2015 Water Quality Summary Series – Chlorophyll-a

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 240 trips to both reservoirs have produced an abundance of data and information. This is Part 2 of a continuing series summarizing the 2015 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 or 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. 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.

2015 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 all of the algae contained in that one liter of water. The filter paper is then analyzed to see how green it is. For 2015, there were 20 chl-a concentrations recorded for each reservoir (Table 1).

Table 1. Barr and Milton 2015 Chl-a data (ug/L). Bold values exceed the water quality target.

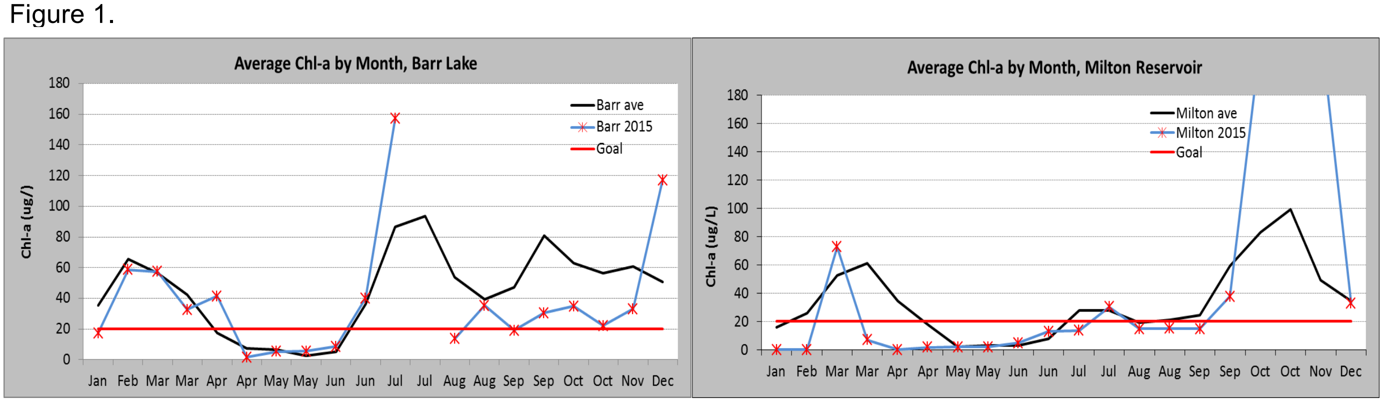
Month	Chl-a (Barr)	Chl-a (Milton)
Jan	17.4	<1.0
Feb	58.8	<1.0
Mar	57.3	72.6
Mar	32.6	6.9
Apr	41.4	<1.0
Apr	1.7	1.7
May	5.38	1.8
May	5.65	1.9
Jun	8.65	4.8
Jun	40.2	12.8
Jul	**157.0**	13.6
Jul	-n/a-	30.2
Aug	13.6	14.8
Aug	35.4	15.0
Sep	19.2	14.7
Sep	30.5	37.6
Oct	34.8	**218.0**
Oct	22.1	**526.0**
Nov	33.1	**227.0**
Dec	117.0	32.5

The average Chl-a for **Barr Lake** in 2015 was 38.5 µg/L and 61.6 µg/L for **Milton Reservoir**. The large diatom community that occurred in both reservoirs in the winter/spring not only caused an increase in pH but also an increase in Chl-a. As with the pH, the Chl-a quickly decreased in late spring before the warmer growing season.

The growing season (July – September) average for **Barr Lake** was 51.1 µg/L and 21.0 µg/L for **Milton Reservoir**. Typically, the growing season average is higher than the annual average, but Milton had high numbers in October and November because of the extremely low water depths of only 2.0 meters.

Figure 1 shows the annual cycle, goal, and 2015 results for Chl-a. **Milton Reservoir** had low Chl-a numbers during the summer season. This was followed by a major bloom when the reservoir was drained in October. An encouraging observation is that the typical summer time algal bloom did not happen in 2015. It is clear that when these reservoirs are drained, the remaining pool grows lots of algae. **Barr Lake** had an average spring diatom bloom and then a very large blue-green bloom in early summer followed by below normal Chl-a for the remainder of the summer season.

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)

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