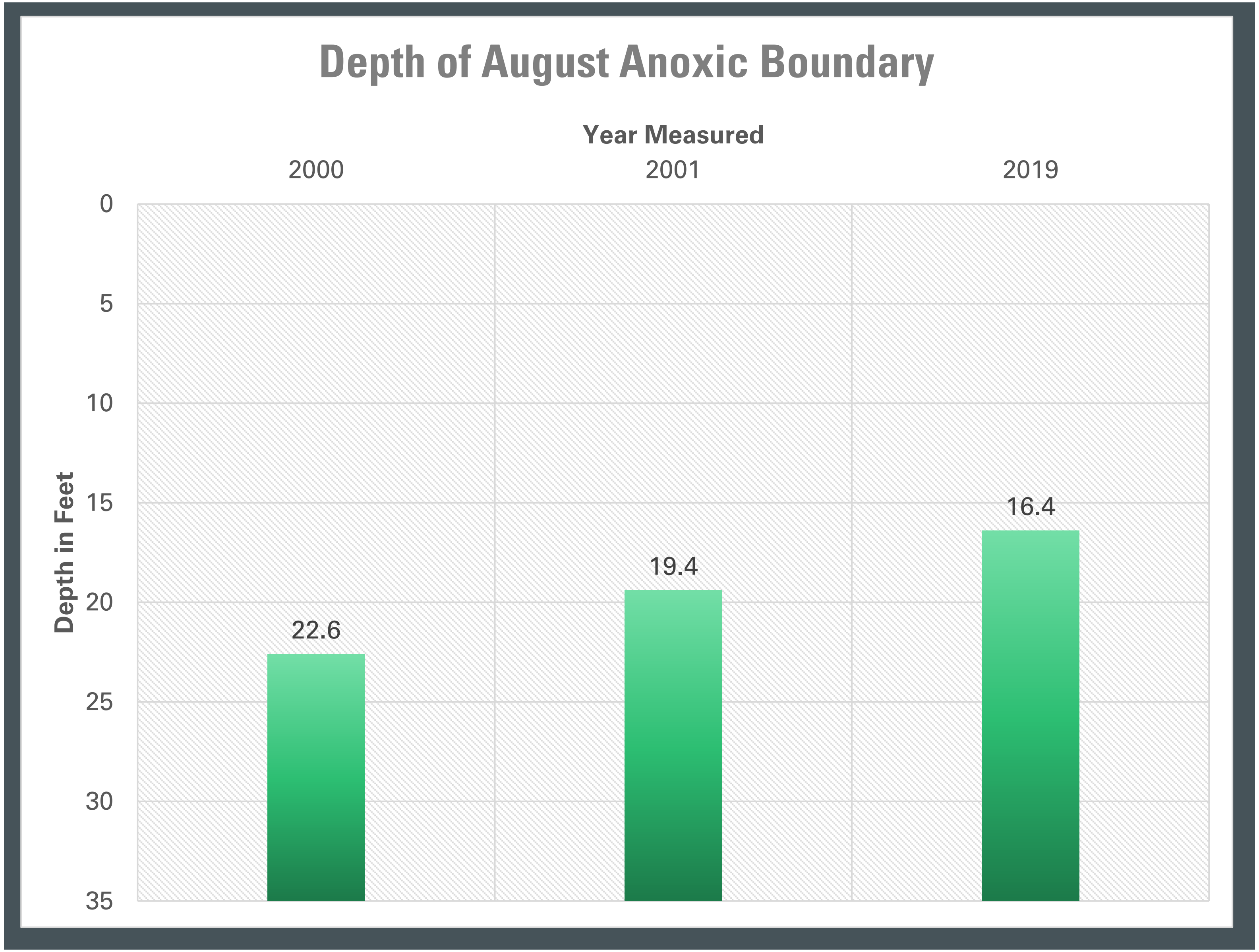
DISSOLVED OXYGEN & THE ANOXIC BOUNDRY

The surface waters of the lake are saturated with dissolved oxygen due to mixing with air. The bottom waters are deficient in dissolved oxygen due to bacterial decomposition of dead leaves and other organic matter. When the dissolved oxygen is essentially zero near the bottom, the water is said to be **Anoxic**.

The depth where water begins to be anoxic is called the **Anoxic Boundary.** The height (inverse of depth) of the anoxic boundary varies over the year, but typically peaks in August. This chart compares the height of the August anoxic boundary in 2019 with prior sampling done in 2000 and 2001.

Anoxic water promotes a number of chemical reactions in the bottom sediments that release nutrients including nitrogen, phosphorous and ammonia from the lake bottom. The higher the anoxic boundary, the more severe anoxic conditions can be expected lake-wide.

Clearly 2019 had the highest anoxic boundary on record.



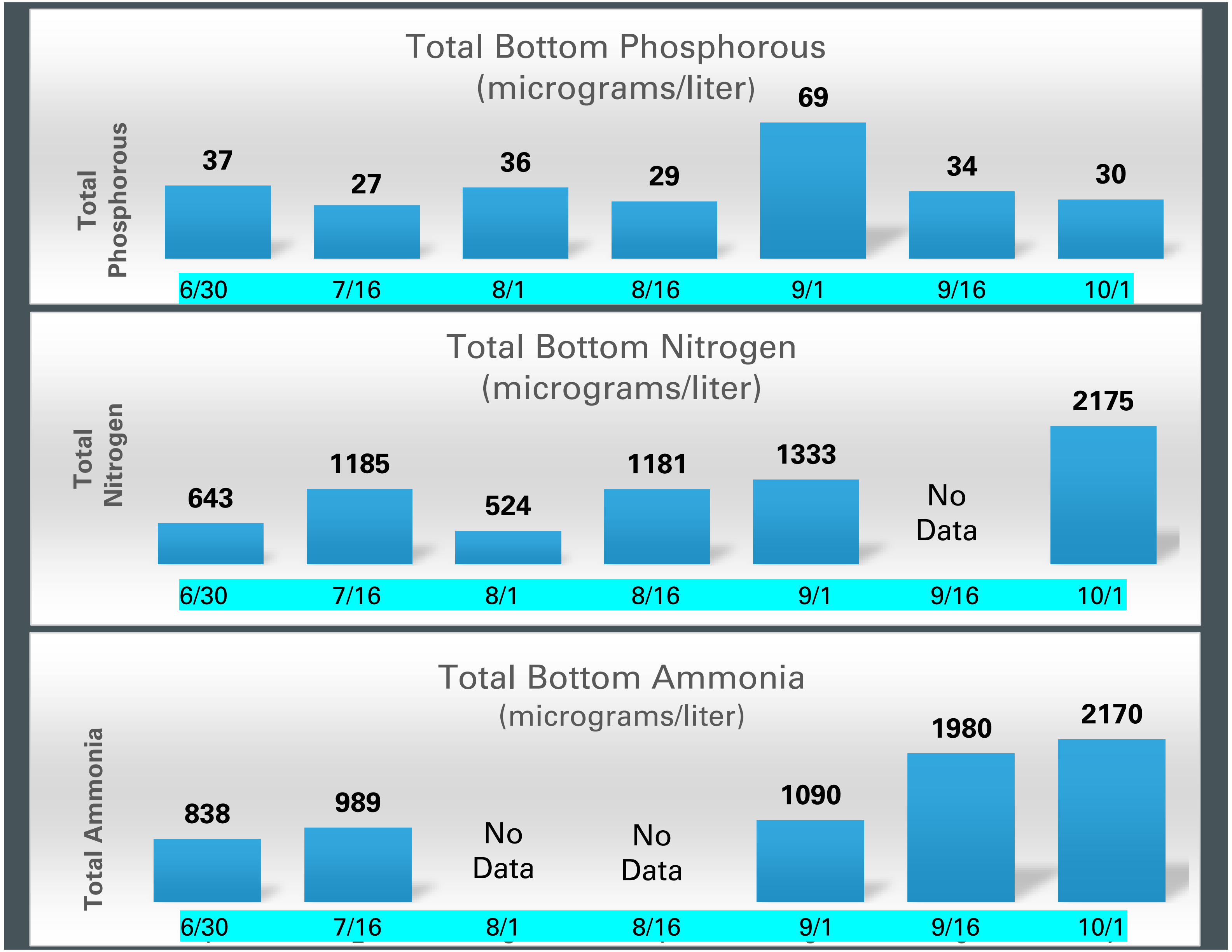
TESTING FOR NUTRIENTS

Phosphorus, nitrogen, and ammonia are nutrients that are natural parts of aquatic ecosystems. They support the growth of algae and aquatic plants, which provide food and a habitat for fish, shellfish and smaller organisms that live in water.

Too much of these nutrients cause algae to grow faster than ecosystems can handle. Significant increases in algae harm water quality, food resources and habitats, and decrease the oxygen that fish and other aquatic life need to survive. Large growths of algae are called algal blooms. (Source: EPA)

The charts show the results of nutrient testing the bottom waters last year. Phosphorus is typically the most limiting nutrient because it naturally exists in very small quantities. Other than a spike on September 1, total phosphorus appears relatively constant in the year. Total nitrogen and ammonia appears to have increased as the year progressed. All these nutrients have higher concentrations at the bottom of the lake compared to the top.

In the fall, the water temperature in the lake becomes uniform with lake turnover and the higher bottom concentration of nutrients can mix with surface waters. An argument can be made that these factors will contribute to algae growth.



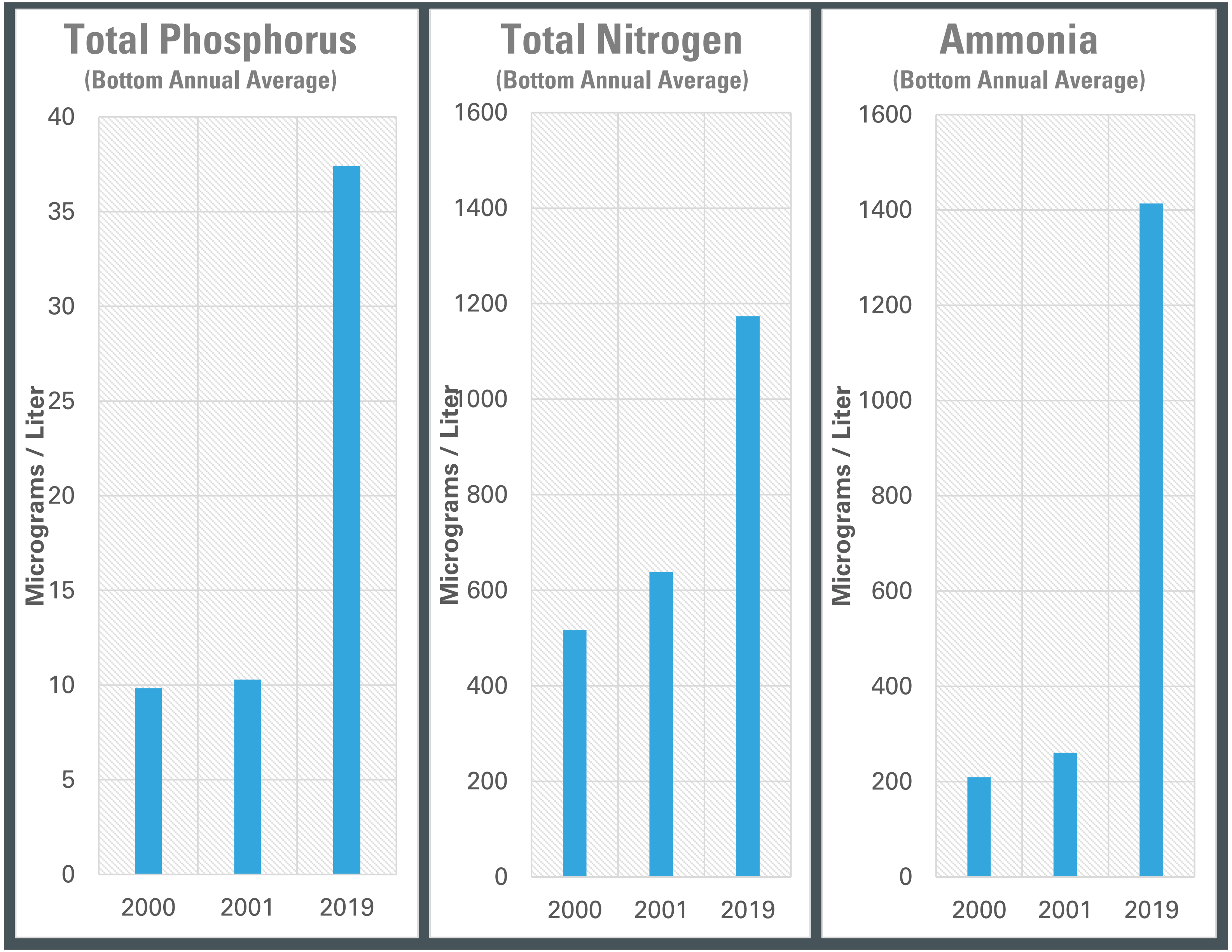
HISTORICAL NUTRIENT PERSPECTIVE

POALH contracted Northeast Aquatic Research (NEAR) to perform a comprehensive study of the lake in 2000 and 2001. This serves as a good baseline to compare with the 2019 sampling data. NEAR also had a limnologist guide the sampling and analysis in 2019.

Comparing nutrient concentrations averaged over the year with prior sampling done in 2000 and 2001 shows an increasing trend in bottom nutrients. This is another indication that lake conditions are worsening.

As stated earlier, phosphorus is typically the most limiting nutrient. It was significantly higher than what was seen in 2000 and 2001. However, it is not extreme. Other lakes have bottom phosphorus in the hundreds to thousands of micrograms / liter.

Total nitrogen includes ammonia. The 2019 ammonia levels are higher than the total nitrogen because of laboratory precision error. However, it is clear that almost all of the total nitrogen is in the form of ammonia in 2019. Ammonia is the preferred form of nitrogen for blue green algae.



DISCUSSION ABOUT ALGAE

Algae blooms can be green, blue, red or brown. They can appear scummy or look like paint on the surface of the water.

Some algae blooms can be harmful based on the concentration of algae cells. Harmful algae blooms are overgrowths of algae in water. Some produce dangerous toxins in fresh or marine water, but even nontoxic blooms hurt the environment and local economies. Harmful algae blooms can produce dangerous toxins that can sicken people and animals. Common sense says to avoid water that is green, scummy, or simply smells bad.

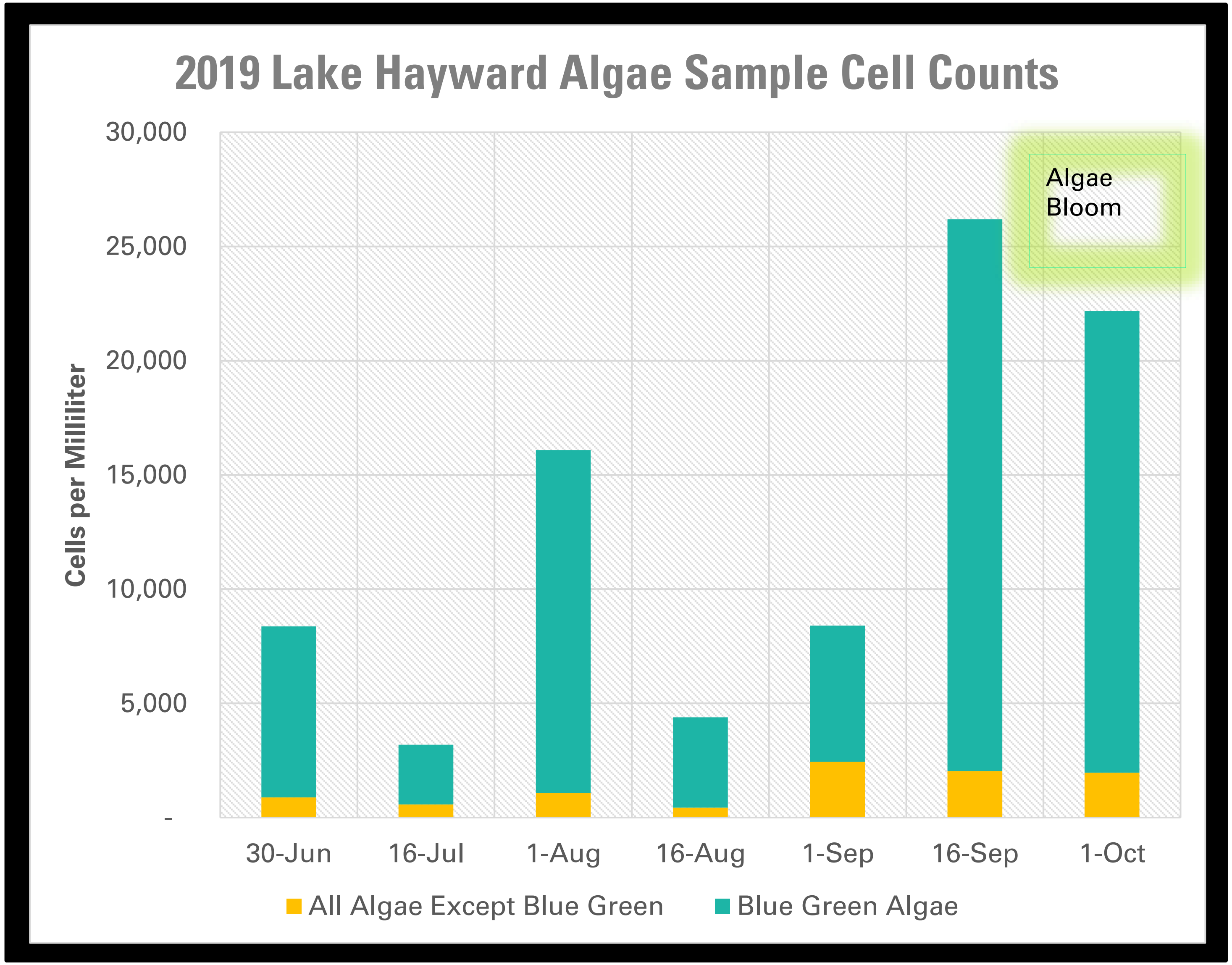
Harmful algal blooms need sunlight, slow-moving water, and nutrient enrichment from nitrogen, phosphorus, and ammonia to prosper.

Source: EPA

The laboratory that LQIC uses to analyze water samples reports on the algae cell counts per milliliter of the sample. Large quantities of the family of algae called blue-green algae (also known as cyanobacteria) may create a harmful algae bloom.

Lake Hayward had a moderate algae bloom starting September 21, 2019 that continued on and off in windswept locations through mid October. The chart shows algae counts peaking around that time. The dominant type of algae was blue green algae all year, and most of that was a type called microcystis. Microcystis can produce toxins.

It takes too long to get algae cell count results from the laboratory to be useful in cautioning residents. The best advice is to stay out of the water if an algae bloom is visible.



So What Does It All Mean?

Throughout most of the summer months, the naturally occurring organic breakdown of nutrients at the bottom of the lake are released but are often "trapped" by the thermocline temperature layer. However, in September and October, when the lake water temperature becomes more consistent top to bottom, those released nutrients on the bottom are now able to move more freely to all levels of the lake including the surface. This is a phenomenon called **Internal Loading**. **External Loading** is the release of nutrients into the lake caused by human activity.

The algae blooms observed at Lake Hayward in the fall may, in part, be the result of a nutrient rich environment in the lake created by 'the perfect storm' when both the nutrients from internal loading and external loading combine together with sunlight to provide the optimal situation for algae to feed and prosper in the lake. One of the unique aspects of algae is that they act like miniature submarines and can rise and lower themselves in the lake. In September and October the algae can 'dive' deep to feed on the internal loading nutrients rising from the bottom of the lake. When the algae floating on the surface get windblown in a given direction, the algae accumulates, and we see an algae bloom. **The best advice is to stay out of the water when a visible bloom is present.**

In comparing water quality test results between 2000/2001 and 2019, the quantity of nutrients in the lake has risen over that period. That said, Lake Hayward remains healthy when compared to other CT lakes like Lake Pocotopaug and Lake Zoar. There is no single triggering event that causes algae blooms. It is a combination of (1) water temperature, (2) internal loading of nutrients from the bottom of the lake, (3) external loading of nutrients in runoff water entering the lake and (4) sunlight.

Of these four phenomenon, there is only one that each of us can control - external loading. As residents surrounding Lake Hayward, we all need to make every effort to control/reduce the amount of nutrients entering the lake via water runoff from our streets and homes. Here is what we can do:

- ✓ If you need to fertilize your plants or lawn, please have your soil tested first (it's free at UCONN http://www.soiltest.uconn.edu/sampling.php) and follow the recommendations. Avoid fertilizer containing phosphorus near the lake or streams.
- ✓ Have your septic tank pumped every 2-3 years. If the lawn gets a little soft after the big family gathering picnic, some sort of repairs may be in order.
- ✓ Try to dispose of grass clippings, pine needles, and fallen leaves off site.
- ✓ Avoid pouring grease or hazardous martials down the drain.
- ✓ While space may be at a premium, try to avoid parking cars, installing patios, or placing a shed over the septic tank leach field.

Recommendations

Our water quality testing consultants have provided the following recommendations to the POALH Board.

1. Continue the deep-water testing program in 2020.
2. Start deep-water testing on May 1 and continue through October 31.
3. Expand the deep-water nutrient testing protocol to take measurements at depths of 1, 6, 9, and 11 meters.
4. Identify a second water testing location near the north end of the lake to monitor water runoff from the wetlands for lower levels of oxygen due to the high concentration of vegetation and vegetation decomposition in the wetlands. Measure water clarity, temperature, and dissolved oxygen.
5. Examine lake bottom sediments to determine the volume of unreleased nutrients residing on the bottom and determine if the nutrient level may be problematic in the future.
6. Continue the public education program outlining the consequences of external nutrient loading and provide mitigation recommendations for each home-owner.
7. Provide a method (emails, newsletters , 'town hall' forums) to share the 2019 testing findings, the 2020 water quality testing action plan, and the public education information with the Association and east side residents.