

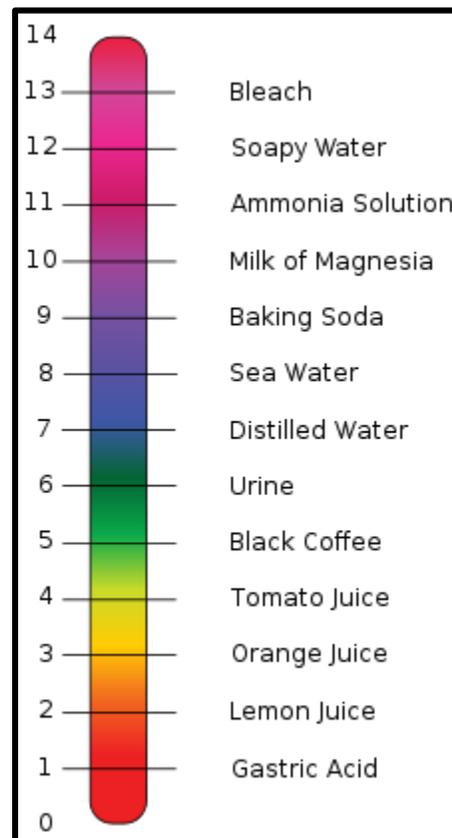
Twenty times a year since 2003, **Barr Lake** and **Milton Reservoir** have been sampled for water quality. These 360 trips to both reservoirs have produced an abundance of data and information. This is Part 1 of 8 of a water quality summary series for 2020 calendar year for both reservoirs. This first summary focuses on pH.

**The Big Picture** – Eutrophication is the addition of nutrients and sediments to water bodies resulting in algae and plant growth and sedimentation. This natural process occurs over a long, geological period - 1,000's of years. Many lakes, reservoirs, ponds, and even estuaries throughout the world experience "*cultural eutrophication*". This term means that water bodies become more productive and shallower much quicker (months to years) due to increased inputs of nutrients and sediments from human activities. This unnatural, accelerated aging of lakes causes an obvious biological response – algae growth that usually leads to blue-green algal scums. This biological response then leads to chemical and physical changes within the water – pH, oxygen, water clarity and color, fish, water safety, plants, and aesthetics can all impact the health of the water.

**pH** – This is the measurement of how many hydrogen ions (H<sup>+</sup>) are in the water (scale is 1 through 14). The higher the concentration of H<sup>+</sup>, the more acidic or lower the number (scale of 1-6). The lower the H<sup>+</sup> concentration, the more basic or higher the number (scale of 8-14). Pure water has a neutral pH around 7.0. Normal rainfall is about 5.6 because of exposure to the air.

Colorado's water quality standard for pH is 6.5 to 9.0. To determine if a lake is satisfying this standard, pH data are collected from the surface (epilimnion) to the bottom of the lake (hypolimnion). pH is important when it comes to aquatic organisms such as fish.

**2020 pH Data** – For Barr Lake and Milton Reservoir, pH data are collected throughout the entire water column in half meter increments during each visit. pH measurements from 0.5 meter to 2.0 meters are then averaged for each visit for the top water. For 2020, there were 19 pH averages recorded for each reservoir (Table 1). The data are then ranked from highest to lowest. The 85<sup>th</sup> percentile pH value is the one that has 15% of the values higher and 85% of the values lower. For **Barr Lake**, the 2020 85<sup>th</sup> percentile pH value was 8.92 and for **Milton Reservoir** it was 9.20. The last time Barr met the pH standard in 2015.



pH Scale 1 to 14

# Water Quality Summary: pH

## 2020 Barr Lake & Milton Reservoir



Table 1. 2020 Barr Lake and Milton Reservoir average pH for the top water (0.5 – 2.0 m) for each sampling event and the 85<sup>th</sup> percentile. Bold values exceed the water quality standard.

Barr Lake				Milton Reservoir			
Month	pH	Rank	%tile	Month	pH	Rank	%tile
Jan	<b>9.25</b>	<b>9.26</b>	<b>100</b>	Jan	<b>9.13</b>	<b>9.50</b>	<b>100</b>
Feb	<b>9.26</b>	<b>9.25</b>		Feb	<b>9.36</b>	<b>9.41</b>	
Mar	8.72	8.93	<b>90</b>	Mar	<b>9.50</b>	<b>9.36</b>	<b>90</b>
Mar	NA	<b>8.92</b>	<b>85</b>	Mar	NA	<b>9.20</b>	<b>85</b>
Apr	8.93	8.91	<b>80</b>	Apr	<b>9.41</b>	<b>9.13</b>	<b>80</b>
Apr	8.91	8.89		Apr	8.86	<b>9.07</b>	
May	8.38	8.81	<b>70</b>	May	8.96	<b>9.02</b>	<b>70</b>
May	8.36	8.81		May	8.88	8.96	
Jun	8.33	8.72	<b>60</b>	Jun	9.07	8.91	<b>60</b>
Jun	8.54	8.69		Jun	8.91	8.88	
Jul	8.69	8.62	<b>50</b>	Jul	8.62	8.86	<b>50</b>
Jul	8.62	8.54		Jul	8.81	8.81	
Aug	8.81	8.42	<b>40</b>	Aug	9.02	8.79	<b>40</b>
Aug	8.42	8.38		Aug	8.71	8.76	
Sep	7.70	8.38	<b>30</b>	Sep	8.42	8.72	<b>30</b>
Sep	8.38	8.36		Sep	8.67	8.71	
Oct	7.77	8.33	<b>20</b>	Oct	8.38	8.67	<b>20</b>
Oct	8.89	8.32		Oct	8.76	8.62	
Nov	8.32	7.77	<b>10</b>	Nov	8.79	8.42	<b>10</b>
Dec	8.81	7.70		Dec	8.72	8.38	

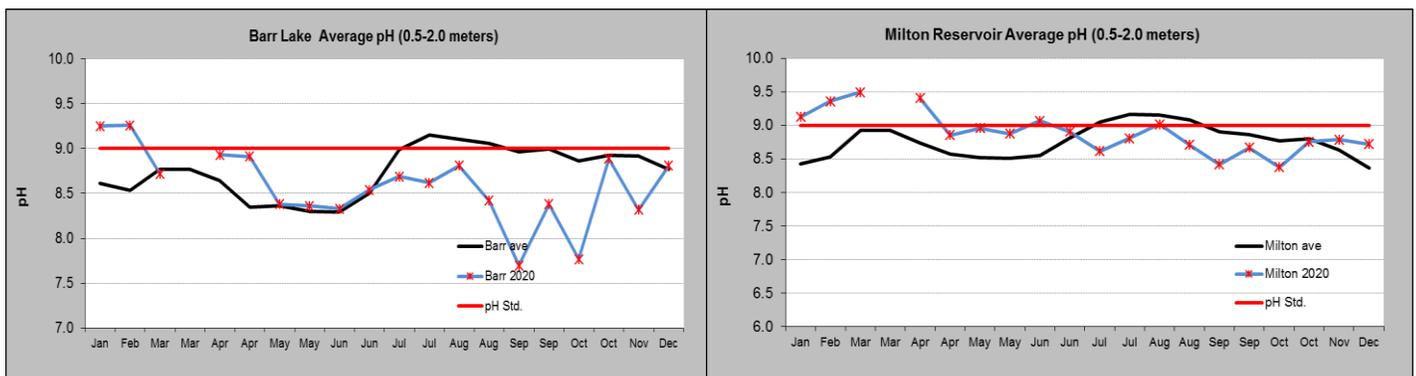
*There is no seasonality for the pH standard, all data collected in a year are included in the calculations.*

*With 19 sampling events, only three can be higher than 9.0. The average between the fourth and third highest pH value is the 85<sup>th</sup> percentile number.*

The median (50<sup>th</sup> percentile) pH for **Barr Lake** in 2020 was 8.62 and for **Milton Reservoir** it was also 8.86. Both reservoirs experienced a typical spring time diatom bloom, and Barr had a bloom in July and August. The lowest pH for both Barr and Milton occurred in September/October after the summer season. All pH exceedances occurred in the first quarter of the year.

Figure 1 shows the annual pH patterns, upper pH standard, and 2020 pH values. The annual algae growth cycle determines the annual pH pattern. It is important to notice that the background pH is over 8.0 so there is not much room for higher pH values.

Figure 1. 2020 pH data compared to WQ target and 2003-2020 annual average



**Algae and pH** – How does the growth of algae change the pH of a lake? When algae grow, they photosynthesize. This is the process of taking in  $\text{CO}_2$  and water in the presence of sunlight and producing oxygen and sugar (food) for growth. Taking  $\text{CO}_2$  out of the water results in less carbonic acid ( $\text{H}_2\text{CO}_3$ ). Less carbonic acid means less  $\text{H}^+$  in the water, and therefore a higher pH. If the algae grow fast, the reservoir does not have enough time to get back into equilibrium with the atmosphere to dissolve more  $\text{CO}_2$ .

The opposite can also occur; decomposition of the algae at the lake bottom consumes oxygen and produces  $\text{CO}_2$ . Bottom water can get below pH of 6.0 (acidic) because of the carbonic acid formation. Due to water movement and alkalinity (ability of the water to neutralize acids), this does not happen in **Barr Lake** or **Milton Reservoir**.