<u>2016 Water Quality Summary Series – Chlorophyll-a</u>

Since 2003, water quality scientists have observed and sampled Barr Lake and Milton Reservoir twenty times a year for a variety of water quality parameters. These 260 trips to both reservoirs have produced an abundance of data and information. This is Part 2 of a continuing series summarizing the 2016 water quality data. The first summary focused on pH; this one discusses chlorophyll-a (Chl-a).

The Big Picture – Many lakes, reservoirs, and even estuaries and bays throughout the world experience "*cultural eutrophication*". This term means that water bodies tend to become more productive and shallower over relatively short periods of time due to increased inputs of nutrients and sediments from human impacts in the watershed. Eutrophication is a natural process, but it generally occurs over a much longer geological period. This accelerated aging of lakes causes a quick biological response – severe algae growth. This response then leads to other chemical and physical changes within the water column – pH, oxygen, water clarity, water color, and aesthetics.

Chl-a around 85 ug/L at Barr Lake (07/15/03)

Chl-a – This is the measurement of how much green pigment is in the water. Algae, like trees and grasses, produce Chl-a through photosynthesis causing the plant to be green. Chl-a is very important in the plant's process of transforming sunlight into biomass. By measuring how green the water is, one can get a relative understanding about how much algae is in the lake. Chl-a concentrations are expressed in units of micrograms per liter (µg/L) or parts per billion (ppb). Chl-a is not an exact measurement of biomass, but it is close. Some algae (e.g. diatoms) don't produce as much Chl-a as others (e.g. blue-green algae) and can change their rate of Chl-a production throughout the day. Chl-a is also not the same as the rate of productivity or how fast the algae are growing. Concentrations below 5 µg/L are considered low and values greater than 25 µg/L are considered high.

Too much algae is the main observable symptom resulting from *cultural eutrophication*. Too much growth leads to aesthetic issues, odor problems, cyanotoxins, large dissolved oxygen fluctuations, and lower water clarity. Typically, more algae mean more zooplankton and more fish. However, there can be a point where too much algae harm fish and zooplankton. The water quality standard for Chl-a for warm water reservoirs is 20 µg/L. The Chl-a goal that has been determined for **Barr Lake** and **Milton Reservoir** is 25 µg/L or less during the growing season.

2016 Chl-a Data – Chl-a data are collected from the one meter depth during each visit. Approximately 1 liter of 1-meter depth water is collected and filtered in the boat. The filter paper collects the algae contained in that one liter of water. The filter paper is then analyzed to see how green it is. For 2016, there were 20 chl-a concentrations recorded for each reservoir (Table 1).

Table 1. Barr and Milton 2016 Chl-a data (ug/L). Bold values exceed the water quality target.

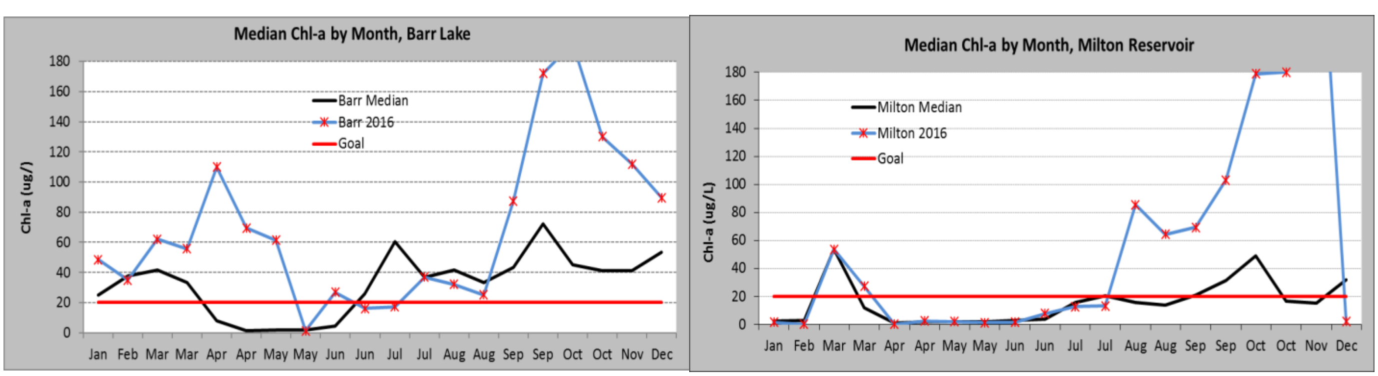
Month	Chl-a (Barr)	Chl-a (Milton)
Jan	48.6	1.4
Feb	34.9	<1.0
Mar	62.1	53.4
Mar	55.8	27.1
Apr	110.0	<1.0
Apr	69.4	2.4
May	61.3	1.8
May	1.3	1.1
Jun	26.8	1.3
Jun	16.2	7.5
Jul	**17.3**	12.6
Jul	37.0	13.0
Aug	32.0	85.5
Aug	25.1	64.1
Sep	87.5	69.2
Sep	172.0	103.0
Oct	192.0	**179.0**
Oct	130.0	**180.0**
Nov	112.0	**338.0**
Dec	89.7	1.9

The median* Chl-a for **Barr Lake** in 2016 was 58.6 µg/L and 12.8 µg/L for **Milton Reservoir**. The large algal community that occurred in both reservoirs in the spring/late summer not only caused an increase in pH but also an increase in Chl-a. As with the pH, the Chl-a quickly decreased in the spring before the warmer growing season.

The growing season (July – September) median for **Barr Lake** was 34.5 µg/L and 66.7 µg/L for **Milton Reservoir**. Typically, the growing season median is higher than the annual median, but Barr had higher numbers in October because of a late season algae bloom.

Figure 1 shows the annual cycle, goal, and 2016 results for Chl-a. **Milton Reservoir** had low Chl-a numbers between April and July. This was followed by a major bloom when the reservoir was drained in October. An encouraging observation is that the algal bloom did not occur until after July. It is clear that when these reservoirs are drained, the remaining pool grows lots of algae. **Barr Lake** had a spring diatom bloom that lasted slightly longer than normal and then a large blue-green bloom in late summer. A difference in 2016 is that there was no blue-green algae bloom in June/July. Barr seemed to be more productive in the spring but less than normal in June and July. Chl-a was below average until September.

Figure 1.



Photosynthesis – This important biochemical process has a major impact on Barr Lake and Milton Reservoir. The process of photosynthesis converts CO_2 into organic matter (sugar) by using the energy from the sun. An evaluation of Chl-a provides a good representation of the primary biomass in a lake. Photosynthesis helps determine the balance between pH (changes in CO_2), organic matter (chl-a or algae), nutrients, and dissolved oxygen (DO)

$$6CO_2 + 6H_2O + \quad Nutrients \quad \underset{\text{(Respiration/Decomposition)}}{\overset{\text{(Photosynthesis)}}{\rightleftharpoons}} \quad C_6H_{12}O_6 + 6O_2$$

** median is used instead of average because Chl-a data has a large range of values and can change quickly. Median does a better job of representing the middle of a data set that has extreme high values along with extreme low values.*