



NANOBUBBLE TREATMENT ENABLES HEALTHIER LAKE PROCESSES IN LAKE ARROWHEAD MARINA

Improved Water Clarity, Dissolved Oxygen Levels and Sediment Hardness

Client Case Study: Lake Arrowhead Marina

<p>Lake Size:</p> <p>295 acres with a 2.5-acre marina area</p>	<p>Unit:</p> <p>Moleaer Titan NBG4 with Oxygen Concentrator</p>	<p>Results:</p> <ul style="list-style-type: none"> • 100% higher DO levels than control after 75 days • Improved water clarity by more than 3 feet • Improved sediment hardness composition
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Tri-Lakes Management District oversees a watershed composed of three interconnected man-made lakes in central Wisconsin. With picturesque views, residents' homes are positioned along the shoreline, for homeowners to enjoy their dock, swimming, boating and fishing.

In recent years, the lakes have been plagued with algae proliferation and deteriorating lake conditions caused by poor water quality and stagnant water. The lakes have numerous fingers, making traditional treatments very challenging and often ineffective. Additionally, excessive nutrients from external loading sources contribute to worsening lake conditions in this community. The lake management district sought a sustainable, chemical-free solution that would provide lasting value to their lake community, so they turned to Moleaer's nanobubble technology.

To evaluate the investment in a larger project to treat all three lakes, the Tri-Lakes Management District decided to conduct a pilot project in Lake Arrowhead's marina, an isolated section that would provide a good comparison to the control.



The Project: Establishing Baseline Parameters & Deploying the Nanobubble Trailer

Sediment hardness mapping was conducted in the marina to help establish a baseline for treatment and quantify the differences. Harder sediment indicates healthier lake processes than softer sediment. Water quality monitoring buoys were set up to measure dissolved oxygen concentrations, saturation and temperature in the marina with a control buoy in Lake Sherwood, one of the three lakes.

Following baseline parameter establishment, Moleaer installed a nanobubble generation trailer with oxygen on the shoreline of the marina, treating the lake at a rate of 1,000 gallons per minute.

The Results: Nanobubble Technology Improves Marina's Natural Lake Processes Increased Water Clarity

Within one day of nanobubble treatment, there were already visual improvements in water clarity. At installation, the water was so murky and full of algae that you couldn't see the intake and discharge pipes in the water, however, shortly after installation, the pipes were more visible from improved water clarity.

Throughout the rest of the study, there was reduced algae in the water column and on the surface. The overall water clarity improved by over 3 feet in depth over the treatment period, noticed by slip owners in the marina. Lastly, slip owners mentioned more fish activity, visible especially near the nanobubble discharge pipe.

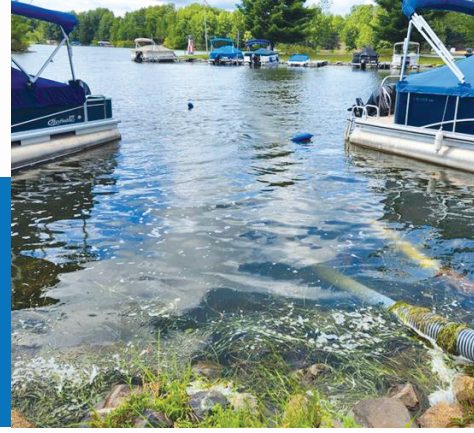


Before Nanobubbles

After One Day of Treatment with Nanobubbles

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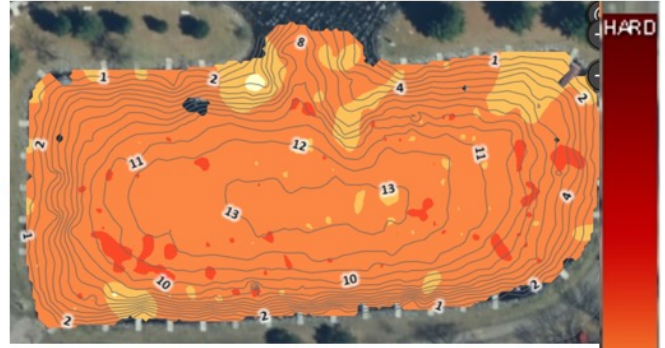
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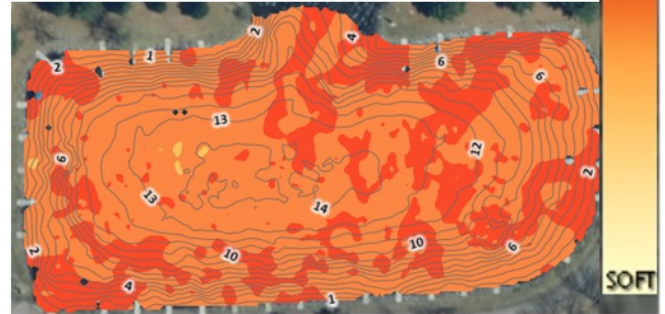
Improved Sediment Hardness Throughout the Marina

The most notable improvement was seen when comparing the sediment hardness before and after nanobubble treatment. There was an overall improvement throughout the marina with an increased depth of one foot. This was attributed to reduced organic sediment, or muck, volumes and better bottom composition as a result of increased natural lake processes from nanobubble treatment.

Before



After



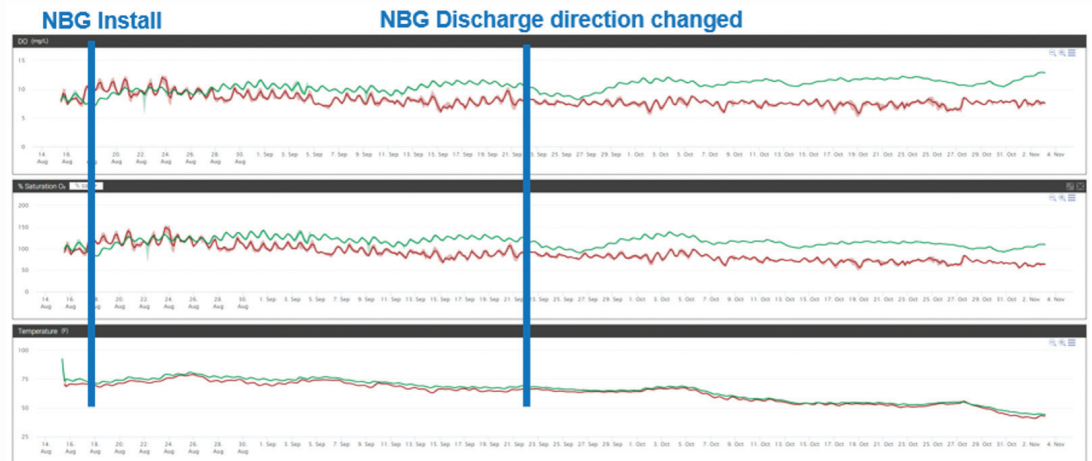
Increased Dissolved Oxygen

Additional improvements were seen in dissolved oxygen (DO) measurements. After two months of treatment, the DO levels were 100% higher than the control.

Overall nanobubble technology raised and kept the DO levels above saturation near the sediment layer. This is significant because beneficial bacteria that break down muck need a more oxygenated environment to thrive. These natural lake processes improve sediment hardness and water clarity.

The marina's DO levels also experienced fewer diurnal changes than the control buoy as seen in the graph. This suggests that nanobubble technology helps stabilize DO levels, even in hotter temperatures when water naturally has less ability to hold dissolved gases.

Following the success of this pilot project, Tri-Lakes Management District is working with their community to implement a prescriptive plan for at scale nanobubble treatment. This will require enough nanobubble generators for the harder-to-reach and stagnant parts of the three lakes, along leading to improved water quality, improved lake resiliency, reduced algae and overall improved natural lake processes.



Green= Marina Red= Sherwood Finger
Note: NBG turns over marina in 3 days.



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