

## HOW NANOBUBBLE TECHNOLOGY IS NATURALLY RESTORING A MINNESOTA COMMUNITY LAKE



### Client Case Study: Tadd Lake , Atwater, MN

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| <b>Treatment Dates:</b><br><b>July 2-October 24, 2024</b>                                                                                                                                                                          | <b>System:</b><br><b>1,000 gallons per minute trailer mounted nanobubble generator system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Problems:</b> <ul style="list-style-type: none"> <li>• High nutrient levels</li> <li>• Poor water clarity</li> <li>• Muck accumulation</li> <li>• Excessive algae blooms</li> <li>• Poor fishing and recreation spot</li> </ul> | <b>Tadd Lake Results Compared to Upper Lake:</b> <ul style="list-style-type: none"> <li>• <b>Better water quality:</b> Over 300 mV ORP &amp; dissolved oxygen over 3 mg/L 99% of the time</li> <li>• <b>Less muck:</b> 90% reduction in soft organic sediments</li> <li>• <b>Improved clarity:</b> 2 times clearer</li> <li>• <b>Reduced algae:</b> 4 times lower algae count</li> <li>• <b>Reduced nutrients:</b> 10.7% lower total dissolved solids &amp; 10.8% lower conductivity</li> <li>• <b>Restored fishing spot</b> for locals</li> </ul> |

Tadd Lake, a 10-acre freshwater lake in Atwater, MN, once thrived as a popular spot for recreational fishing. However, excess algae and aquatic weeds covering the surface have made it hard to get a hook into the lake depths. As a terminal lake, or a lake that has no natural outlet, Tadd Lake is connected to the 25-acre Upper Lake, and receives inputs from Upper Lake via a small canal. Historically, Tadd Lake has been plagued by issues typical in nutrient-laden water bodies: muck accumulation, low clarity, and frequent algae blooms. In response, the Middle Fork Crow River Watershed District (MCFRWD), the agency dedicated to protecting and preserving water quality throughout the entire watershed, launched a restoration program. The results of this initiative will serve as a model for natural lake restoration, in both the local watershed and beyond.

In search of a chemical-free, foundational solution, MCFRW partnered with Moleaer to use their innovative nanobubble technology, offering a sustainable solution to effectively address water challenges. This partnership aimed to help kickstart the natural recovery of the lake and boost its resilience against common issues like excessive algae growth. Moleaer deployed its trailer-mounted nanobubble system on July 2-3, 2024, introducing oxygen throughout the lake's water column, including the lake bottom, helping mitigate nutrient loading and support aerobic (oxygen-loving) microbial activity. To track impacts of the nanobubble treatment, MCFRWD monitored water quality in both Tadd Lake and neighboring Upper Lake, which served as a comparison site that didn't receive any treatment.

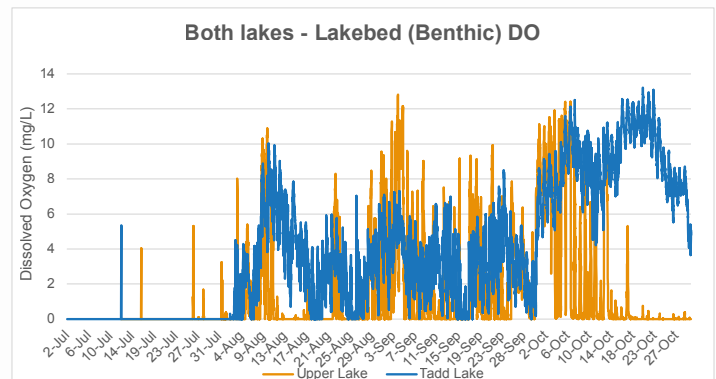


**Figure 1.** An aerial view of Tadd and Upper Lakes, showing the locations of the Moleaer nanobubble treatment unit and buoy-mounted water quality sensors.

### Results of Nanobubble Treatment Show Significant Improvements in Water Quality

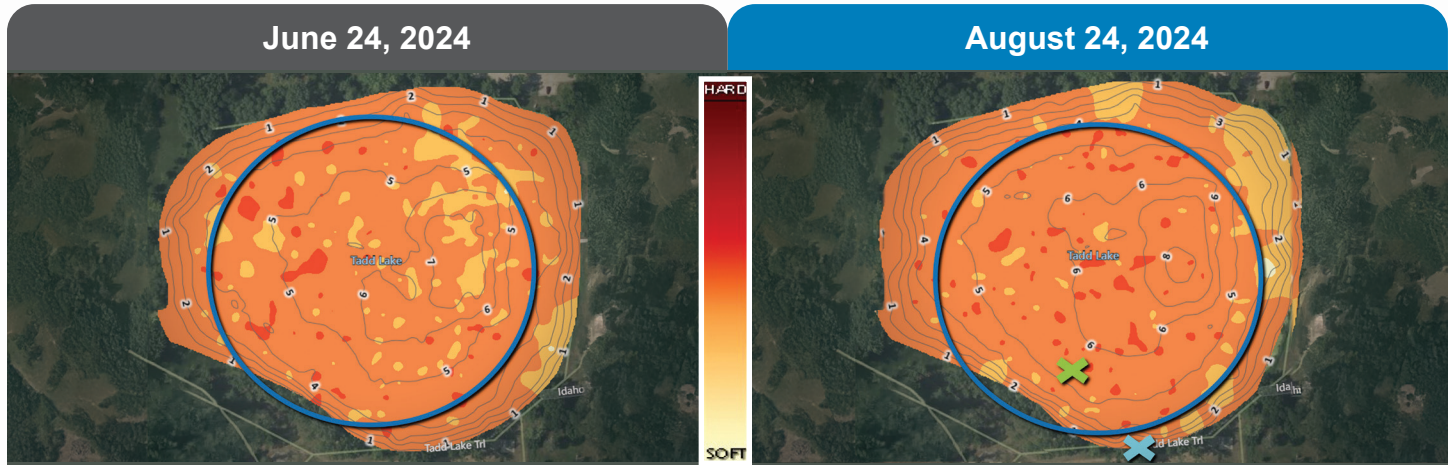
Throughout Tadd Lake, Moleaer's system successfully increased and stabilized dissolved oxygen (DO) and oxidation-reduction potential (ORP) levels. ORP reflects how well water can naturally break down contaminants and maintain good water quality. During the four-month monitoring period from July 2 to October 24, 2024, significant improvements were documented:

- **Oxygenation and Water Quality:** DO levels in Tadd Lake consistently remained above critical thresholds for aquatic life. Surface DO stayed above 3 mg/L for 99% of the treatment period, preventing hypoxic (low oxygen) conditions, and never fell to zero. In contrast, Upper Lake's DO levels dropped to zero at times, particularly during warmer periods. At the lake bottom, the average DO at the bottom (benthic DO) of Tadd Lake was twice that of Upper Lake, staying above 3 mg/L for 65% of the time, compared to only 25% in Upper Lake.
- **Reduction in Muck:** By the end of summer, the bottom of Tadd Lake saw a 90% reduction in soft organic muck in central areas and a 30-40% increase in harder sediment.
- **Nutrient Levels:** Tadd Lake displayed lower nutrient loads compared to Upper Lake, with 10.7% less average total dissolved solids (TDS) and 10.8% less conductivity. This stability potentially results from reduced internal and external nutrient loading due to the nanobubble treatment.



**Figure 2.** Dissolved oxygen measurements from the RDO Blue sensor in the benthic zone (i.e. 1-2 ft above the lake bottom) in Tadd and Upper Lakes after nanobubble treatment in Tadd Lake began.

## HOW NANOBUBBLE TECHNOLOGY IS NATURALLY RESTORING A MINNESOTA COMMUNITY LAKE



**Figure 3.** Sediment hardness mapping results from Tadd Lake before treatment (June 24, 2024) and 30 days after treatment began (August 2, 2024). Green X indicates location of discharge point from Moleaer nanobubble generator. Light blue X indicates location of Moleaer system on land. Area circled in blue shows greatest reduction in softer, organic matter ("i.e. muck") between the two dates.

- **Algae Control:** Tadd Lake had four times fewer blue-green algae cells than Upper Lake and maintained a more diverse algae community.
- **Enhanced Clarity and Ecological Resilience:** Water clarity in Tadd Lake improved significantly. By the treatment's end, it was more than twice as clear as Upper Lake. The enhanced clarity allowed sunlight to reach greater depths, fostering more photosynthesis and encouraging a healthier and more diverse phytoplankton community essential for a resilient ecosystem. Daily imagery of both lakes confirmed that Tadd Lake remained clear while Upper Lake experienced a severe algae bloom, creating a stark visual contrast.



**Figure 4.** Aerial photos of Tadd and Upper Lakes taken before July 2, on July 28, and September 29, 2024. Pictures courtesy of Tony Vruwink.

### From Challenges to Solutions: Natural Restoration for Minnesota Lakes and Beyond

The Tadd Lake restoration project showcases the effectiveness of Moleaer's nanobubble technology in naturally restoring lake health. The results are compelling: higher DO and ORP levels, reduced muck, greater water clarity, reduced total and blue-green algae, and a more diverse algae ecosystem – despite the challenges posed by summer heat, exceptionally heavy and frequent rainfall, and associated nutrient influx events. Nanobubble technology has proven to be a powerful, chemical-free solution for lake restoration, achieving results that pave the way for sustainable water quality management for MCFRWD and other communities facing similar issues.



Learn how nanobubbles naturally restore waterbodies to reduce algae, muck and foul odors. Visit our website:  
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