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Water Clarity Changes in Gregg Lake

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As you may have heard, a Gregg Lake Watershed Management Plan Committee formed about two years ago to address observed changes in Gregg Lake's water quality. We received $25,000 in funding from a United States Environmental Protection Agency grant under Section 319 of the Clean Water Act, which is administered by the New Hampshire Department of Environmental Services (NHDES), to develop a watershed management plan for Gregg Lake.

For the past twenty years, led by Bob Southall, members of the Gregg Lake Association have collected Gregg Lake water samples for water quality testing through the NHDES Volunteer Lake Assessment Program (VLAP). One of the concerns that have come to light in our preliminary analysis of the water quality data accumulated so far is an apparent decline in water clarity in Gregg Lake. Water clarity can be affected by the presence of algae, dissolved colored substances and suspended particulate matter. Loss of water clarity can be harmful to aquatic plants and animals, including fish, and can lead to increased algal blooms. Three measures of water clarity are routinely made:

- Turbidity—a measure of light scattering by particles suspended in water
- Color—usually contributed by metals and organic compounds dissolved in the water
- Transparency—how far down in the water column objects can be seen

Turbidity. Turbidity in water is caused by suspended particulate matter, such as clay, silt, algae and plant fragments, that cause light to be scattered and absorbed, rather than transmitted in straight lines. Particulate matter can be carried into the lake by stormwater runoff from roads and disturbed land areas, or can be stirred

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Antrim Grange Restoration Fund Challenge

Renee Mercier-Gerritsen, Grange Master

Antrim Grange #98 announces a $5,000 matching challenge to its restoration fund this fall. The Grange has supported our community for the past 133 years. Many of us have memories of harvest suppers and programs in the historic building at the foot of Meeting House Hill. Now we have an opportunity to show our appreciation by doubling our donations to the Grange's restoration project.

The 1785 building was originally the first meeting house in Antrim at the top of the hill by the old cemetery. In the 1830s the upper section was moved to its present location in Antrim Center to serve as the town hall. The Grange acquired the building in 1894 and continues to meet there. However, the old building is showing its age, and the group has started much-needed restorations.

For many years, loyal Grange members Byron and Vera Butterfield ran a dairy and produce farm on Clinton Road, just down the hill from the Grange Hall. In memory of her grandparents, Antrim native Jane Butterfield McLean will match donations up to $5,000 made to the restoration fund from September 1 through December 31, 2018.

All contributions, large and small, to the $5,000 challenge are welcome. Here's how you can help:

- For a tax-deductible donation: NH Grange Foundation, Attn: Andrew Savage, Treasurer, 86 Church St., Unit #4, Rochester, NH 03839
- For a secure online donation: *https://www.gofundme.com/https-8snt6r-antrim-grange-hall-restorati*
- For a regular donation: Renee Mercier-Gerritsen, Master of Antrim Grange #98, 5 High Street, Antrim, NH 03440

or chopped up from shallow bottom areas by motorboats, waves and wake. According to NHDES, a 50-horsepower motorboat can stir up the water to a depth of fifteen feet. This means that a 50-horsepower motorboat will impact the bottom in 44% of the surface area of Gregg Lake, including anywhere in the vicinity of the shoreline and a large part of the north end. Even a 10-horsepower motor impacts the water to a depth of six feet.

Stirred-up sediments and those washed into the lake with stormwater runoff can increase phosphorus levels, which leads to increased aquatic plant and algal growth. Sediments can also clog fish gills and prevent aquatic insects from getting enough oxygen. Turbidity can also block sunlight from reaching plants growing in the water, causing them to die and release more phosphorus, possibly leading to algal blooms.

Turbidity is measured in samples taken at three different spots on Gregg Lake—the Deep Spot, where, as you might guess, the lake reaches its maximum depth of 11 meters (35.9 feet), the Inlet, which is measured at the Gregg Lake Road bridge, and the Outlet, which is measured at the dam. At the Deep Spot samples are taken at three depths—in the middle of the upper warm water layer, in the middle of the middle layer where the temperature changes rapidly, and in the middle of the uniformly cold bottom layer. First, we slowly lower a temperature sensor to the bottom, recording the temperature just below the surface and then every meter until it is just above the bottom. From the temperature recordings we determine the positions of the three water layers. We lower a contraption called a Kemmerer bottle to the appropriate depth, drop a stainless steel "messenger" down the line to close the bottle, and (hopefully!) pull up a sample in the closed bottle. As you might imagine, sometimes the bottle fails to snap closed—after all, the messenger may have to travel smoothly thirty feet down the chain—or the contents spill all over us as we pull it over the side of the boat. But eventually, we proudly nestle our labeled samples into the ice in the cooler for transport to the VLAP labs. Sometimes, we can even see that algae are gathered in the middle layer, which can have the highest nutrient levels.

To assess trends in turbidity in Gregg Lake from 1997 through 2017, a mean was calculated from turbidity values obtained at different depths at the Deep Spot for each year, and yearly means were calculated separately for the Inlet and Outlet (Fig. 1). Each set of values shows a clear trend towards increased turbidity in Gregg Lake since 1997.

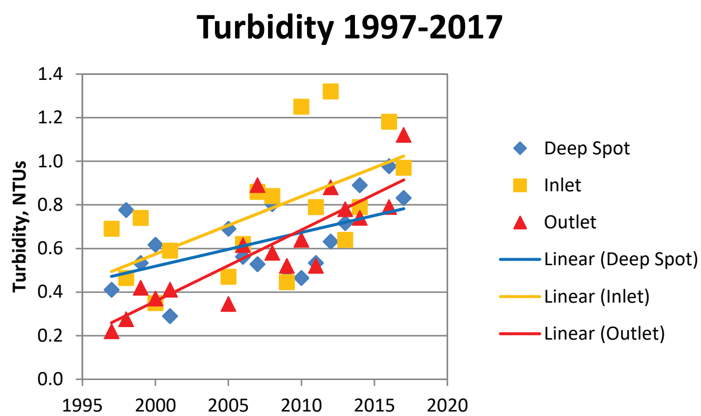

Figure 1. *Turbidity levels measured in Gregg Lake samples collected from 1997–2017. Deep Spot values are the means of values obtained for the upper, middle and lower water layers for each year; mean Inlet and Outlet values for each year were also calculated. Linear trend lines are shown for each location. The median value for NH lakes is 1.0 NTU.*

Color. Apparent color is a visual measure of the color of water. This color is usually caused by decaying organic matter or naturally occurring metals in the soils, such as iron and manganese, which are dissolved in the water. A highly colored lake generally has extensive wetlands along the shore or within the watershed, and often has a mucky bottom. High color can block sunlight from reaching aquatic plants, which can then die and release stored phosphorus, which can cause proliferation of algae.

Apparent color data for Gregg Lake is scarce. Measurements made in 1978, 1994, 1995 and 1997 ranged from "Clear" to "Light Tea." After noticing color in recent Gregg Lake samples, the NHDES VLAP coordinator recommended adding apparent color analyses to Gregg Lake sampling in 2017. Apparent color was measured monthly from spring to fall in 2017, each time in the upper water layer at the Deep Spot (Fig. 2). The color appeared to increase over the season from "Light Tea" to "Tea Color," and the mean for all samples was 45.7 platinum cobalt units (PCU), in the "Tea Color" category. Although there is a large amount of variability in the data, it appears that the overall color has increased in Gregg Lake over the last twenty years.

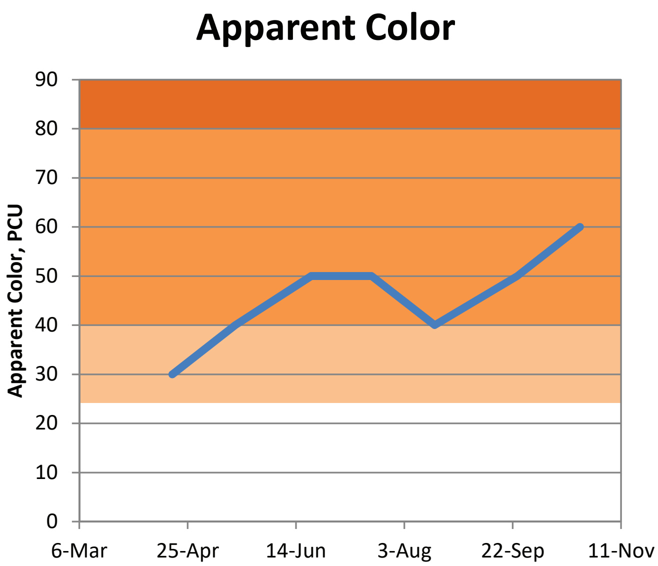

Figure 2. *Changes in the apparent color in upper water layer samples collected at the Deep Spot in Gregg Lake from April through October, 2017. Values below 25 PCU are considered "Clear", values from 25–40 PCU are considered "Light Tea" color, values from 40–80 PCU are "Tea Color" and values above 80 PCU are "Highly Colored."*

Transparency. Lake water transparency is measured by lowering a black and white plate, called a Secchi-disk, into the water with a marked chain and measuring the depth at which it is just visible. This is done by peering into the water either with the naked eye or through a viewscope, which can help to minimize the effects of waves and surface glare. Imagine a small rowboat tossing in heavy whitecaps with one person leaning over the edge trying to keep an eye on the sinking Secchi-disk and the other person leaning over the other side to balance the boat and slowly lowering the disk. There's a reason we calculate the mean of readings taken by at least two different people.

Gregg Lake transparency appears to have decreased between 1997 and 2017 (Fig. 3). Although there is considerable scatter in the data, the trend line suggests that the transparency is dropping from the "Exceptional" range into the "Good" range. Since data has been collected over a longer period of time without using a viewscope, that data is used to determine trends.

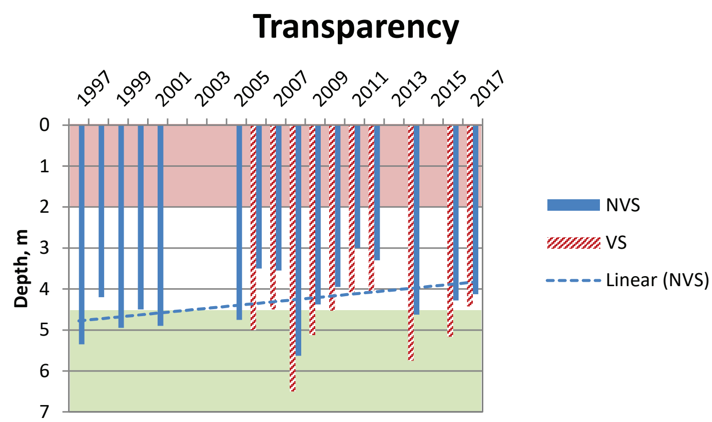

Figure 3. *Gregg Lake water transparency measured at the Deep Spot between 1997 and 2017. A Secchi-disk was lowered to the depth at which it could just be seen either with the naked eye on the shady side of the boat (NVS) or with a viewscope on the sunny side (VS).The dashed line shows the trend in the NVS transparency. Values of less than 2 meters (6½ feet) lie in the "Poor" range; values between 2 and 4.5 meters (6½ and almost 15 feet) are considered "Good"; and values above 4.5 meters (almost 15 feet) are considered "Exceptional".*

Summary. Turbidity and color contribute to the loss of lake water transparency. Decreasing transparency, increasing turbidity and increasing color are all indicators that Gregg Lake is undergoing eutrophication, or aging. Eutrophication is a natural process, but can be greatly accelerated by human activities. Particulate matter can clog gills of fish, tadpoles and other aquatic animals. Turbidity and increased color can block sunlight from aquatic plants, which then die, decay and release phosphorus back into the water, potentially giving rise to algal blooms as the summer progresses, including cyanobacteria blooms that may be toxic. Decaying plants also remove oxygen from the water, and may reduce dissolved oxygen to below levels that support fish and other aquatic life, especially in the lake's deepest waters, as we are now observing in Gregg Lake.

Can we do anything to reverse these worrisome trends in the Gregg Lake water quality? We hope so. The purpose of developing a watershed management plan is to analyze what the problems are, prioritize remedies and put a plan in place for implementing them. ▣

NHDES
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