

VLAWMO Board Memo to the City of White Bear Lake

Date: August 28, 2019

Re: Goose Lake recommendations and draft language for use in establishing an ordinance to maximize effectiveness of proposed alum treatment

The City of White Bear Lake and Vadnais Lake Area Water Management Organization (VLAWMO) seek to improve water quality in East Goose Lake such that it is possible to remove it from the Impaired Waters List. The VLAWMO Board formally recommends using best practices to maximize alum-treatment results. We request support of these best practices through an established motorized-boat activity ordinance by the City of White Bear Lake. Recommendations have been determined using best-available science and include timing of treatments and specifications for motorized boat limitations.

More information and documentation are available on the East Goose Lake page on the VLAWMO website: <http://www.vlawmo.org/news/blog/goose-lake-alum-science-review/>

Restrictions:

To maintain pH levels in the lake, the full alum dose will likely need to be applied over 2 years with a rest year in-between, for a total of 3 years. The specific timeframe will need to be adjusted if funding is not approved as part of the current grant round with the Board of Water and Soil Resources. Pending funding, we propose:

- Fall 2020: Initial partial dose alum treatment. No motorized boating starting immediately post-treatment on East Goose Lake.
- Calendar year 2021: No motorized boating on East Goose Lake
- Spring 2022: Remaining alum dose treatment
- Summer/Fall 2022: No motorized boating on East Goose Lake

- Beyond 2022, we see 3 possible options:
 1. No motorized boating
 2. Re-evaluate based on monitoring data collected to determine if motorized boating should be allowed to resume with trolling motors ≤ 10 HP
 3. Motorized boating allowed with trolling motors ≤ 10 HP

- In all 3 scenarios, VLAWMO will continue monitoring and share Phosphorus (P) results with the City and other stakeholders via the VLAWMO website. Boating and water skiing will be allowed to continue on West Goose Lake.

Findings and Purpose:

An alum treatment is an effective and expensive (~\$170,000 for East Goose Lake) in-lake treatment to bind phosphorus and improve water quality. Though the cost may seem high, alum

treatments are 50 times more effective in P removed per dollar spent when compared to structural BMPs in urban settings (Brattebo *et al.* 2017). The proposed alum treatment has the potential to improve property values. Lake eutrophication decreases property and recreational value of lakes. Zamparas & Zacharias (2014) estimated \$2.2 billion per year is lost due to eutrophication. Numbers were calculated for 2009; this is equivalent to \$2.6 billion in 2019. Greatest losses were from lakefront property values.

Phosphorus (P) is the key nutrient in fresh-water systems that leads to high algal growth and low water quality. P binds to sediment and is washed into lakes and streams in stormwater. Alum treatments are especially effective in improving lakes with internal loading, which has accumulated through time often due to high historical nutrient additions. Internal loading is caused by high P levels in the sediment that are released during anoxic conditions. Goose Lake was the receiving body of water for wastewater discharge from the 1930s through the late 1960s. This historical input, combined with continued subwatershed inputs in stormwater, has created the high internal-load situation and nutrient impairment that we seek to address.

Sediment cores were used to determine the extent of internal loading in East Goose Lake. Results showed that internal loading in East Goose Lake is 88%. External load is also being reduced through efforts with the City of White Bear Lake and VLAWMO; external load is 11%. A reduction of external load is warranted but does not have the potential to improve East Goose Lake to the point that it would meet state standards without addressing the accumulated internal load. In addition to external load reductions, 16,000 pounds of bullhead were removed (see below). P levels improved following rough fish removal. Even with improvement, P levels remain at three times the state standard (State standard = 60 µg/mL).

Maintaining pH of the lake during an alum treatment is critical to health of the system. Alum treatments in shallow lakes are usually administered over the period of a couple of years to maintain safe pH levels and add sufficient alum to bind available P. The amount of alum to add is calculated through modeling, and dosage is lake specific.

Alum treatments work by binding with P in the sediment and water column and deactivating it. Phosphorus binds with aluminum (Al) sulphate to form aluminum hydroxides. Aluminum hydroxides are not reactive during low oxygen conditions at the bottom of the lake and do not release bound P. When an alum treatment is applied, a precipitate is initially formed called an Al floc. Floc is light and fluffy at first and can be easily resuspended into the system. Allowing floc to stabilize and a biofilm to form over the top prevents mixing bound P back into the water column and extends the effective life of the alum treatment. A period of 2-4 months is required to allow the floc to form, compress, and a biofilm to form over the top in optimal conditions (Egemoose *et al.* 2009). The time required is extended during in cold temperatures, outside of the growing season. Even with a biofilm present, minimizing disruption of the sediment is recommended.

Motorized boating is an activity that disturbs bottom sediments. Turbulence from propeller wash extends below the boat (4-6 feet below the propeller for overall depths down to 10 feet) (Asplund 2009; Gucinski 1982). Declines are most pronounced in shallow lakes. East Goose Lake is a shallow lake with a maximum depth of 7.4 feet. Effectiveness of alum treatments depends upon dose and bioturbation/disruption of sediment (Steinman *et al.* 2018). We recognize findings of peer-reviewed research and white papers.

We also recognize that:

- High algal growth prevents healthy plant growth that would help maintain a clear water system,
- East Goose Lake is nearly devoid of plants because it is dominated by algae,
- High algal growth in East Goose Lake includes cyanobacteria--the source of potentially harmful algal blooms,
- Property values are negatively affected by lakes dominated by algae blooms,
- And that East Goose Lake is priority for remediation in the City of White Bear Lake and the Vadnais Lake Area Watershed.

Efforts to Date:

- VLAWMO worked with Blue Water Science to conduct fish surveys in 2012 and 2017. The high density of bullheads was deemed a potential problem for an alum treatment because these fish feed by disrupting the bottom. Note: Bullheads do not disrupt the bottom to the extent that Common carp do. Common carp are not present in Goose Lake.
- VLAWMO hired and participated in bullhead harvests on East and West Goose Lakes during 2014 and 2015; 16,000 pounds of bullhead were removed. The 2017 fish survey showed that results of harvests were sustained, and bullheads remained reduced by 75% from 2012 levels. VLAWMO is considering a follow-up fish survey for Fall 2019.
- VLAWMO worked with Barr Engineering to conduct a feasibility study for East Goose Lake. That study included modeling and sediment cores to determine P content and source distribution. The study showed that internal loading is extremely high in East Goose Lake (88%) and recommended an alum treatment as the most effective option to improve the lake. The report is available on the VLAWMO website.
- Ramsey County Soil and Water Conservation Division conducted a vegetation survey in 2014 and followed-up to detect changes in 2019. In 2019, RCSWCD delineated Curly-leaf pondweed, an invasive species found in East and West Goose Lakes. Delineation was requested by MN DNR to inform future plant-management efforts. A healthy shallow lake should have an established plant community and low algae cover. High algae density prevents light penetration through the water column, and plants are unable to establish. In the 2019 survey, aquatic plants were only found at 10 of 116 points. All points with plants were in West Goose Lake. No plants were documented at survey locations in East Goose Lake. Algae abundance was high and included cyanobacteria, which is potentially dangerous to pets and humans. The report is available on the VLAWMO website.
- VLAWMO conducted a literature review to update scientific understanding regarding alum treatments and best practices. That presentation was recorded on June 26, 2019, and made available to the City of White Bear Lake. The recording is available on the VLAWMO website.
- The City of White Bear Lake, working with VLAWMO, seeks to improve water quality, support native plant diversity, control invasive species, and continue to allow use of West Goose Lake for water skiing.

