MOLEAER®

Pokegama Lake Nanobubble Treatment Options

Sep 2024

Who We Are

Category Creator & Global Leader of Nanobubble Technology

Today: *Enabling Industries & Municipalities to Produce More Using Less Water, Energy, and Chemicals*

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>3,000
Installations

>1M
Gallons Treated per Minute

55
Countries

15
Unique Patents and Patent Applications

94
Employees focused on advancing NB technology

2
Manufacturing Facilities: Los Angeles (HQ) & Spain

2016 — **Founded** in Southern California & patented nanobubble technology.

BRUCE SCHOLTEN
Co-Founder,
Chief Technical Officer

WARREN RUSSELL
Co-Founder,
Chief Commercial Officer

2017 — **First** commercial nanobubble generator launched for wastewater.
Company seed funded.

2018 — **Tested in greenhouses**, saw 50% yield and entered market.
Tested on ponds, saw 300% improvement in clarity and entered market.

2019-2020 — **Shifted our focus** to greenhouses and small ponds.
Moleaer delivers its 500th nanobubble system. Expands into Canada and Mexico.

2021 - 2022 — **Expanded** into Aquaculture and Oil & Gas.
Began to form partnerships (Jacuzzi).

2023 — **Moleaer opens** manufacturing facility in Spain and office in Norway. Nanobubbles can go beyond water; develop new applications in food, water, energy and industrial processes. Built R&D and App Development team.

2024 — **Moleaer opens** office in Chile.
Reaches 3,000 installations and >1M gallons of water per minute in treatment.

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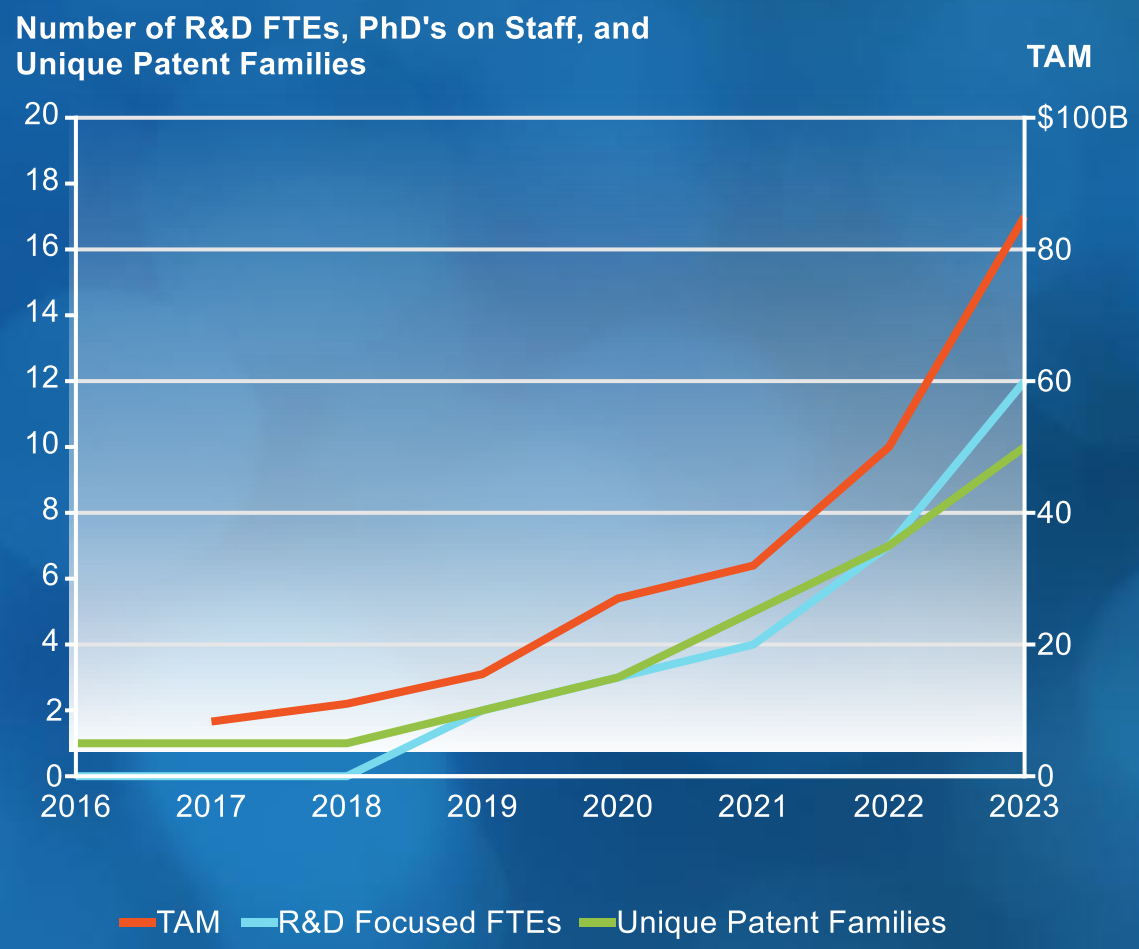
Largest R&D Team Studying Nanobubbles in the World

Exponential Growth in R&D Team and Patents Filed



- June 2022: Moleaer built out the **largest NB R&D team in the world focused on the fundamental and applied research of nanobubbles**

- Moleaer's ability to develop effective solutions has both expanded and accelerated, resulting in a wider range of applications and faster commercialization of nanobubble applications

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Our Strengths: Innovation, Flexibility & Efficiency

Cutting Edge R&D & Intellectual Property

- Discover & Apply Nanobubble Properties and Benefits
- 15+ University & Research Partnerships
- 8 PhD's in Chemistry, Electrochemistry, Environmental Engineering
- 15 Unique Patents & Patent Applications

Diverse Suite of Products

- Requires Minimal Additional Infrastructure
- Scalable to Any Flow: 1 – 8000+ Gallons per Minute
- Versatility: Inject Any Gas into Any Liquid

High Volume Production, close to Customers

- Assembly Facilities in Los Angeles and Spain; Warehouses in Norway & Chile
- System Engineering expertise to develop products tailored to each Application
- Outsource Fabrication as Needed

Global Footprint & Leadership

- Sales and Service Technicians in N. America, L. America and Europe
- Local Distributors and Global Partner Network

Flexible Sales Models

- Capital Equipment, including Custom-Built Systems
- Nanobubbles-as-a-Service (NaaS)
- OEM Partnerships: Core Tech Designed as Components into Partners' Products
- After Market Services

Origin | Zirku Island Wastewater Treatment Facility

Problem: lagoon couldn't keep up with the high volume of wastewater, causing foul odors and low oxygen levels in the water

Solution: **Tinybubbles LLC** develops a Nanobubble Generator to make small bubbles that will improve oxygen transfer efficiency and hit the DO target

Results: Within 24 hours:

- DO levels rose to 7.0 ppm (>4x higher than before)
- 59% decrease in Biological Oxygen Demand (BOD) from 110 mg/l to 45 mg/l

Conclusion: nanobubbles behave differently, they have a secondary affect beyond dissolved oxygen, and can significantly improve biological processes such as wastewater treatment

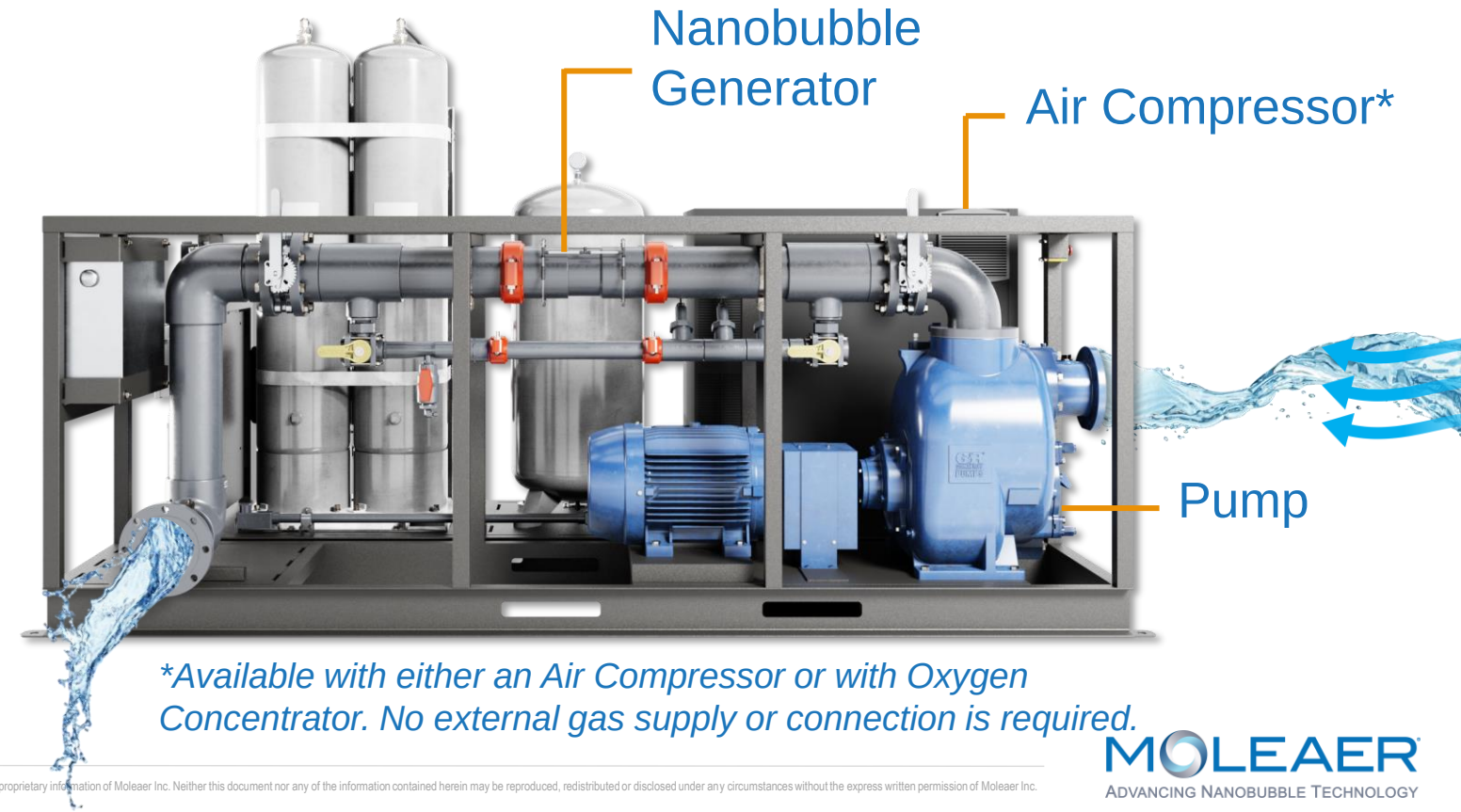
Moleaer's Patented Technology

Scalable to meet the needs of any size waterbody:

100's of installations over 1000 GPM

Introduces **dissolved oxygen** and **nanobubbles**:

- Most cost-effective way to provide critical dissolved oxygen to waterbodies
- Nanobubbles deliver the oxygen into the sediment where it is needed most
- Promotes natural lake cleaning processes



**Available with either an Air Compressor or with Oxygen Concentrator. No external gas supply or connection is required.*

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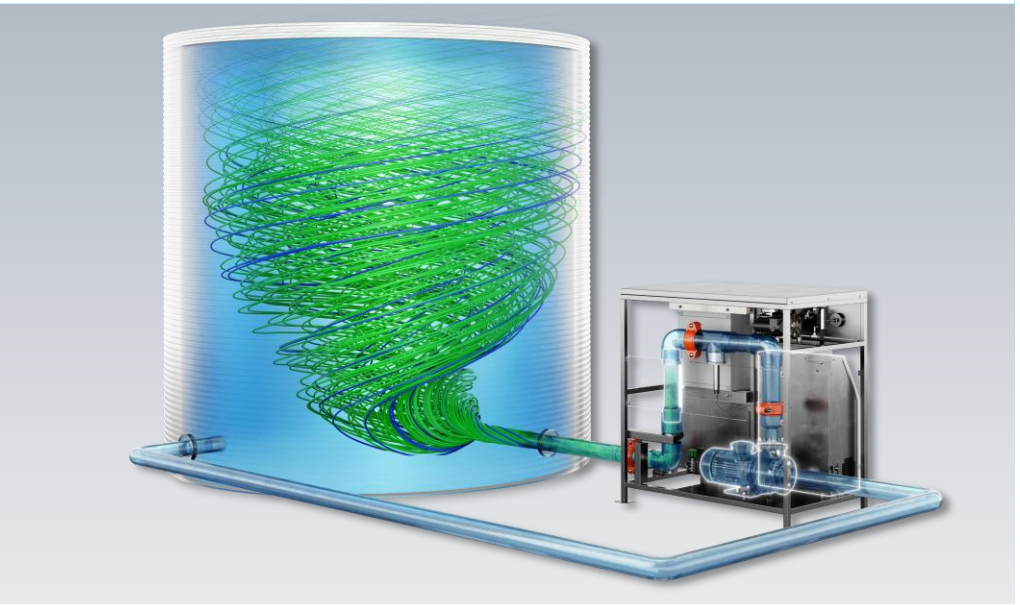
Patented Technology Produces Two Forms of Air in Water

DISSOLVED

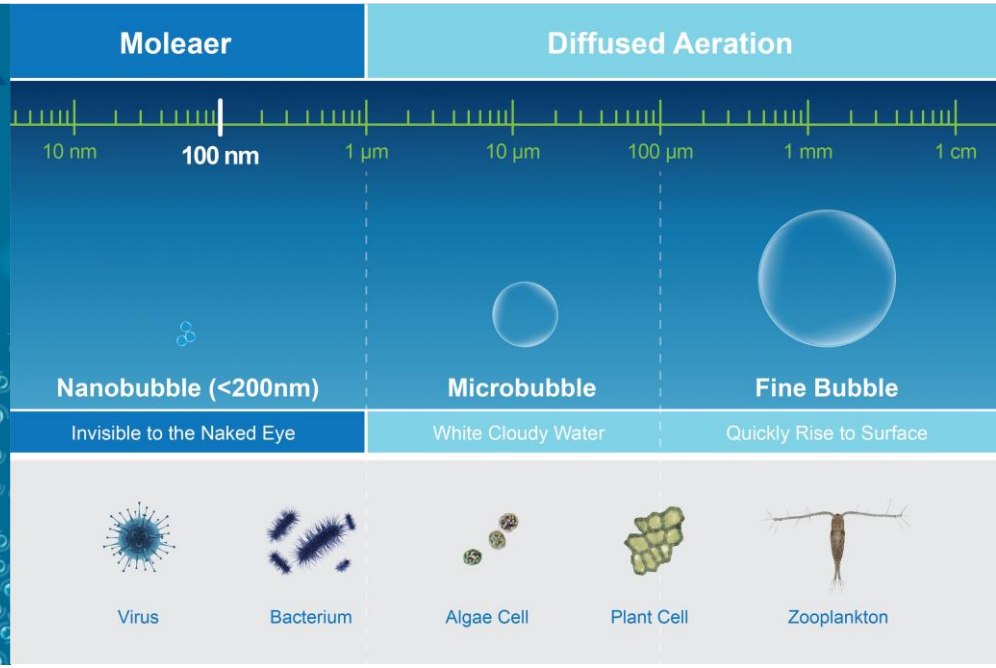
Dissolved Oxygen = Amount of Oxygen in Water

Moleaer's nanobubble technology **dissolves oxygen** with best-in-class efficiency in any depth waterbody at scale



NANOBUBBLES

Nanobubbles behave differently from all other bubbles
All their beneficial attributes — **stability, surface charge, neutral buoyancy, etc**. — are the result of their size
These unique features enable nanobubbles to disperse throughout a water body, delivering and retaining oxygen at all depths



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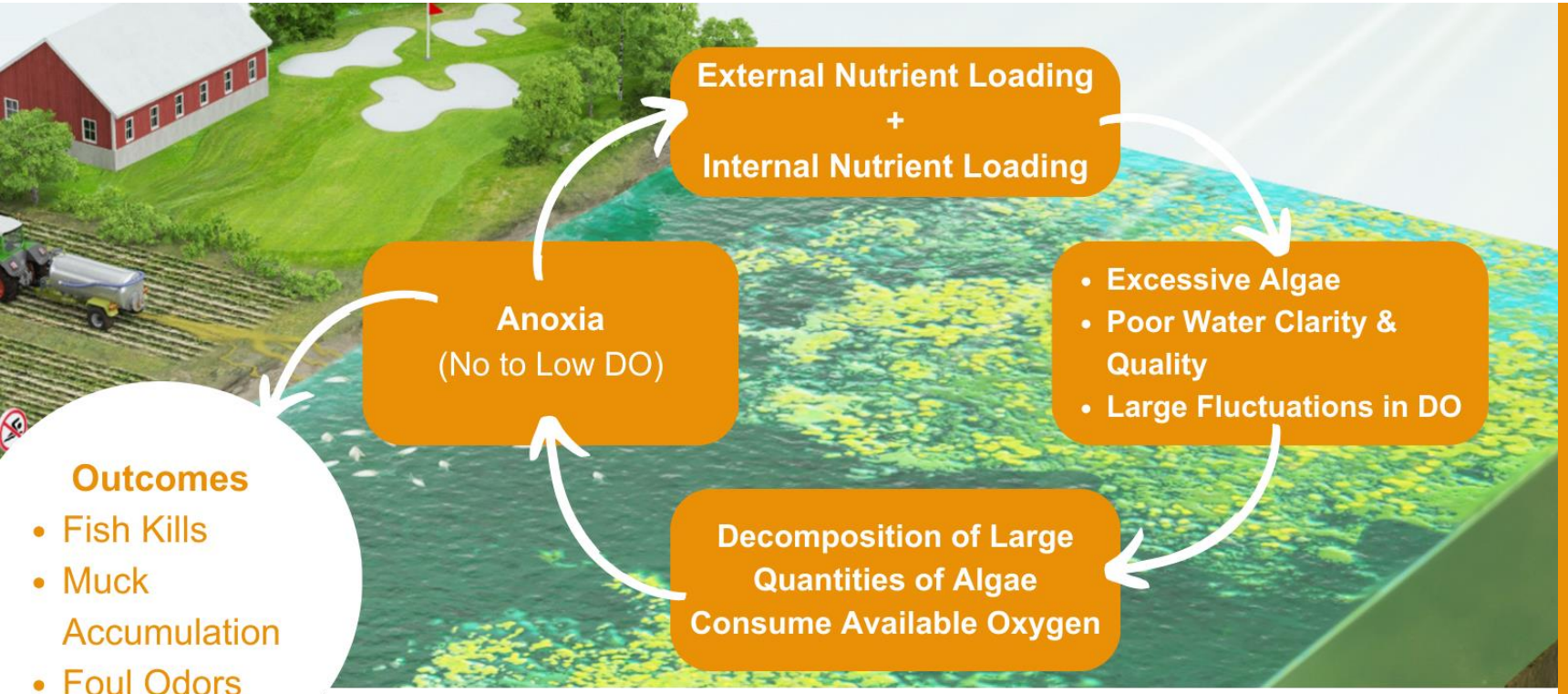
How Does a Lake Become Impaired?

Excess nutrient levels create a cycle that continues to worsen with time



STATUS QUO

- Excess nutrients (lawns, farms, storm water, wastewater) enter a lake
- Nutrients > natural biology need
- Temperatures ↑, algal cysts germinate, feed off nutrients and bloom
- Decomposing algae consume oxygen, → organic matter (muck) and internal nutrient loading
- Warmer temperatures → dissolved oxygen levels drop further → more muck and even more nutrient loading
- These nutrients drive more algae blooms, creating a feedback loop
- Vicious Circle: reoccurring algae blooms, low oxygen, thick muck, high odors, fish kills

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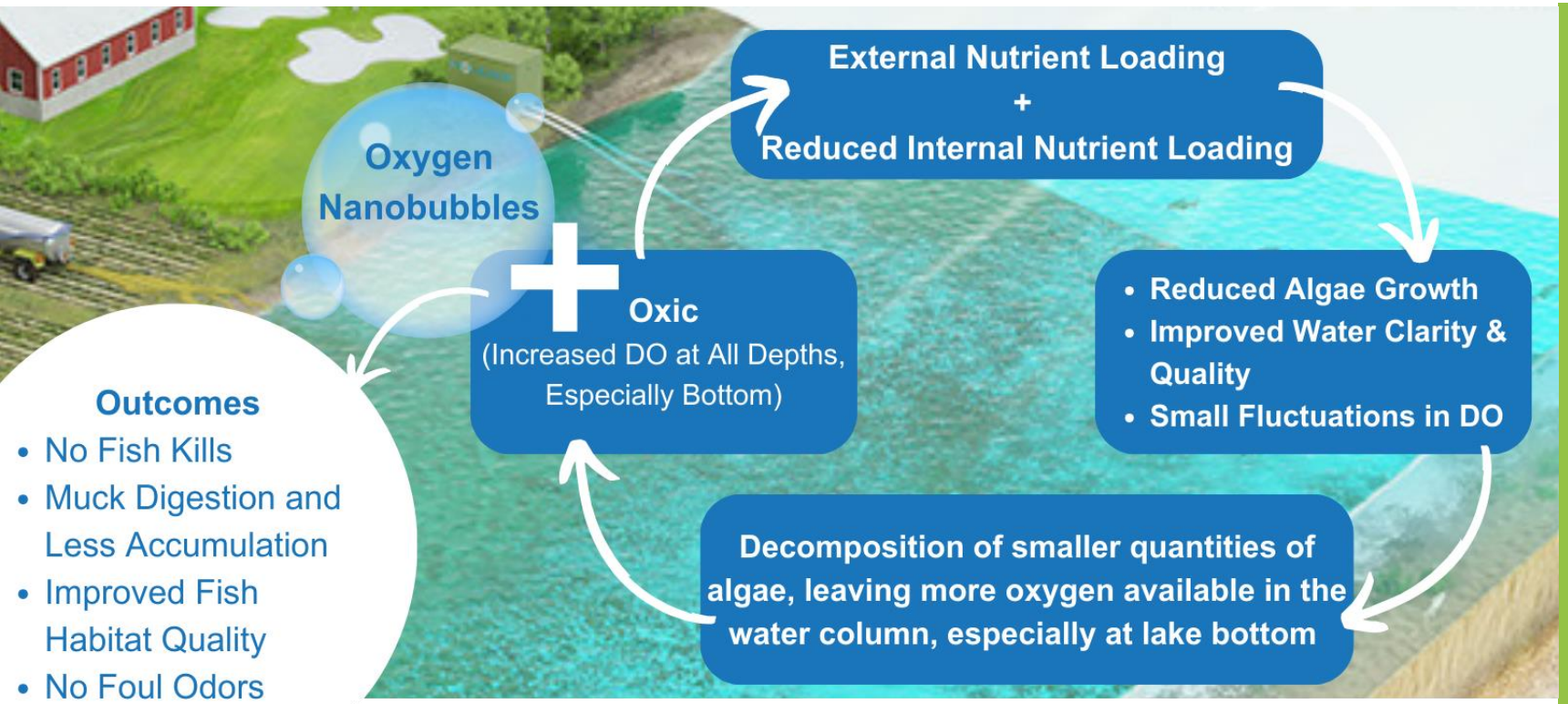
Oxygen Nanobubbles Change the Status Quo

Moleaer oxygen nanobubble treatment helps break the negative loop



- Moleaer introduces **dissolved oxygen** and **nanobubbles** into the waterbody
- Most cost-effective way to provide critical dissolved oxygen to waterbodies
- Nanobubbles deliver the oxygen into the sediment / muck where it is needed most
- Promotes natural biological lake restoration processes

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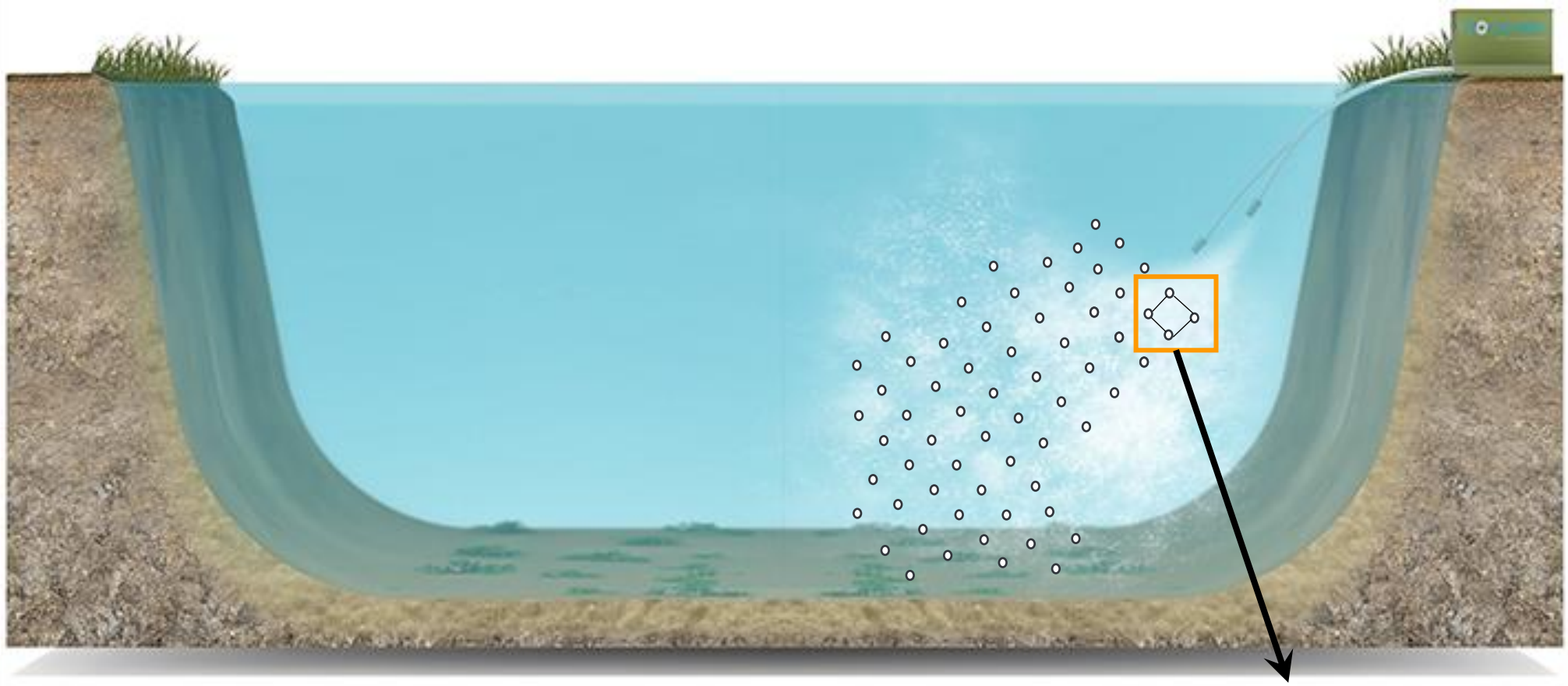
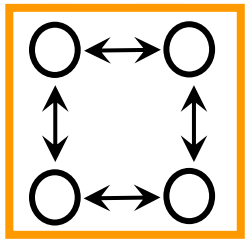
How Nanobubbles Spread in a Lake (At the Start)



A nanobubble is a hollow sphere enclosing gas (e.g. air, oxygen, etc.). The inside of each bubble is characterized by very high internal pressure, while the outside is characterized by a strong electrical negative charge. This negative charge pushes individual bubbles away from each other, causing them to self-arrange in a grid-like fashion in water (as part of a cloud of nanobubbles), upon discharge from the nanobubble generator.



= Individual nanobubble with strong negative surface charge

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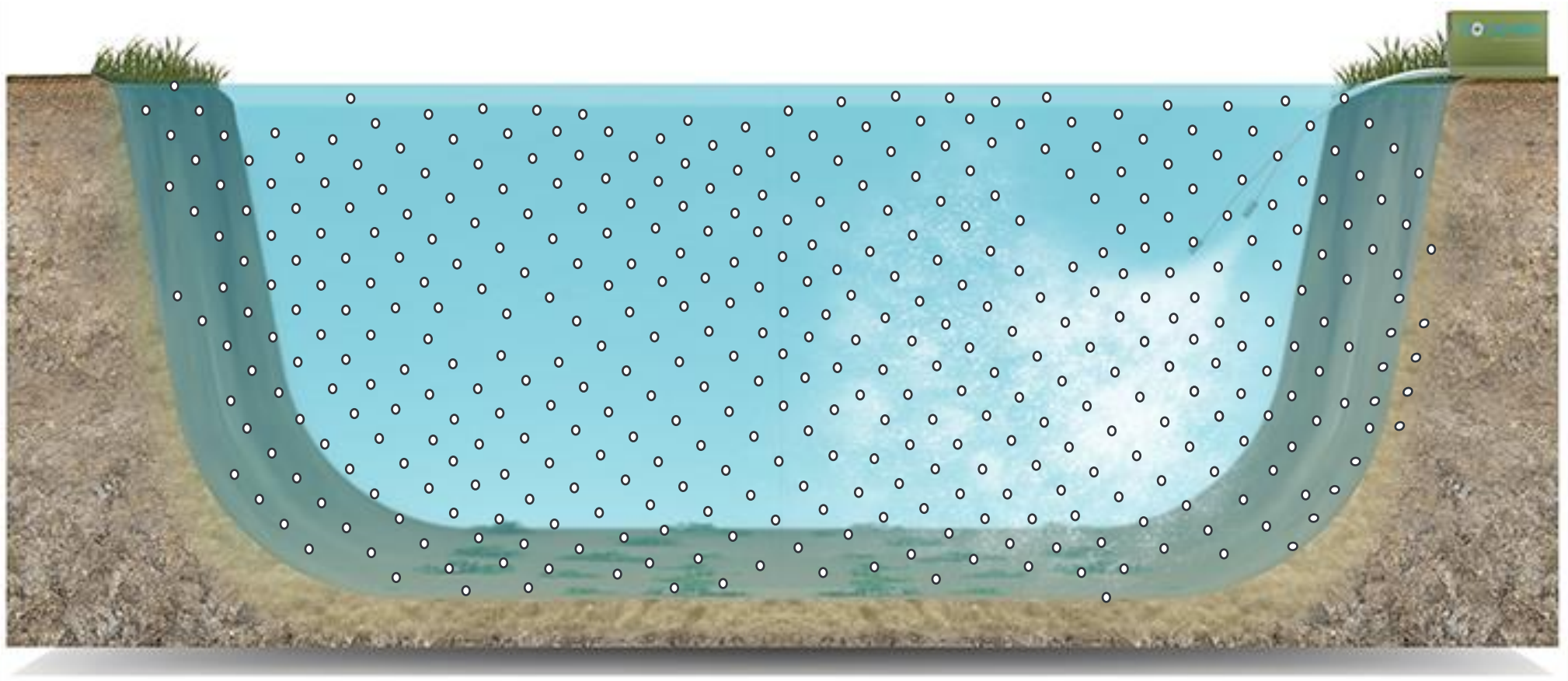
How Nanobubbles Spread in a Lake (Over Time)



Also, because of their size, individual nanobubbles are not buoyant (i.e. do not rise to the surface to pop), and so, remain stable in the water column. They behave like Brownian particles, meaning they move in random directions. As the cloud of nanobubbles expands with continued nanobubble generation and moves in the water, the previously-mentioned behavioral features of nanobubbles, combined with their strong negative surface charge keeping individual bubbles apart, enable the nanobubbles to spread evenly in all directions in a lake from a single discharge point. In addition to this, large fetches, wind, inflow and outflow water movement, and natural lake mixing processes all work to further enhance this spread of nanobubbles in a lake.

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Nanobubbles Increase & Stabilize:

1) Dissolved Oxygen (DO)

2) Oxidation-Reduction Potential (ORP)

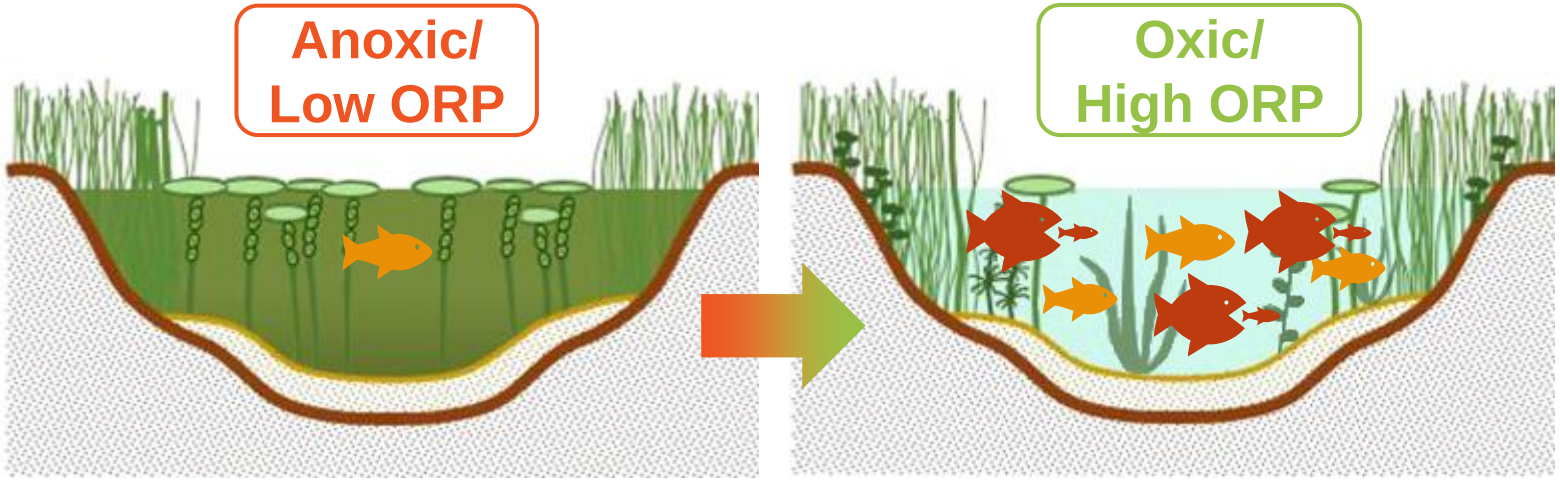


Image credit O'Hare et al. (2018) Front. Plant Sci.

In an impaired, anoxic water body, NB treatment ↑ lake DO and ORP which:

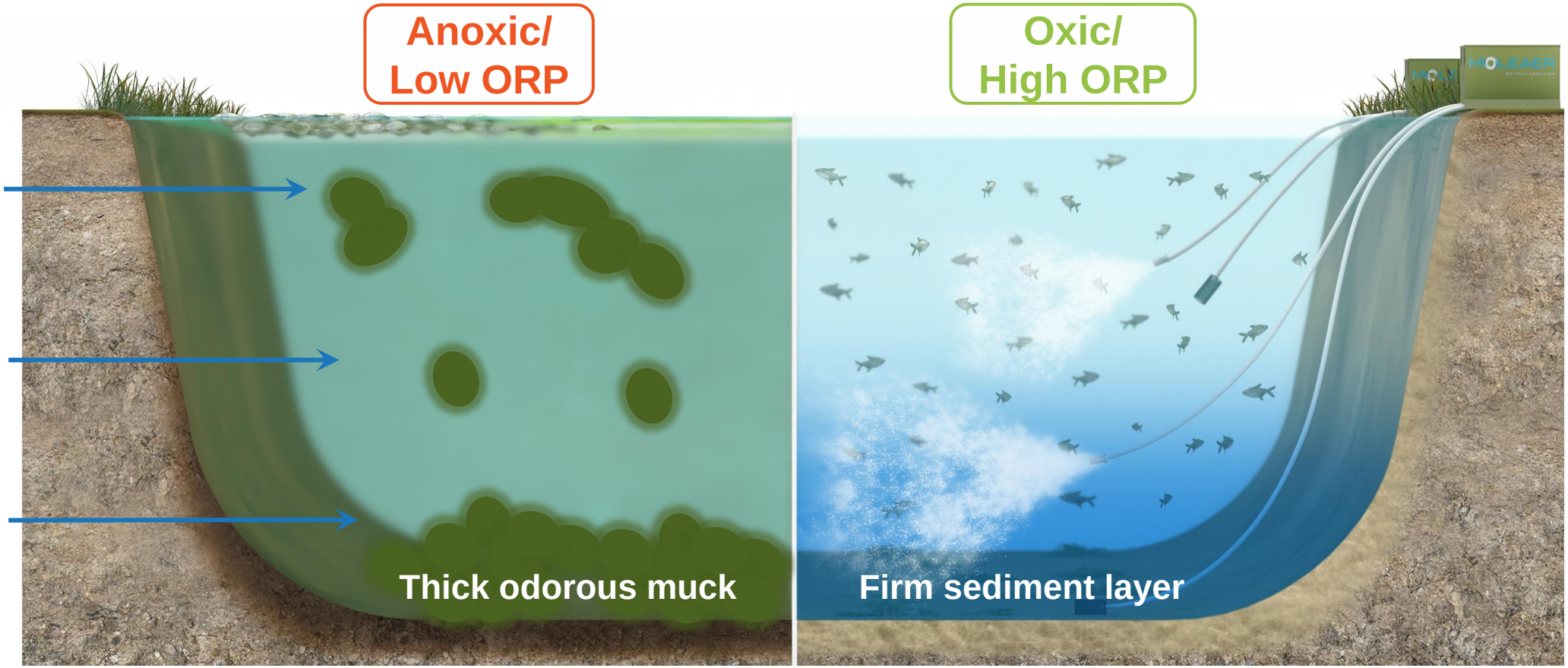
- ↑ Muck digestion
- ↓ Internal nutrient loading
- ↓ External nutrient loading*

A restored, oxic water body characterized by:

- Improved water quality and clarity
- ↓ Algae growth, blooms, and toxin levels
- ↓ Excessive aquatic plant growth*
- ↑ Biodiversity throughout the lake and boosts fish stocking capacity by maintaining DO levels > 3 mg/L[#]

[#]*DO threshold for hypoxia (i.e. minimum DO level below which aquatic organisms have difficulty surviving)*

Nanobubbles Support Natural Muck Digestion



Anoxic/Low ORP Conditions

- Decomposition of large quantities of dead algae consumes oxygen in the water column, resulting in accumulation of organic matter (i.e. “muck”) at lake bottom

Oxic/High ORP Conditions

- Decomposition of smaller quantities of dead algae leaves more oxygen available in the water column
- Increased oxygen availability re-starts aerobic microbial metabolism that digests the muck, revealing firm sediment

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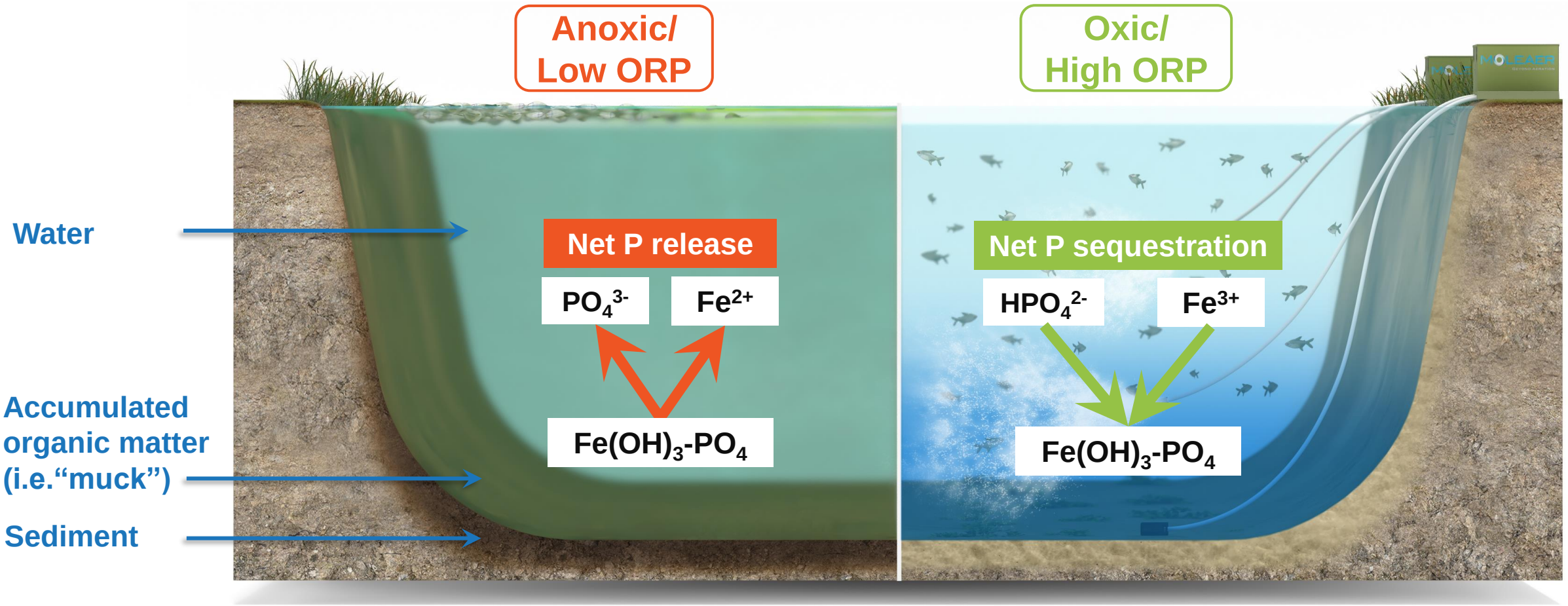
Internal Nutrient Loading: Net P Sequestration

Mainly chemically-mediated



Anoxic/Low ORP

Iron (or manganese)-bound P gets reduced, releasing Fe^{2+} (or Mn^{2+}) and PO_4^{3-} (Net P release)

Oxic/High ORP

Fe^{3+} (or Mn^{3+}) combines with HPO_4^{2-} , gets oxidized, and binds P (Net P sequestration)

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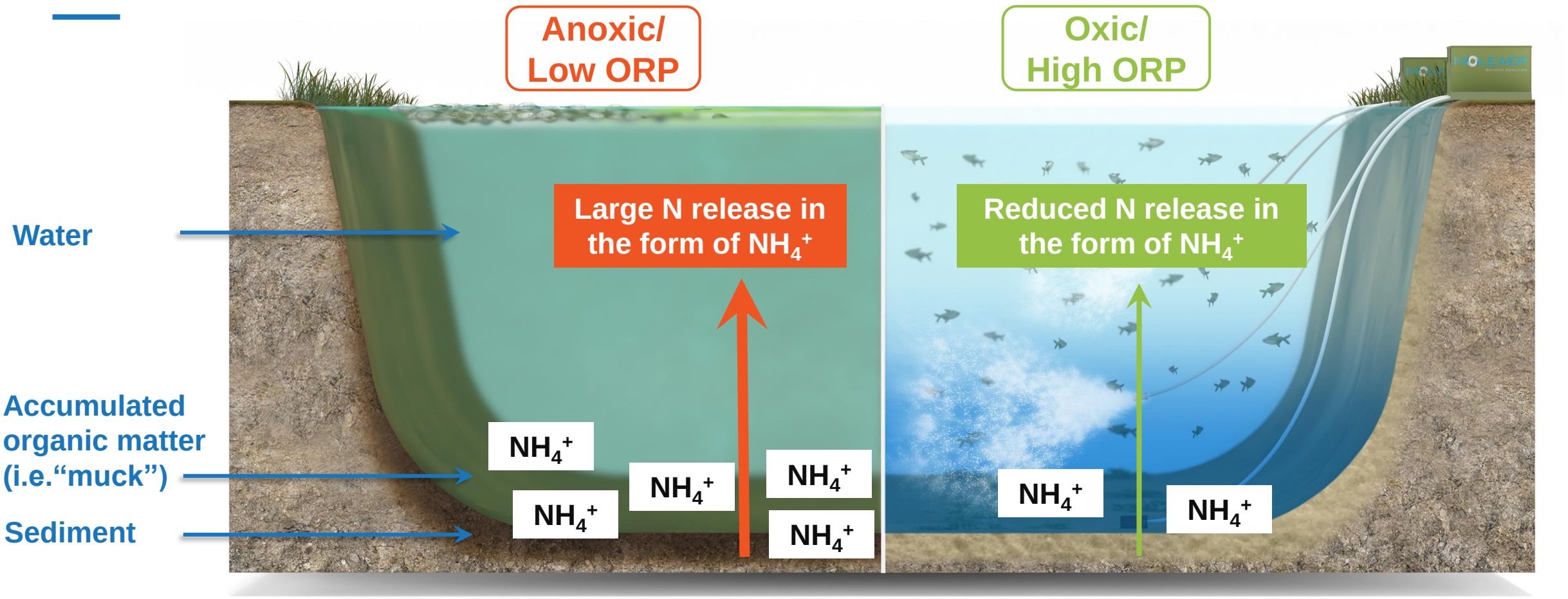
Internal Nutrient Loading: Reduced N Release

Mainly microbially-mediated



- Both conditions: Decomposition of dead biomass by microbes releases N
- **Anoxic/Low ORP**: Rate of NH_4^+ release from certain microbes > Rates of NH_4^+ uptake and conversion to N_2 gas by other microbes
  → Large NH_4^+ release into water column
- **Oxic/High ORP**: Rates of NH_4^+ uptake and conversion to N_2 gas rate by certain microbes > Rate of NH_4^+ release from other microbes
  → Reduced NH_4^+ release into water column

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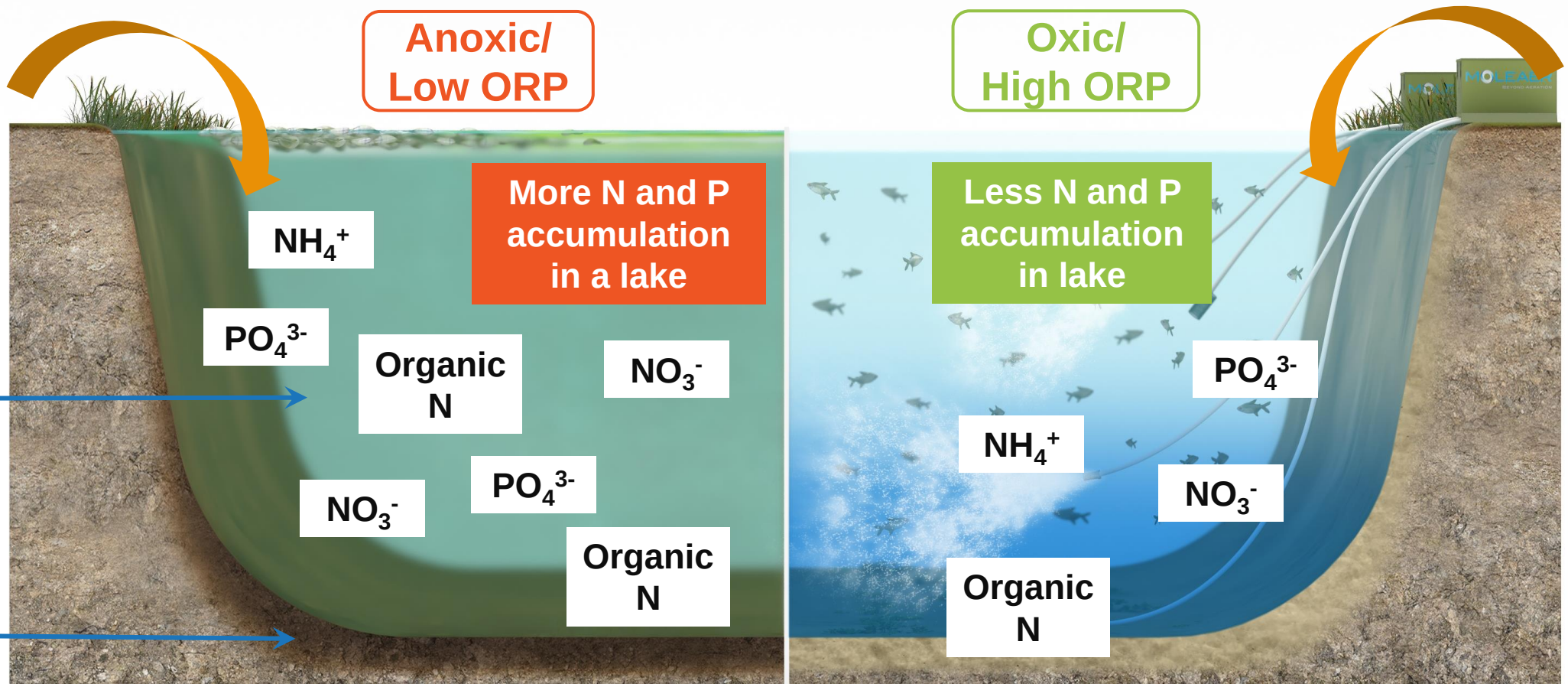
External Nutrient Loading*: N and P Reduction

External loading of N and P

Water

Sediment



Low ORP (< 300mV)

Lower chemical, bio-chemical, and biological N and P uptake and sequestration rates

→ Higher N and P levels in lake

High ORP (300 – 500 mV)

Higher chemical, bio-chemical, and biological N and P uptake and sequestration rates

→ Lower N and P levels in lake

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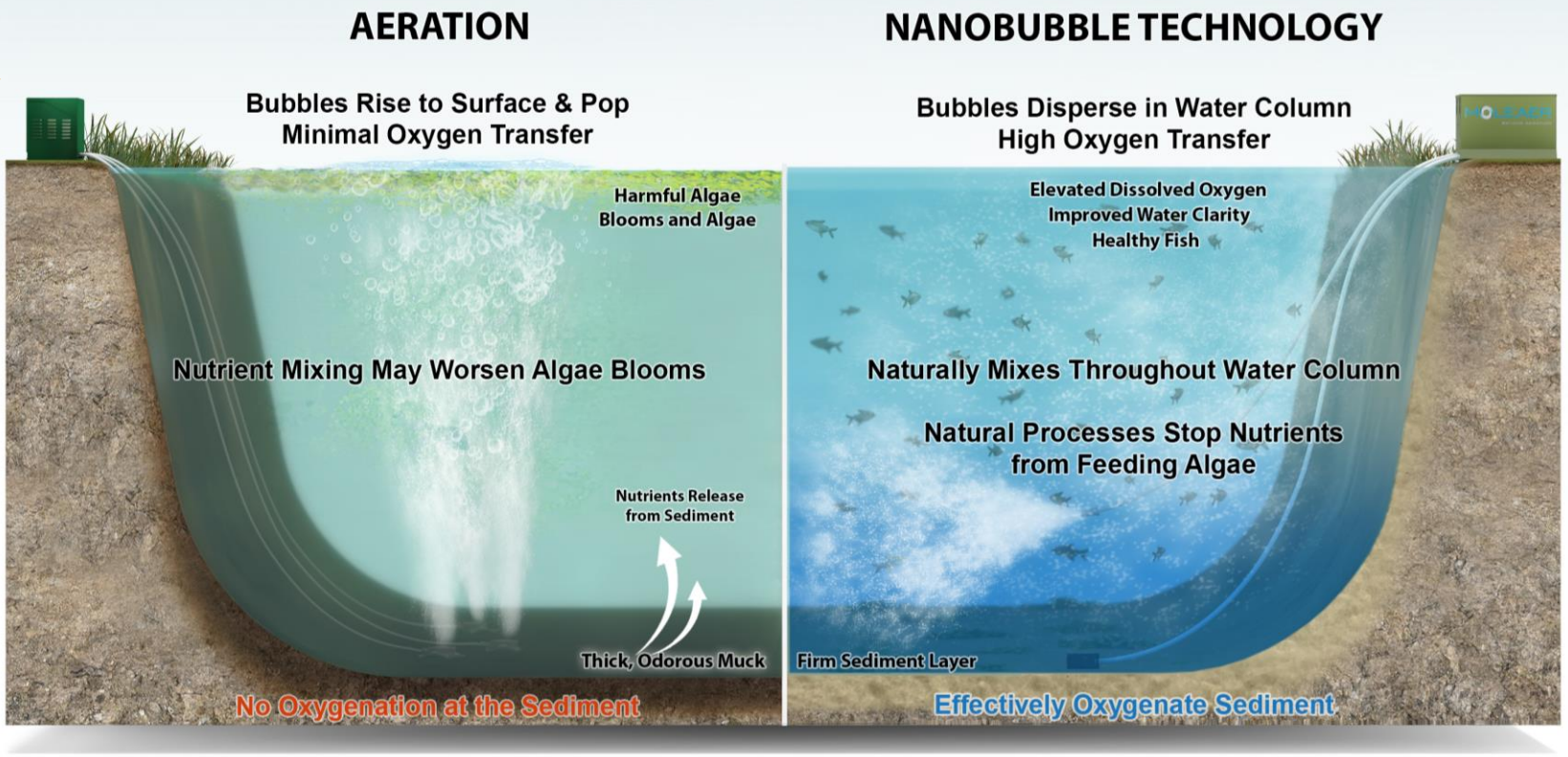
Moleaer's Nanobubble Technology vs. Aeration / Oxygenation Systems

Aerate means to "supply with air" or to "supply with oxygen by respiration"

Localized benefit only
No benefits
to flowing water

Submerged components or large areas and require high maintenance

May require dredging for installation



Easy to maintain, shore-mounted equipment

Single treatment point for large areas

Flexible air sources (air, oxygen or ozone)

Works in all waterbodies (big, small, deep, shallow and flowing)

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Basis of Adaptive Lake Management Program

*Moleaer's Nanobubble Treatment is the Foundational Component of a Larger, Long-Term, Multi-Faceted, Adaptive Lake Management Program

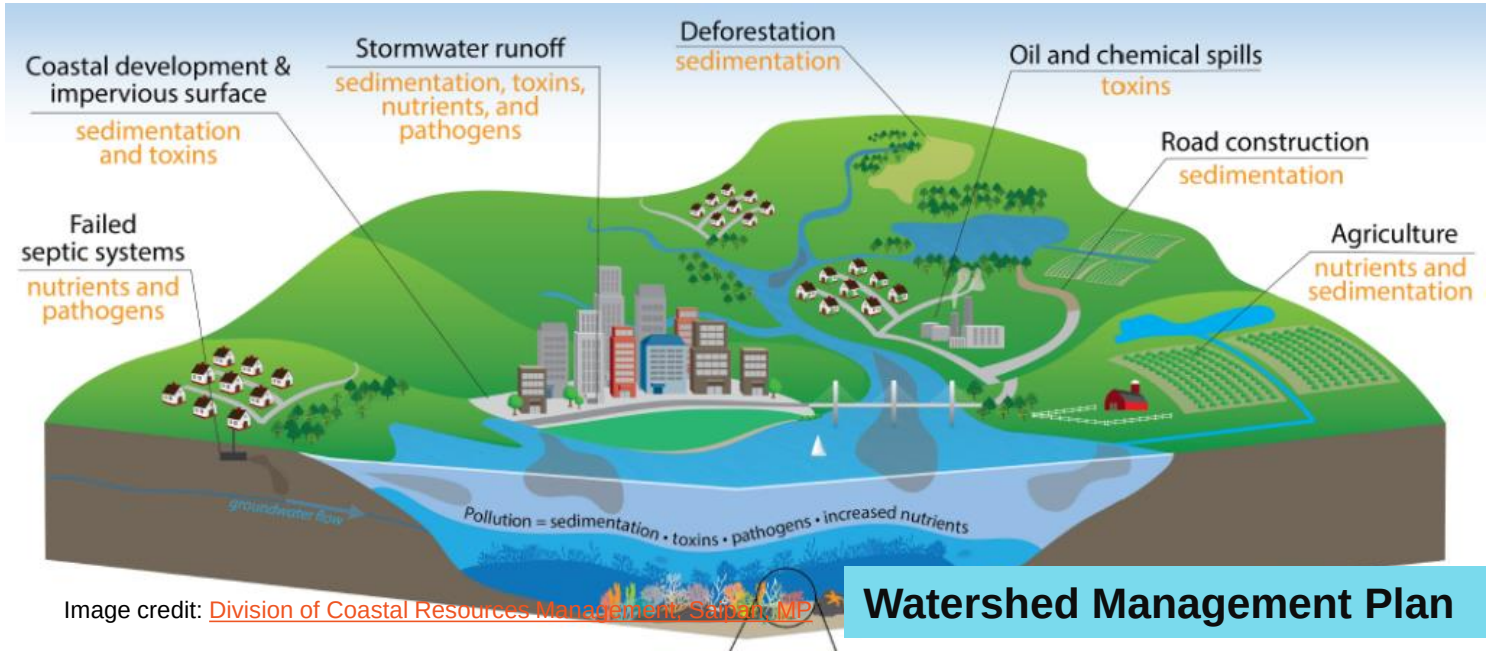

Image credit: Division of Coastal Resources Management, Saipan, MP

Watershed Management Plan

- **Reducing external nutrient loading** to the lake **still needs to be done.**
- **Lake-focused** efforts such as periodic aquatic weed harvesting and chemical treatments (i.e. nutrient sequestrants, herbicide, algaecide, etc.) **may need to be used,** especially at the start of nanobubble treatment, until lake nutrient levels are under control.
- **Long-term nanobubble treatment and external nutrient loading reduction should reduce the frequency, effort, and funds invested in such lake-focused efforts in the long-run.**

Image credit: Weeder's Digest

Surface Water Case Studies

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Lake Elsinore, California

Lake Metrics:

- Surface Area: 3,311 acres (1334 ha)
- Max Depth: 16 ft (4.9 m)
- Volume: 30K acre-feet (37 million m^3)
- Receives 6.5M GPD (24 million m3) of treated effluent

Climate: Mediterranean/ Semi-arid

- Temperatures: 53 to 81°F (11 to 27°C)
- Precipitation: 12.4” (32 cm)/year

Main use of lake:

- Recreation (boating)

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Lake Elsinore: Reduce Algae & Improve Clarity

Nanobubble System Metrics:

- NBG Barge: 2,400 GPM (545 m^3/hr) system
- Turnover Rate: 7.8 years

Danger advisory levels and/or lake closures for 4 out of the last 7 years

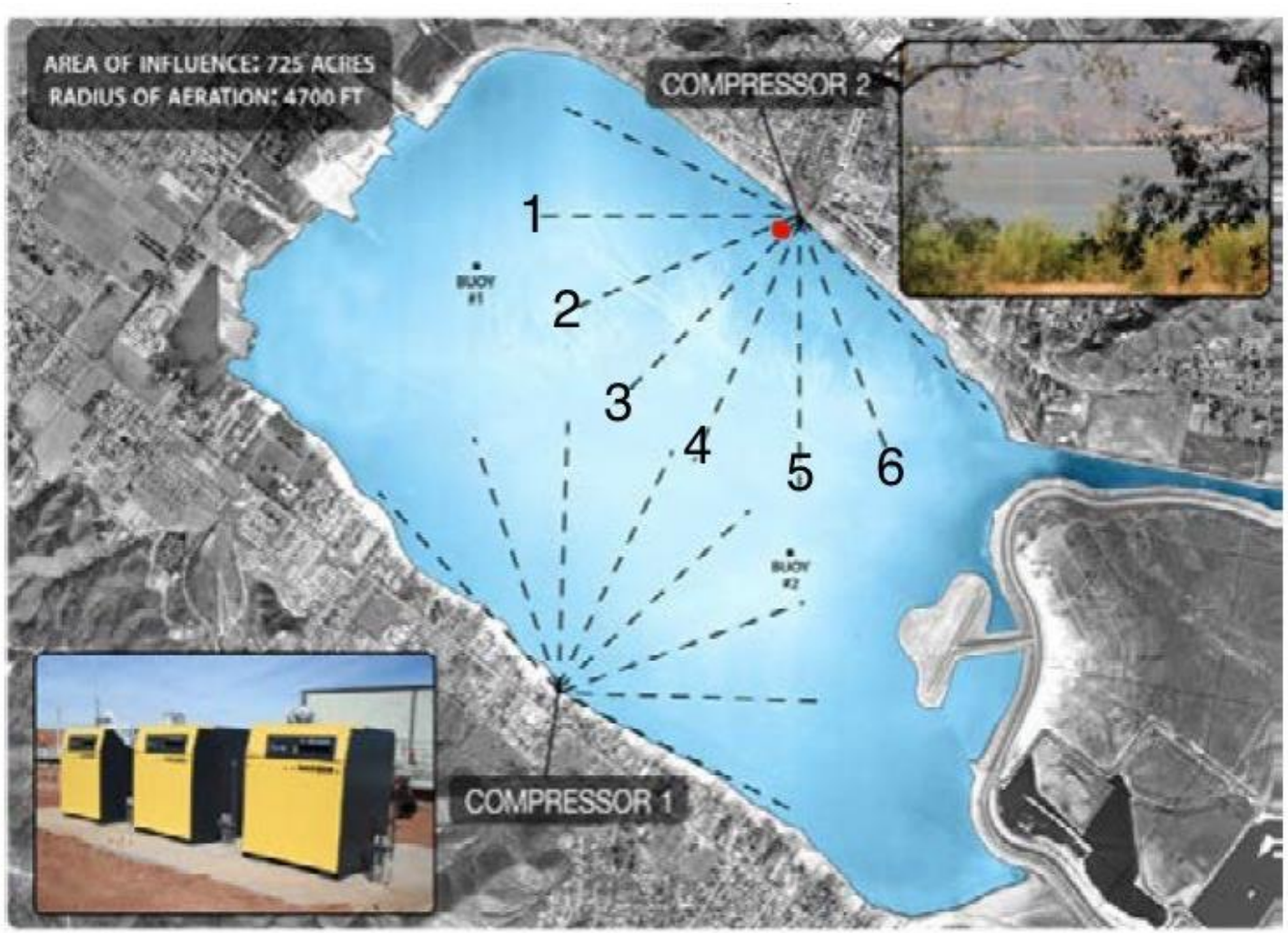
Summer 2022 - Lake closes for 8 months to recreation due to harmful algae blooms

Lake Elsinore: LEAMS (Aeration) System

Installed: 2006

Approximate Cost: $5M

Replacement and Redesign Currently Underway



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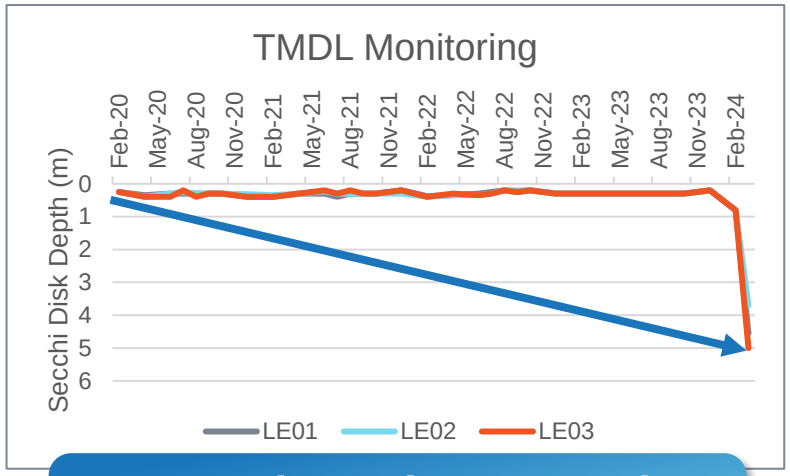
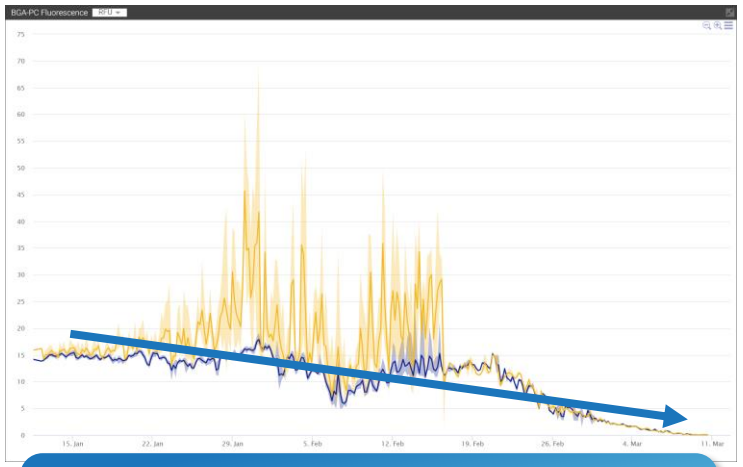
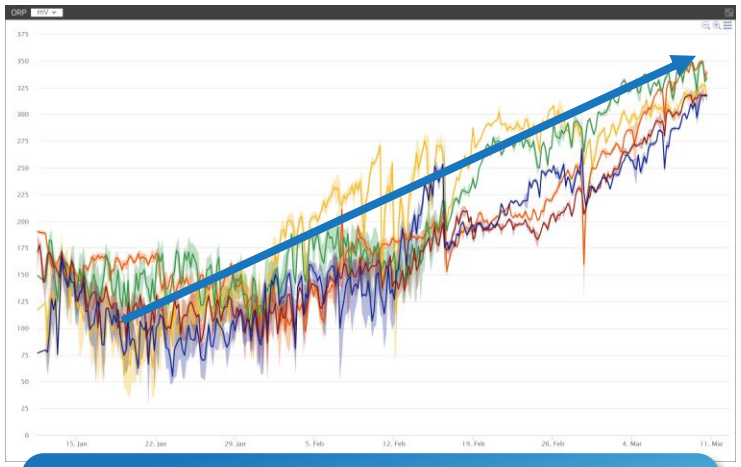
Lake Elsinore: Summary of 60-Day Results







12 Ft (3.7 m) Improved Water Clarity

- Water clarity (Secchi Disk) went from 8-31 inches* (20-79 cm)

*Increased to 12' (3.7m) average within 45 days

50-99% Reduced Blue-Green Algae

- Blue-green algae levels significantly reduced
- Reduced to near undetectable levels (less than 1 RFU) in the 90-acre area around treatment**
- Reduced by 50% over the entire lake***

**Historic average of 30 RFU
***Changed from average 30 RFU to less than 15 RFU

Increased ORP to Over 300 mV

- ORP (Oxidation-Reduction Potential) went from average of ~150mv to over 300mv at all 5 monitoring points across the lake
- Improved habitat and presence of beneficial organisms
- Improved lake resiliency (+ORP/DO)

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Lake Elsinore:
Sediment Hardness Map Comparison

HARD

SOFT

Before Installation

After 120 Days of Moleaer Treatment

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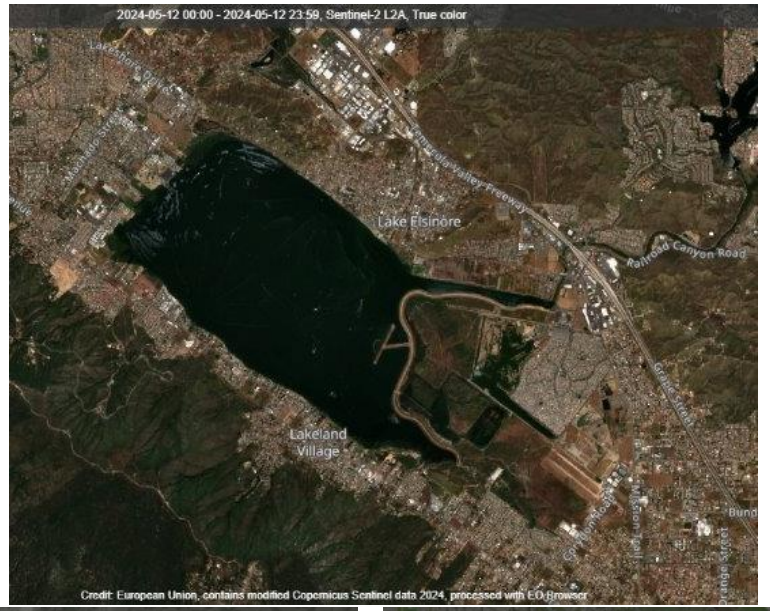
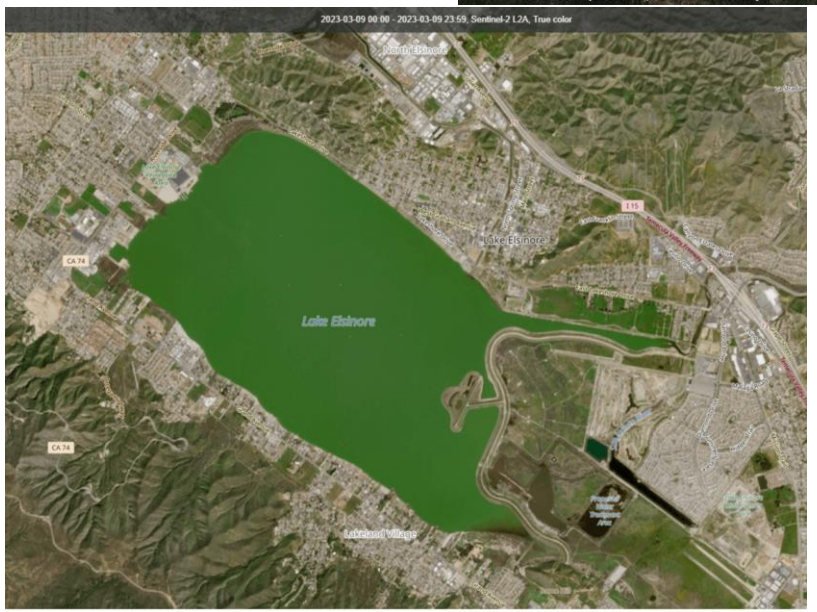
Lake Elsinore

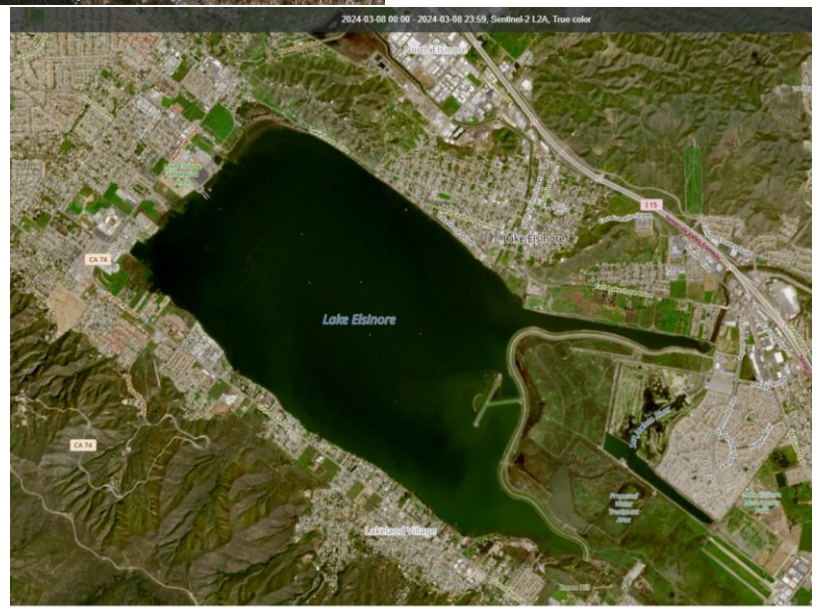
Satellite Image Comparison



Lake Elsinore, Sept. 8, 2024



Lake Elsinore - March 9, 2023



Lake Elsinore - March 8, 2024

City of Lake Elsinore Letter of Recommendation

CITY OF LAKE ELSINORE
DREAM EXTREME

April 24, 2024

To Whom It May Concern,

I am writing to share our experience with Moleaer and the remarkable impact their nanobubble generator has had on Lake Elsinore. In November 2023, the City of Lake Elsinore entered into a contract with Moleaer for the installation and servicing of a nanobubble generator system, and I am pleased to report that the outcomes have far exceeded our expectations.

Moleaer delivered the equipment promptly, and the system became operational on February 6, 2024. Since its activation, we have witnessed a transformative change in the quality of our lake water—so much so that it is the clearest it has been in over twenty years. The installation included five water quality sensors, providing our staff with comprehensive monitoring capabilities.

During the initial two months of operation, we observed significant improvements in critical water parameters such as Dissolved Oxygen and Oxidative Reduction Potential, both essential indicators of lake health. Previously, Lake Elsinore had a water visibility of less than two feet; today, our aquatic biologists are reporting visibility over sixteen feet—a remarkable turnaround that underscores the effectiveness of Moleaer's technology.

The success of this project has garnered widespread attention and satisfaction among our residents. Many have taken to social media platforms to express their astonishment at the lake's newfound clarity, with numerous individuals noting that they have never seen Lake Elsinore looking so pristine.

Given these outstanding outcomes, we are currently in discussions with Moleaer to potentially install a second unit later this year. This decision reflects our commitment to sustaining and enhancing the environmental quality of Lake Elsinore for the benefit of our community.

In summary, Moleaer's nanobubble generator has proven to be a game-changer for Lake Elsinore, delivering tangible improvements in water quality and overall aesthetics. We look forward to continuing our partnership with Moleaer and exploring additional opportunities to further enhance the health and beauty of our beloved lake.

If you have any questions or require further information, please do not hesitate to contact Adam Gufarotti, Community Support Manager responsible for overseeing our Lake Management Plan. Adam can be reached at agufarotti@lake-elsinore.org.

Jason Simpson
City Manager
City of Lake Elsinore
951.674.3124
130 S. Main Street
Lake Elsinore, CA 92530
www.lake-elsinore.org

Based on results of first months of treatment , the City of Lake Elsinore City Councill approved purchase of 2 additional systems ($3.5M) to increase treatment capacity by 10X over initially deployed system

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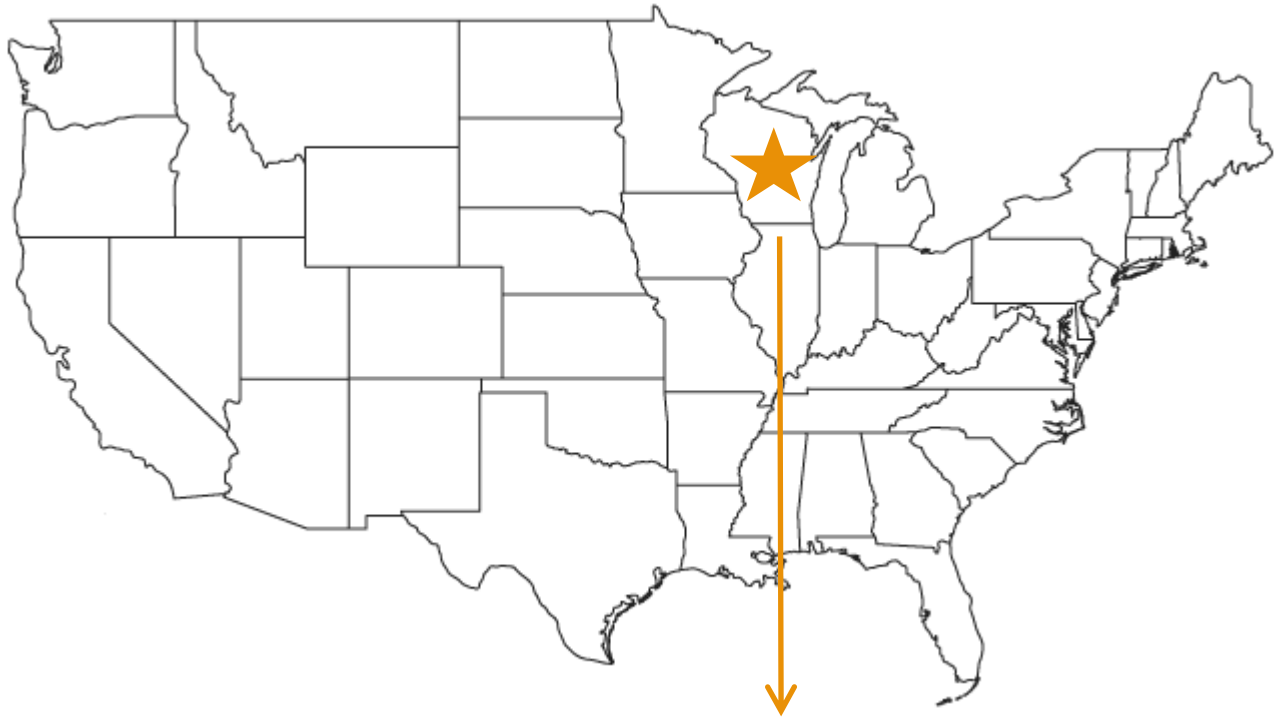
Lake Arrowhead Marina, Wisconsin



Marina Metrics:

- Surface Area: 2 acres (0.8 hectares)

Lake Metrics:

- 300 Acre (121) Lake apart of a 900 Acre (364ha) flowing lake system

Climate: Humid continental

- Temperatures: 9 to 80°F (-12 to 27°C)
- Precipitation: 12.4” (32 cm)/year

Main uses of lake:

- Residential (lake-front property), recreation (boating)

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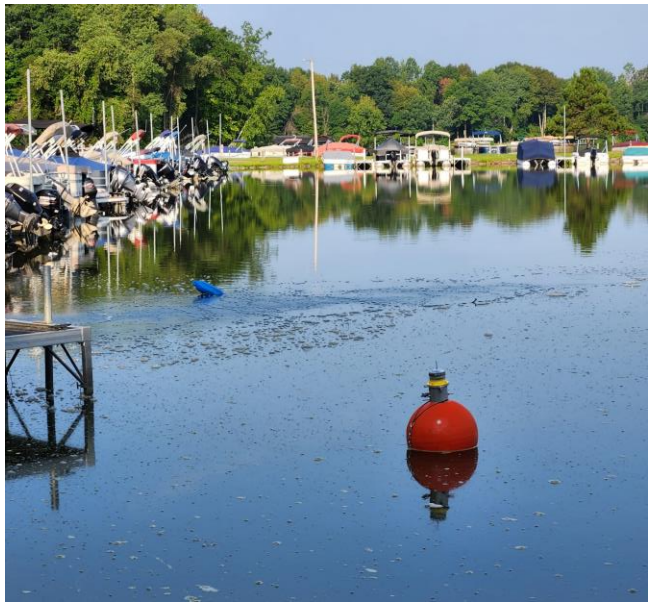
Lake Arrowhead Marina: Reduce Muck & Improve Water Clarity

Nanobubble System Metrics:

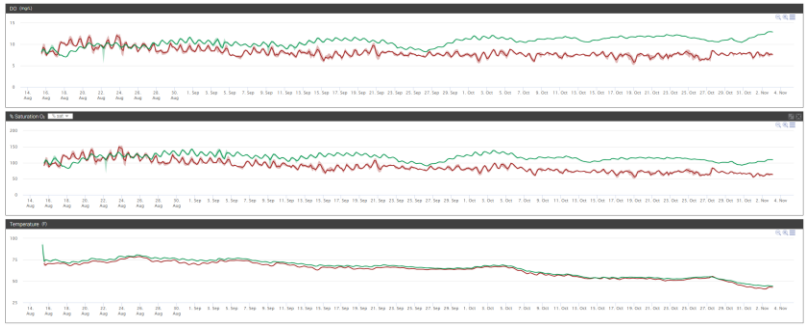
- NBG Trailer: 1000 GPM (227 m^3/hr)
- Turnover Rate: 3 days

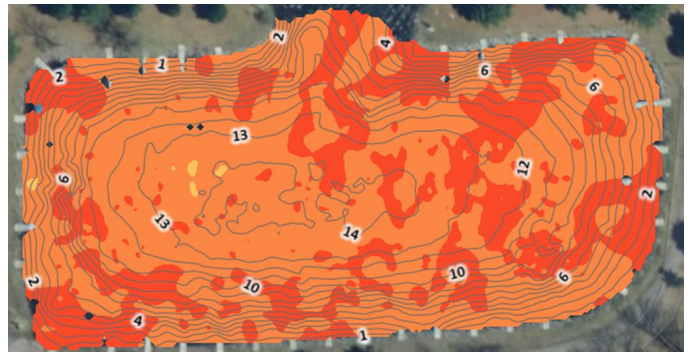
Problems:

- Excessive algae and very poor water clarity
- Higher than average amount of soft sediment and muck accumulation
- Stagnant area of lake with poor circulation
- Legacy poor water quality issues



Lake Arrowhead Marina: Summary of 75-Day Results





3 Ft (91 cm) Improved Water Clarity in 30 days

- Reduced algae visible in the water column and on the surface
- Water clarity improved by 2-3’ (61-91 cm)
- Abundant fish populations seen in marina
- Numerous slip owners commenting on improvement in water clarity and fish activity

Dissolved Oxygen 50% Higher Than Control

- Raised and kept DO level above saturation near sediment layer
- Marina dissolved oxygen levels experienced less diurnal changes in oxygen levels than control
- 50% higher than control group in 2 months

Improved Sediment Hardness

- Increased depth by 1’ (30 cm)
- Improved hardness throughout marina
- Reduced softest spots with accumulation to same hardness as other areas

Stable, Elevated Dissolved Oxygen Regardless of Temperature

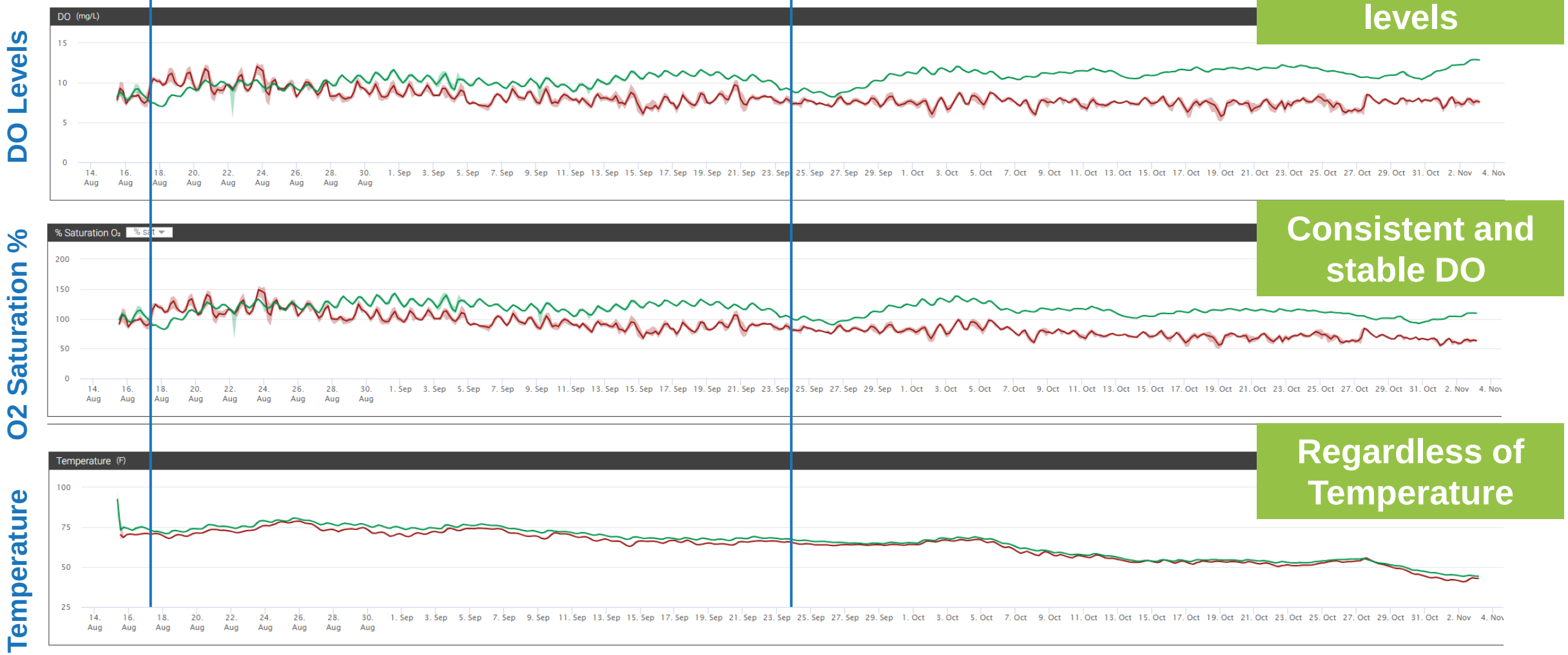
NBG Install

NBG Discharge direction changed

+50% DO levels

Consistent and stable DO

Regardless of Temperature



Green = Marina Treated with Moleaer Red = Control (Sherwood Finger)

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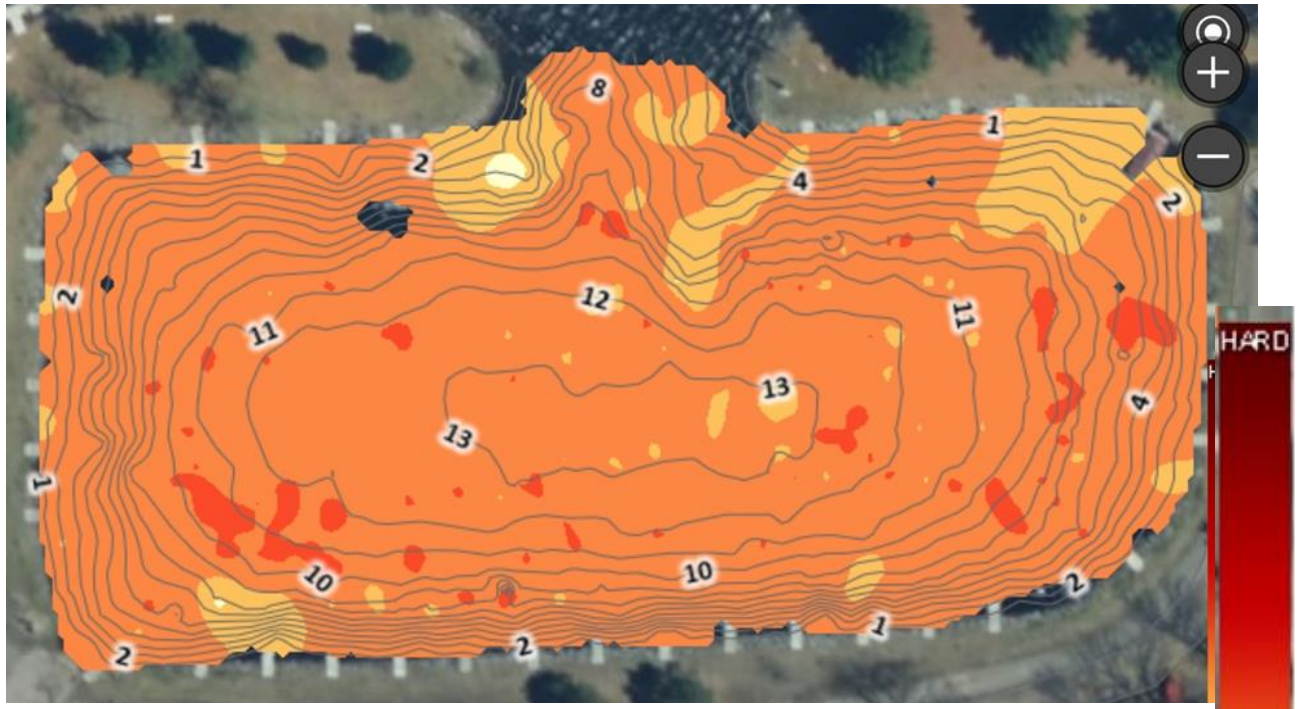
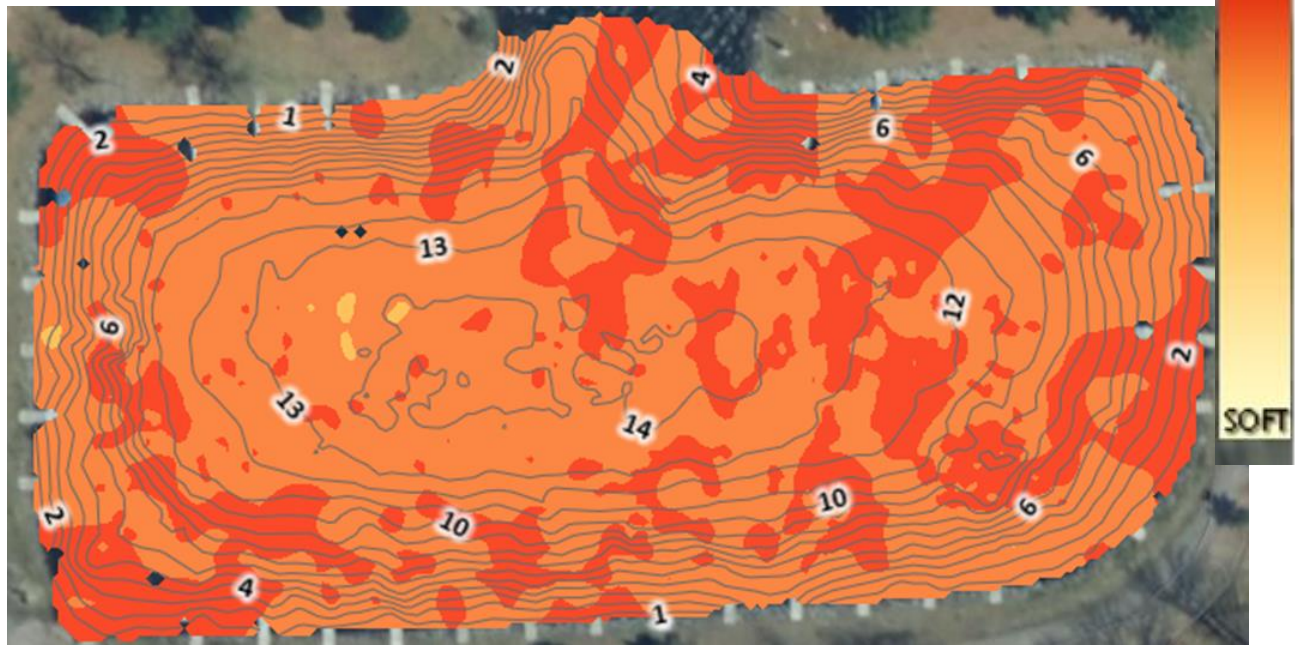
Sediment Hardness Map Comparison- Before and After

- Increased depth by 1’ (30 cm)
- Improved hardness throughout marina
- Reduced softest spots with accumulation to same hardness as other areas

Before



After



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Lake Arrowhead, Wisconsin

Sediment Columns taken from points in all 3 lakes of Tri Lakes District

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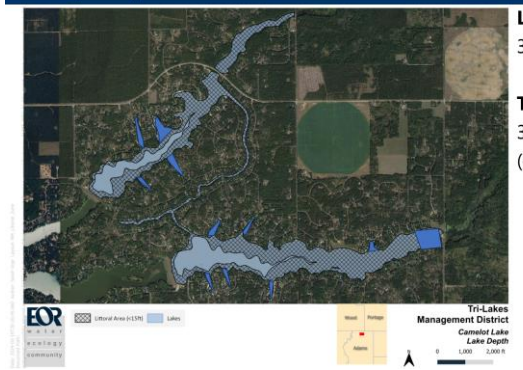
Lake Arrowhead, Wisconsin

Based on quantifiable data collected and during pilot treatment of Lake Arrowhead Marina, the Tri Lakes Management District and the residents in the District have voted to purchase $3M Nanobubble Systems to begin their restoration of the lakes.

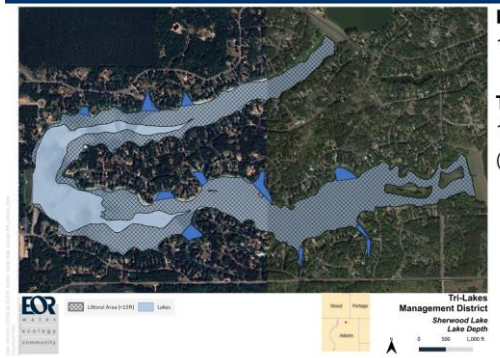
Concept Map-Camelot



Littoral zone –
309 acres (~78%)

Treatment Area-
30 acres
(ex. Dark blue areas)

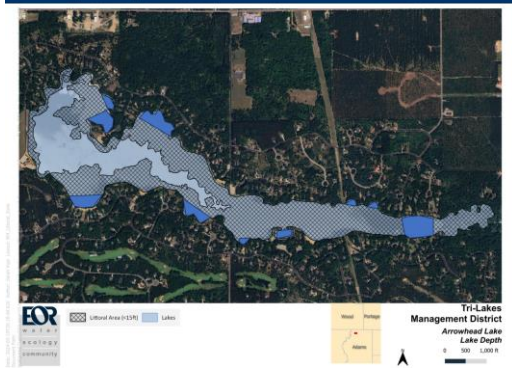
Concept Map-Sherwood



Littoral zone –
170 acres (~80%)

Treatment Area-
17 acres
(ex. Dark blue areas)

Concept Map-Arrowhead



Littoral zone –
220 acres (~75%)

Treatment Area-
22 acres
(ex. Dark blue areas)

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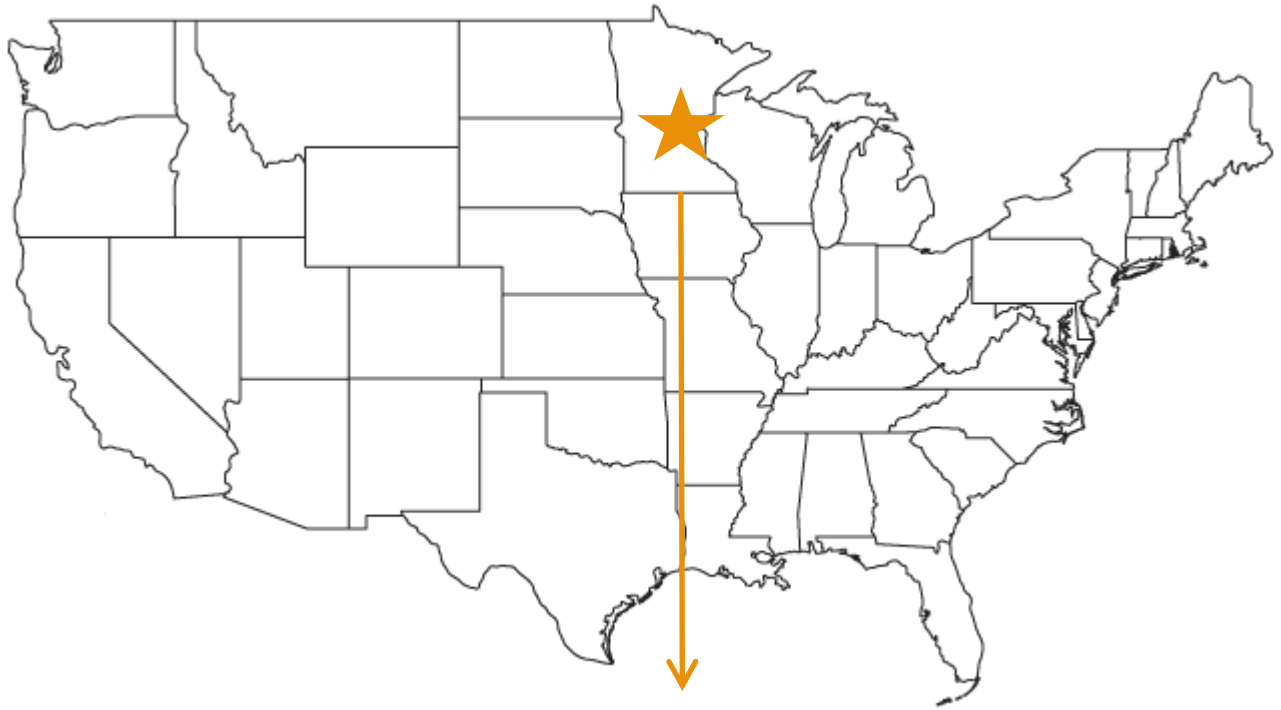
Tadd Lake, Minnesota



Lake Metrics:

- Surface Area: 10 acres (4 ha)
- Max Depth: 8 ft (2.4m)
- Volume: 50 Acre Ft (61,714 m3)
- Terminal lake, connected to Upper Lake (surface area: 25 acres (0.1 km^2)) via a channel

Climate: Continental

- Temperatures: -20 to 85°F (-29 to 29°C)
- Precipitation: 78” (198 cm)/year

Main uses of lake:

- Stormwater retention, recreation (fishing)

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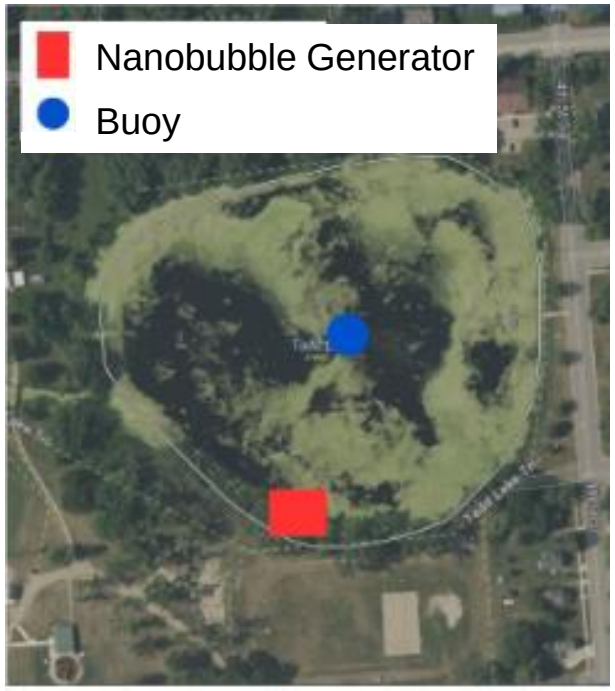
Tadd Lake, Minnesota

Nanobubble System Metrics:

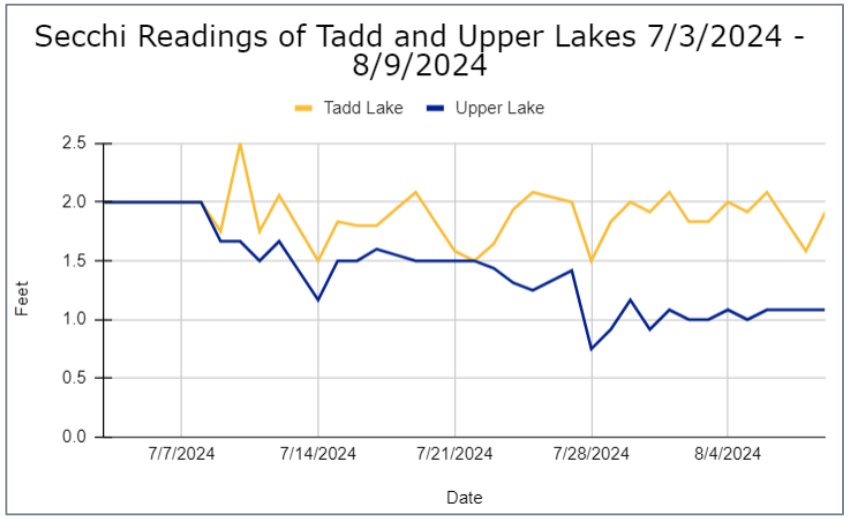
- NBG Trailer: 1,000 GPM (227 m^3/hr)
- Turnover Rate: 11-30 days, depending on flow

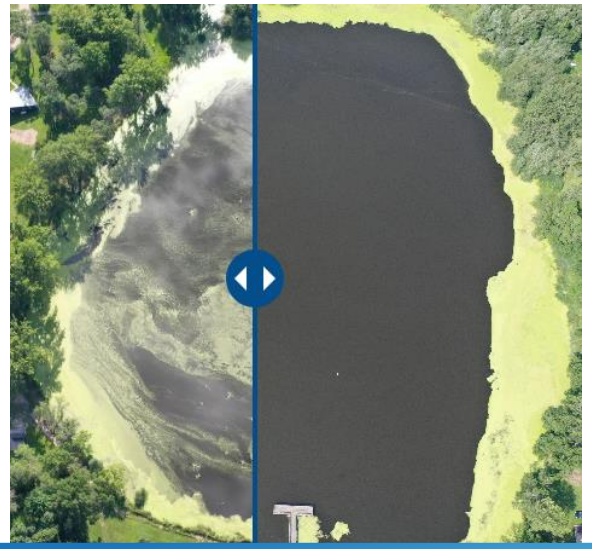
Problems:

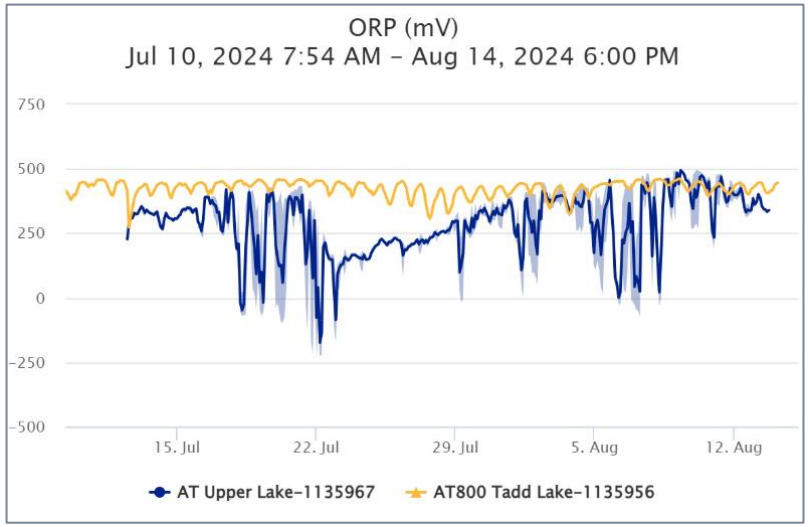
- Poor water clarity
- Algae
- Invasive Aquatic Weed Proliferation
- Unable to use recreationally
- Odor



Tadd Lake: Summary of ~1 Month Results







83% Improved Water Clarity in 30 days

- Upper and Tadd Lake had identical Secchi disk readings upon installation
- Near total reduction of visible surface floating algae in Tadd Lake

Reduced Indicators of Nutrient Loads

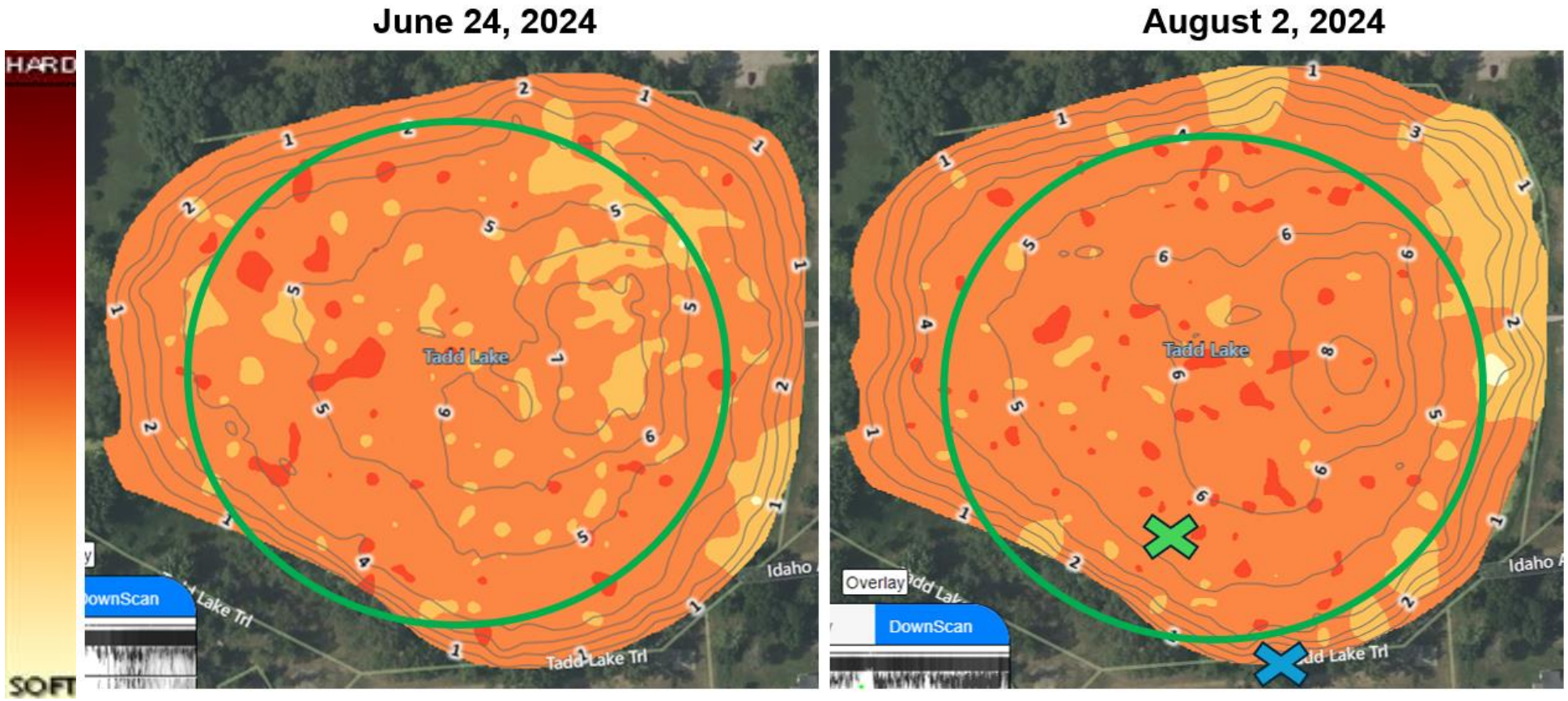
- Total Dissolved Solids (TDS) and Conductivity) suggest consistently more stable and lower nutrient load in Tadd Lake vs. Upper Lake (average TDS: 262 vs. 286 mg/L; average conductivity: 402 mV vs. 440 mV),

ORP

- Consistent ~300mv in Tadd Lake and highly variable in Upper Lake
- Similarly, sediment DO stayed above hypocxic levels vs consistent anoxic conditions in Upper Lake

TADD LAKE NANOBUBBLE PILOT PROJECT 2024 (arcgis.com)

Sediment Hardness Maps- Tadd Lake



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 NBG. Blue X indicates location of Moleaer NBG on land. Area circled in green shows greatest reduction in softer, organic matter (“i.e. muck”) between the two dates.

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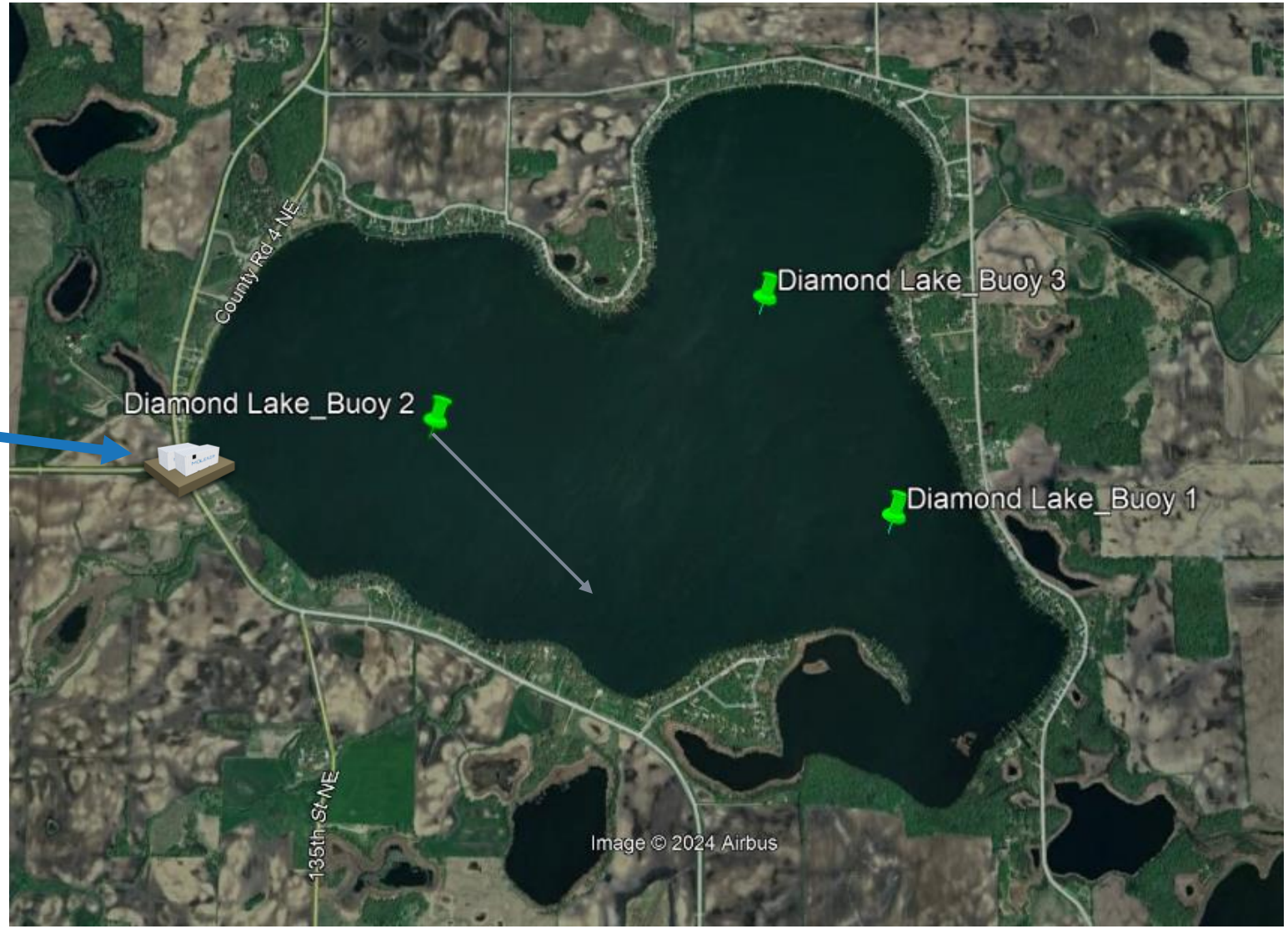
Diamond Lake: Proposed Deployment Locations

Surface Area: 1609 Acres (647 ha)

Volume: 25,744 Acre Feet (31.775M m^3)

Proposed Nanobubble Generator Location



Based on Results from Tadd Lake and another year of deteriorating conditions , the Diamond Lake Assocation Board has approved the purchase of Containerized NBG8 O2 Nanobubble System, subject to District/State Funding

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Pokegama Lake

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Pokegama Lake, Pine City, MN

General Info

Pokegama (58014200)

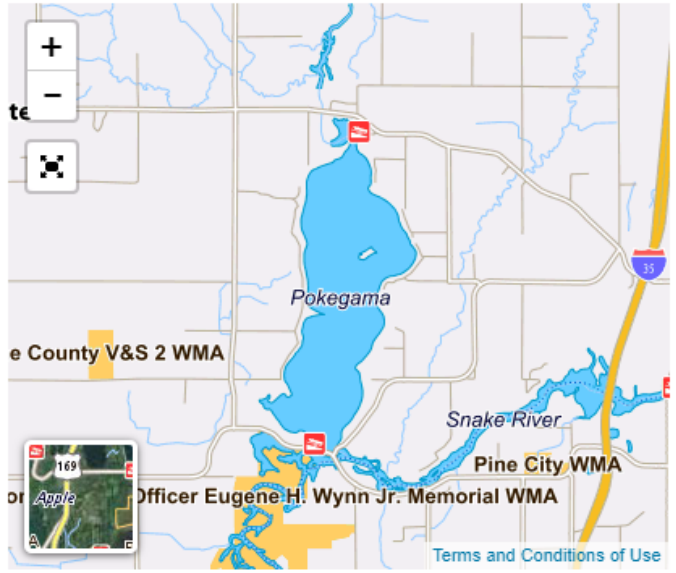
Fish consumption advisory
See the Fish Consumption guidance provided by the Minnesota Department of Health.

ID: 58014200
County: Pine
Near: Pine City
Border water: No
Sentinel Lake: No

Size and depth

Area: 1521.47 acres
Littoral Area: 903 acres
Shore length: 10.4 miles
Mean depth: 9.8 feet
Maximum depth: 25 feet

Fish species: black bullhead, black crappie, bluegill, brown bullhead, burbot, channel catfish, crappie, hybrid sunfish, lake sturgeon, largemouth bass, muskellunge, northern pike, pumpkinseed, rock bass, shovelnose sturgeon, smallmouth bass, sunfish, walleye, white bass, white crappie, yellow bullhead, yellow perch, bigmouth buffalo, bowfin (dogfish), chestnut lamprey, common carp, freshwater drum, golden redhorse, greater redhorse, longnose sucker, quillback, redhorse, river redhorse, shorthead redhorse, silver redhorse, suckers, white sucker, blackchin shiner, bluntnose minnow, brook silverside, brook stickleback, central mudminnow, common shiner, emerald shiner, fathead minnow, golden shiner, Johnny darter, logperch, minnows, shiners, spotfin shiner, spottail shiner, tadpole madtom, trout-perch



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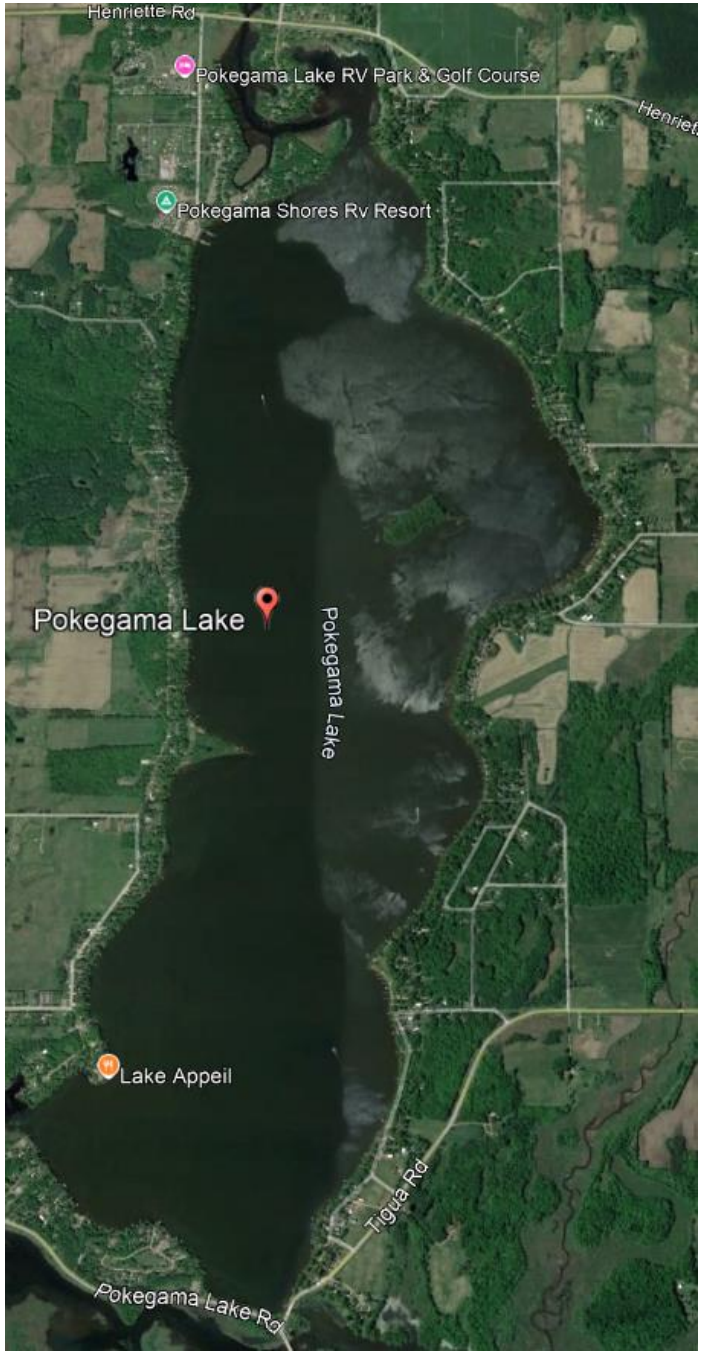
Pokegama Lake, Pine City, MN

Satellite Map

Area: 1521.47 acres
Littoral Area: 903 acres
Shore length: 10.4 miles
Mean depth: 9.8 feet
Maximum depth: 25 feet



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Pokegama Lake, Pine City, MN

Bathymetry Map

Area: 1521.47 acres
Littoral Area: 903 acres
Shore length: 10.4 miles
Mean depth: 9.8 feet
Maximum depth: 25 feet

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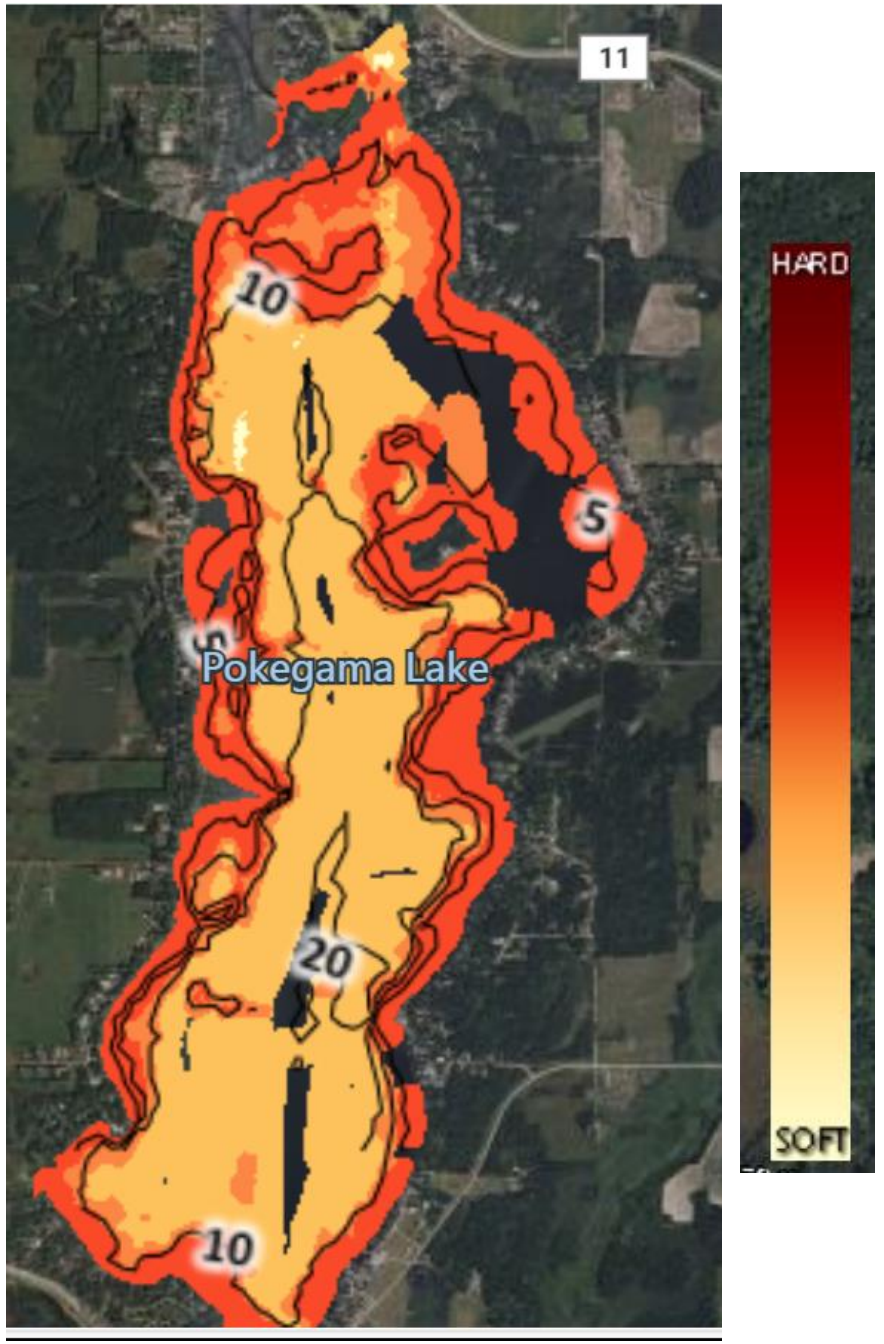
Pokegama Lake, Pine City, MN

Sediment Hardness Map- Whole Lake

Lighter the color=
Soft
Soft~ Organic (Muck)

Darker the color=
Hard
Hard~ Inorganic (rock/sand)



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Pokegama Lake,
Pine City, MN

Pokegama Lake Challenges

- ✓ Blue Green Algae Blooms (HAB) becoming more frequent/severe
- ✓ Invasive/aquatic weed proliferation
- ✓ High External loading (60%)
- ✓ Legacy Internal loading (40%)
- ✓ Soft, mucky bottom (accumulated organics) and high oxygen demand

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Solution: Moleaer NB Treatment as Foundational Tool in Pokegama Lake Management Plan

How does improving the aerobic condition of the water body with Moleaer Oxygen Nanobubbles help solve Pokegama Lake challenges?

- Blue Green Algae (HAB)
  - Improved and stabilized Dissolved Oxygen (DO) (above 3mg/L) at the sediment water interface limits nutrient flux that allows for algae proliferation, especially cyanobacteria.
  - Improving aerobic conditions allow for more balanced food web, where microrganisms like Zooplankton consume algae

- Muck and Internal Loading
  - Improved and stabilized DO at sediment layer allows for increased digestion of organics by already present micro organisms. This decreases total oxygen demand.

- Improved Habitat
  - Harder sediment composition improves conditions for fish spawning, habitat and recreation.
  - Improved vegetation at depth and forage area for fish

MOLEAER
ADVANCING NANOBUBBLE TECHNOLOGY

Solution: Moleaer NB Treatment as Foundational Tool in Pokegama Lake Management Plan

How does improving the aerobic condition of the water body with Moleaer Oxygen Nanobubbles help solve Pokegama Lake challenges?

- External Loading
  - NB improve ORP (Oxidative Reduction Potential) and overall resiliency of water body to better handle incoming contaminants and reduce lake upsets.
  - High ORP naturally precipitates Iron, binding with Phosphorus, reducing impacts of external loading

- Proliferation of aquatic vegetation
  - According to MN DNR and U of MN 10 yr study, improved water clarity results in light induced stress to Curly Leaf Pond Weed. This results in less germination of CLPW the following season.
  - Reduced available nutrients and/or balanced food web does not provide excess nutrients for proliferation of vegetation
  - Improved sediment composition/reduced muck does not provide rooting for proliferation of submerged plants.

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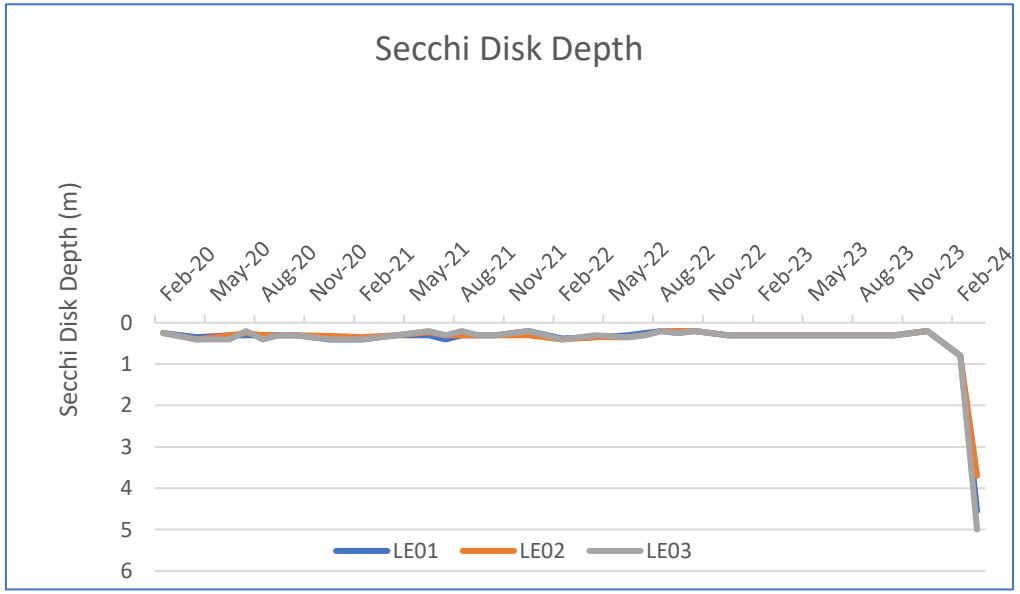
How to Measure Success

- ***What you can measure***
- What you can see

Ways to Measure Success- What You Can Measure

- **Baseline Data**-Information gathered ahead of installation to be used as comparison
  - Historic sampling, monitoring and studies
  - Monitoring and sampling prior to installation

- **Control Data**-Information gathered at the same time as baseline and progress data, but outside the area of influence/treatment area to allow for comparison



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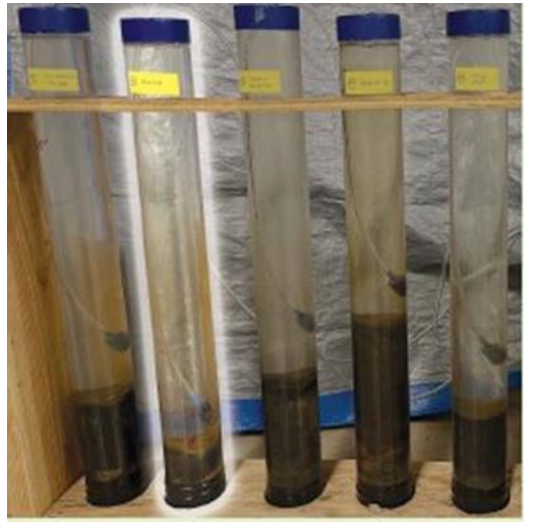
How to Measure Success

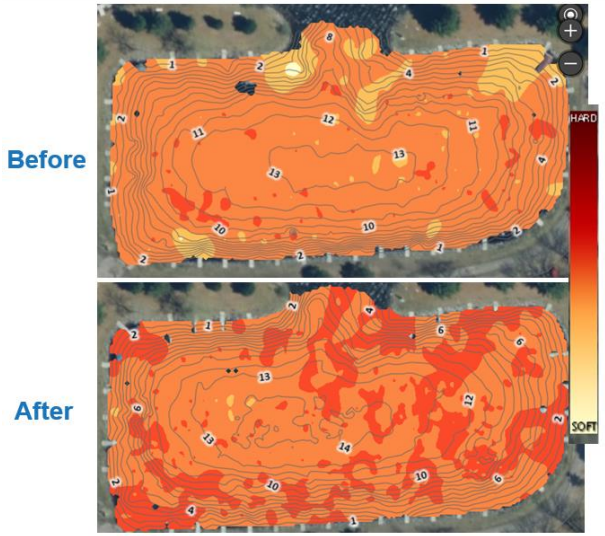
- ***What you can measure***
- What you can see

Where and How to Measure Success- What You Can Measure Sediment (Bottom of the Lake)

- Core Sampling
  - SOD (Sediment Oxygen Demand)
  - Nutrient Release
    - Oxic and Anoxic
    - Nutrient
  - Sediment Composition
    - Organic/Inorganic
    - Substrate types/mix



- Sediment Mapping
  - Biobasemaps.com to generate heat maps
    - Sediment Hardness
    - Bathymetry
    - Aquatic Vegetation



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How to Measure Success

- ***What you can measure***
- What you can see

Where and How to Measure Success-What You Can Measure

Water

- **Real Time Water Quality Monitoring**
  - Takes readings 4x per hour of up to 6 water quality parameters. Uploads daily.
  - Shows trends and correlations over time
  - More informative than grab samples for those parameters

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How to Measure Success

- ***What you can measure***
- What you can see

Where and How to Measure Success- What You Can Measure

- **Real Time Water Quality Monitoring-**
  - Parameters Commonly Measured
    - Dissolved Oxygen (DO)
      - Near sediment layer AND in upper water column
    - Oxidative Reduction Potential (ORP)
    - pH
    - Phycocyanin (Blue Green Algae Pigment)
    - Chlorophyl A (All algae pigments)
    - Temperature
    - Surrogates for Nutrients
      - TDS (Total Dissolved Solids)
      - Conductivity

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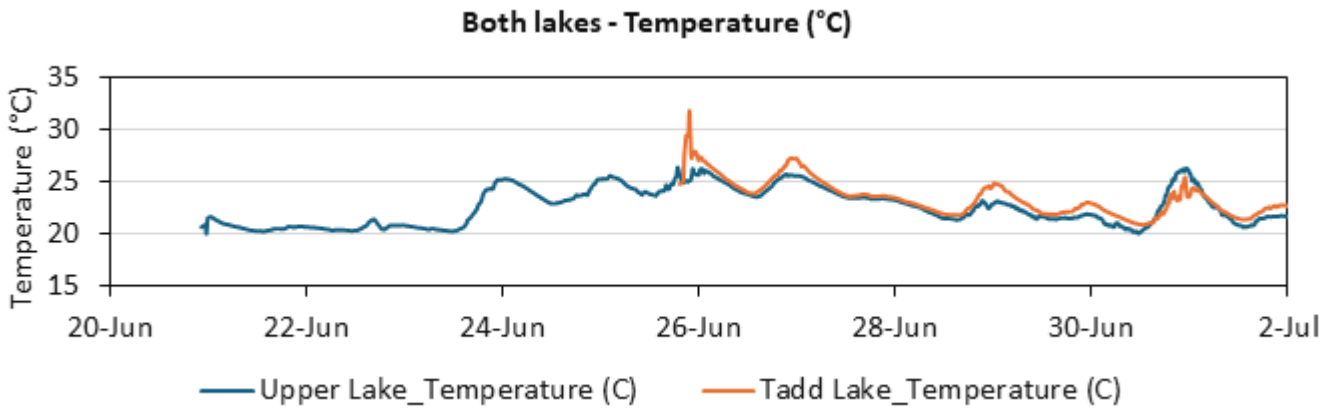
How to Measure Success

- ***What you can measure***
- What you can see

Where and How to Measure Success-What You Can Measure

Water

- Grab Samples- Water collected from lake and sent to lab for analysis
  - Monthly Water Quality Analyses (Grab & Continuous Sampling Systems) includes TP, SRP, TN, Nitrate, Nitrite, Turbidity, DO, pH, ORP, TP, Chlorophyll A and Phycocyanin
- Weekly on site sampling
  - Secchi disk
  - Temp



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How to Measure Success

- What you can measure
- ***What you can see***

Where and How to Measure Success- What You Can See

Water

- Improved Clarity-Less Turbid
  - Secchi Disk
  - Naked Eye
  - Drone
  - Satellite

BEFORE AFTER 30 DAYS

- Reduced Algae
  - Floating mats
  - In the Water Column
  - On the surface
- Less Aquatic Vegetation over time
  - Curly Leaf Pond Weed
  - Submerged
  - Improved vegetation at depth

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Nanobubble Pilot Treatment Options

Pokegama Lake

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NB Pilot Treatment Goals

Goals of NB Treatment/Pilot (Within the Treatment Area)

- ✓ Show quantitative and qualitative improvements in water and sediment conditions
- ✓ Improve ORP and resiliency
- ✓ Reduce accumulated organics (muck)
- ✓ Reduce algae frequency and severity vs untreated areas with similar conditions

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NB Solution Options

Install Trailer Mounted 1,000 GPM Moleaer O2 O3 NB Generator to treat 10-20 acre area, while improving surrounding water quality

Rent 1,000 gpm High Flow unit:
Demonstrate success in one area and expand to other areas or whole lake treatment

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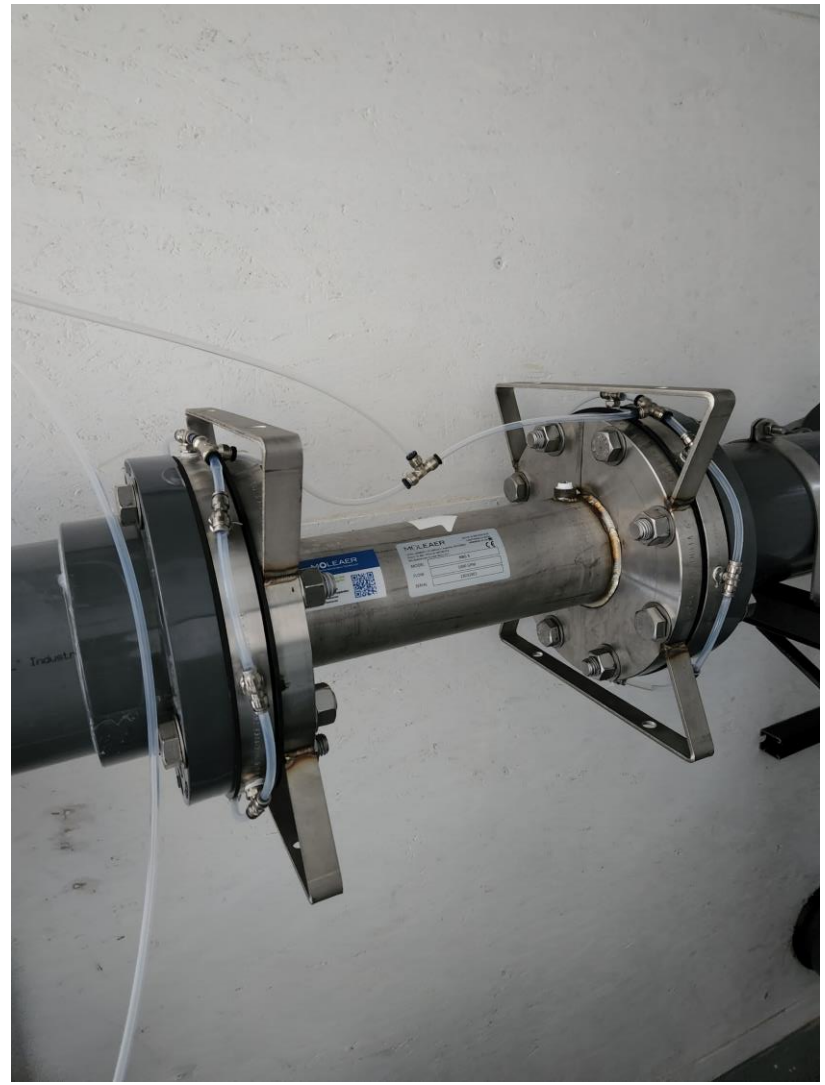

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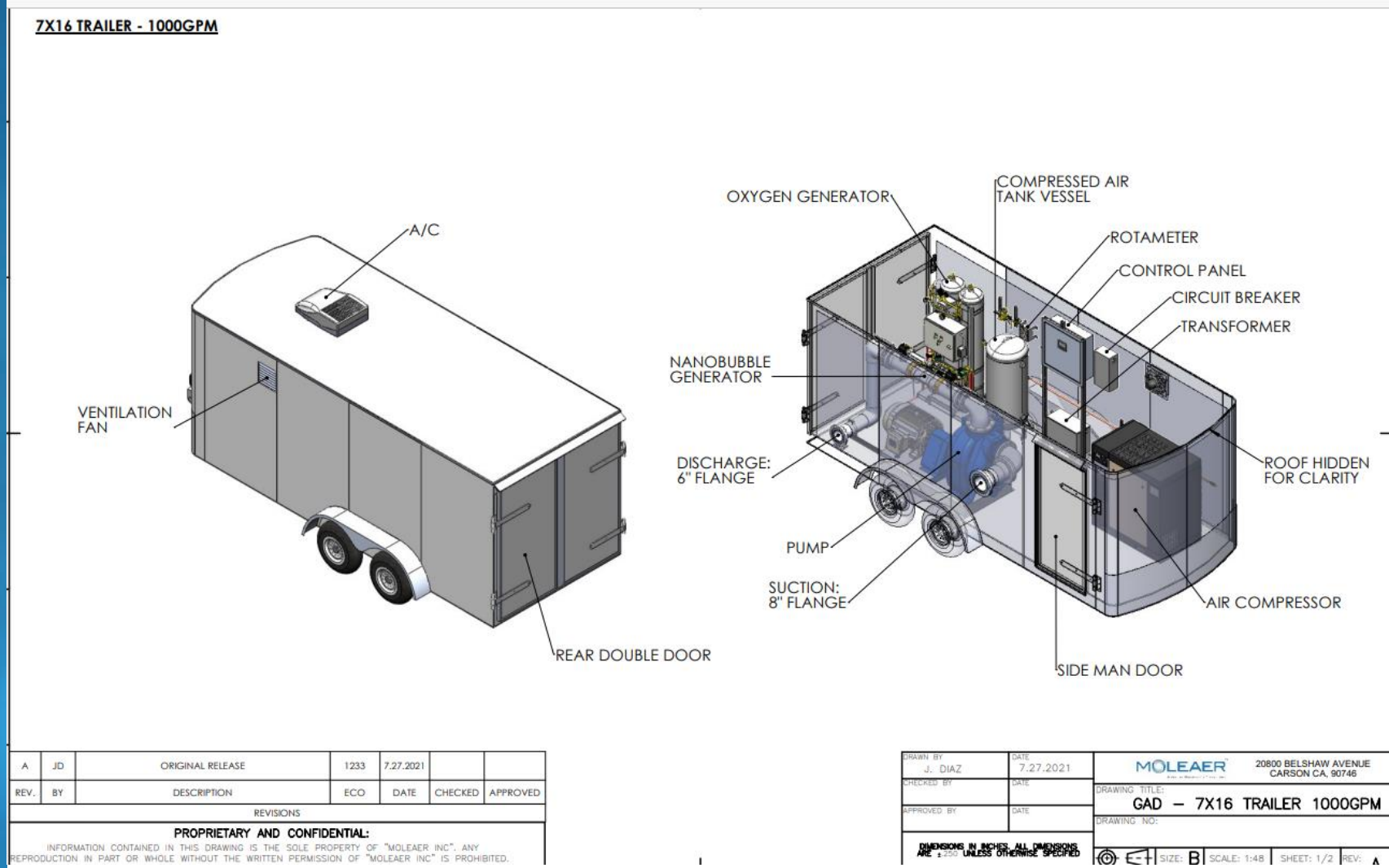

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NB Solution Options

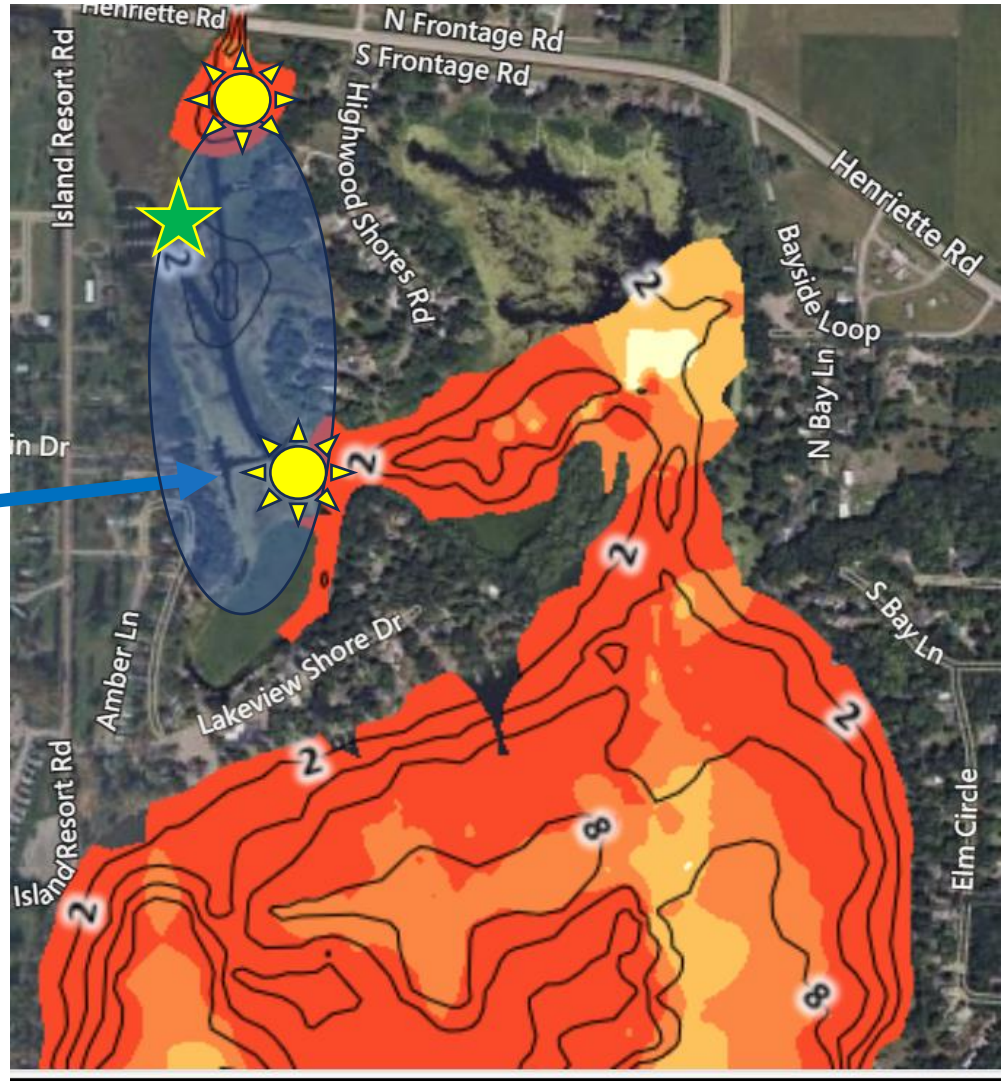
Option 1- Pokegama Creek Inlet Area

Moleaer NBG4 O2 O3 Nanobubble Trailer

2 In Situ Monitoring Locations- 24/7 info

Install Trailer Mounted 1,000 GPM Moleaer O2 O3 NB Generator to digest muck, improve resiliency and water clarity at Pokegama Creek Inlet Area

Primary Area of Influence



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NB Solution Options

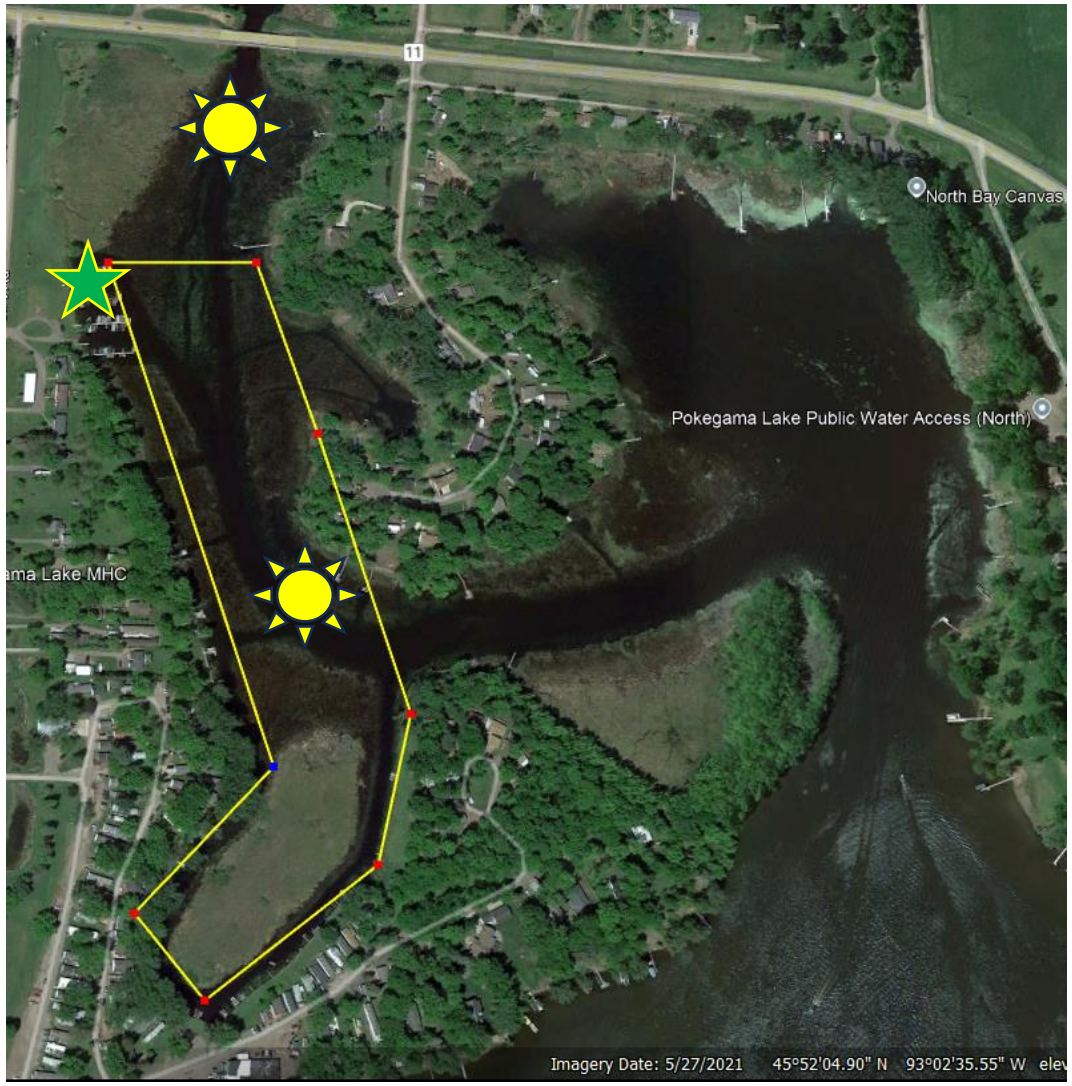
Option 1- Pokegama Creek Inlet Area

Moleaer NBG4 O2 O3 Nanobubble Trailer

2 In Situ Monitoring Locations- 24/7 info

Install Trailer Mounted 1,000 GPM Moleaer O2 O3 NB Generator to digest muck, improve resiliency and water clarity at Pokegama Creek Inlet Area

Area of Influence: ~20 acres



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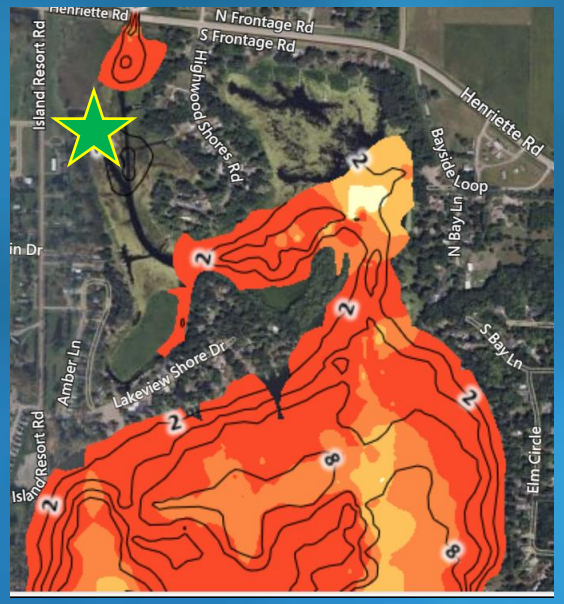
NB Solution Options

Option 1- Pokegama Creek Inlet Area



Pros:

- Ideal location for increasing resiliency at inflow point and beginning of whole lake treatment.
- Mitigate impact of incoming organics and nutrients
- Flow distributes treatment in immediate area and carries to larger lake
- Improve conditions in area with dense ownership

Cons:

- Flow distributes treatment into the entire lake, diluting immediate impacts in the localized area.
- Treatment at this location is ideal for greater lake treatment, but less ideal for A>B comparison/control
- Shallow depth, limiting ability to upsize to distribute more treatment into entire lake. Best suited in combination with larger lake treatment

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NB Solution Options

Option 2-Boat Launch Area

Moleaer NBG4 O2 O3 Nanobubble Trailer

2 In Situ Monitoring Locations- 24/7 info

Rent 1,000 gpm High Flow unit:
Demonstrate success in one area and expand to other areas or whole lake treatment

Area of Influence: 25 Acres

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NB Solution Options

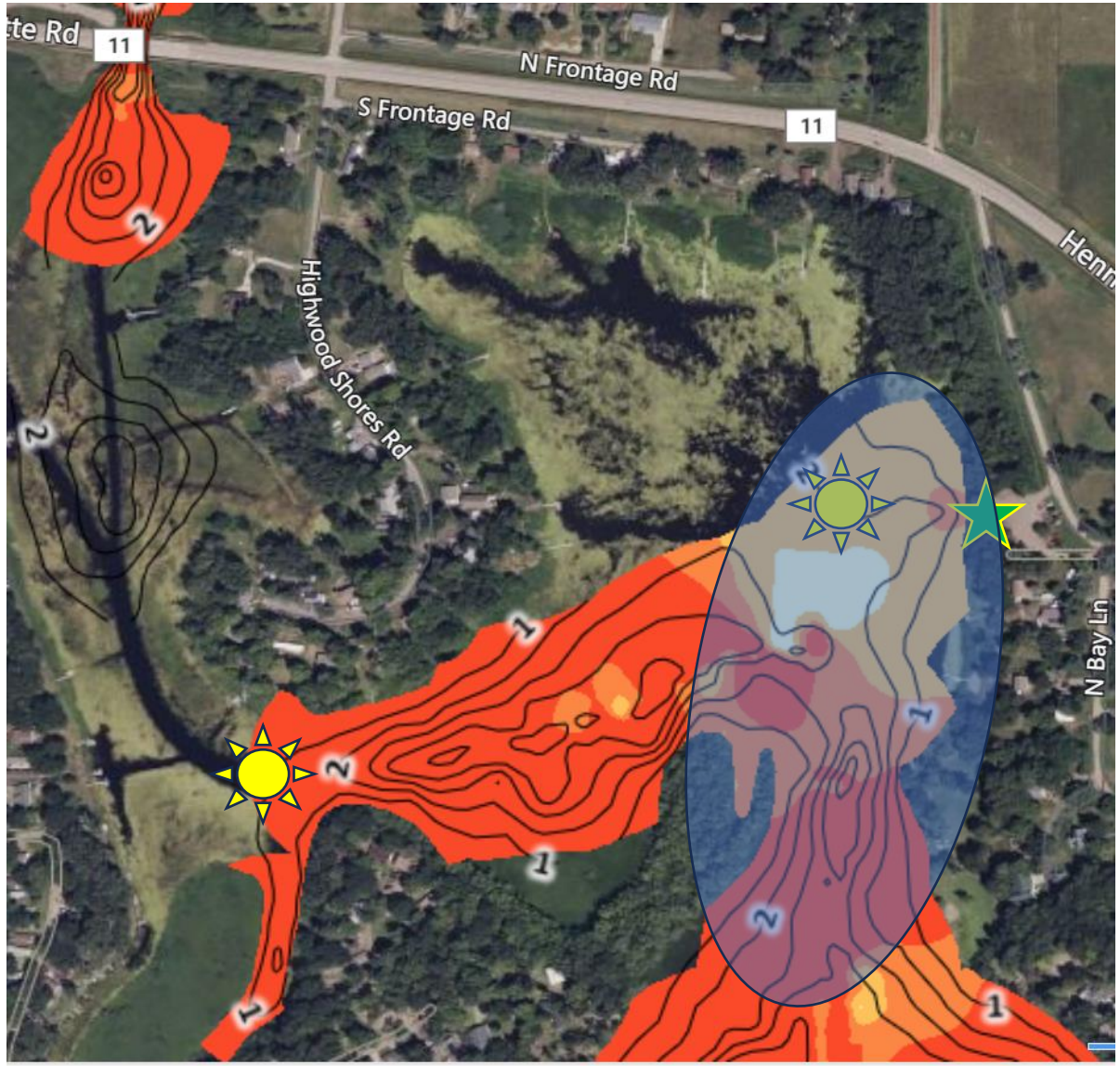
Option 2-Boat Launch Area

Moleaer NBG4 O2 O3 Nanobubble Trailer

2 In Situ Monitoring Locations- 24/7 info

Install Trailer Mounted 1,000 GPM Moleaer O2 O3 NB Generator to digest muck, improve resiliency and water clarity at Pokegama Creek/boat launch Area

Area of Influence: 25 Acres



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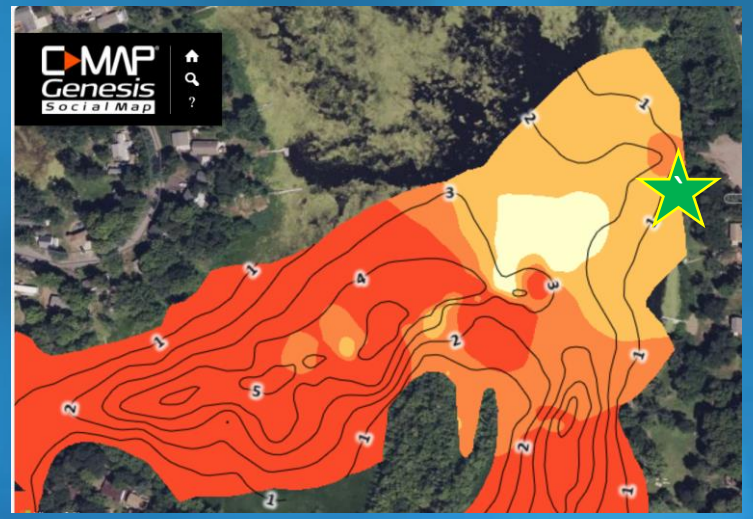
NB Solution Options

Option 2- Possible Installation Location



Pros:

- High muck accumulation in this area.
- Ideal location for increasing resiliency at inflow point and beginning of whole lake treatment.
- Mitigate impact of incoming organics and nutrients
- Flow distributes treatment in immediate area and carries to larger lake
- Able to compare with upstream areas

Cons:

- Very shallow depth, making installation more involved/$
- Public installation site making permissions and planning more extensive
- Flow distributes treatment into the entire lake, diluting immediate impacts in the localized area.
- Area upstream is more ideal for permanent treatment

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Short Term NB Treatment *Budgetary* Costs

Pokegama Lake Pilot Trailer Plan		
NBG4 O2 O3 Trailer System Rental-4 months		
	$	**91,550**
Contingency	**$**	**4,578**
TOTAL ESTIMATED PILOT PROJECT COSTS	**$**	**96,128**
Rental Costs, including	**$**	**48,000**
NBG4 O2 O3 Trailer Nanobubble System		
Freight In/out		
Monitoring Buoys-rental		
Installation, including	**$**	**24,500**
Electrical Supply/Construction		
NBG4 Trailer piping		
Moleaer on site commissioning 2 x 2 days		
Operating Costs- 4 months, including	**$**	**19,050**
Moleaer Service		
Sediment Mapping		
Electric Service		

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Permanent Solution Options

Pokegama Lake

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NB Permanent Treatment Goals

Goal of Permanent NB treatment:

- Make short and long term quantitative and qualitative improvements in water and sediment conditions across a large area of the lake
- Improve ORP and resiliency in the majority of the lake area
- Reduce accumulated organics (muck)
- Reduce algae frequency and severity of blooms

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NB Permanent Treatment and Monitoring Locations- At Scale

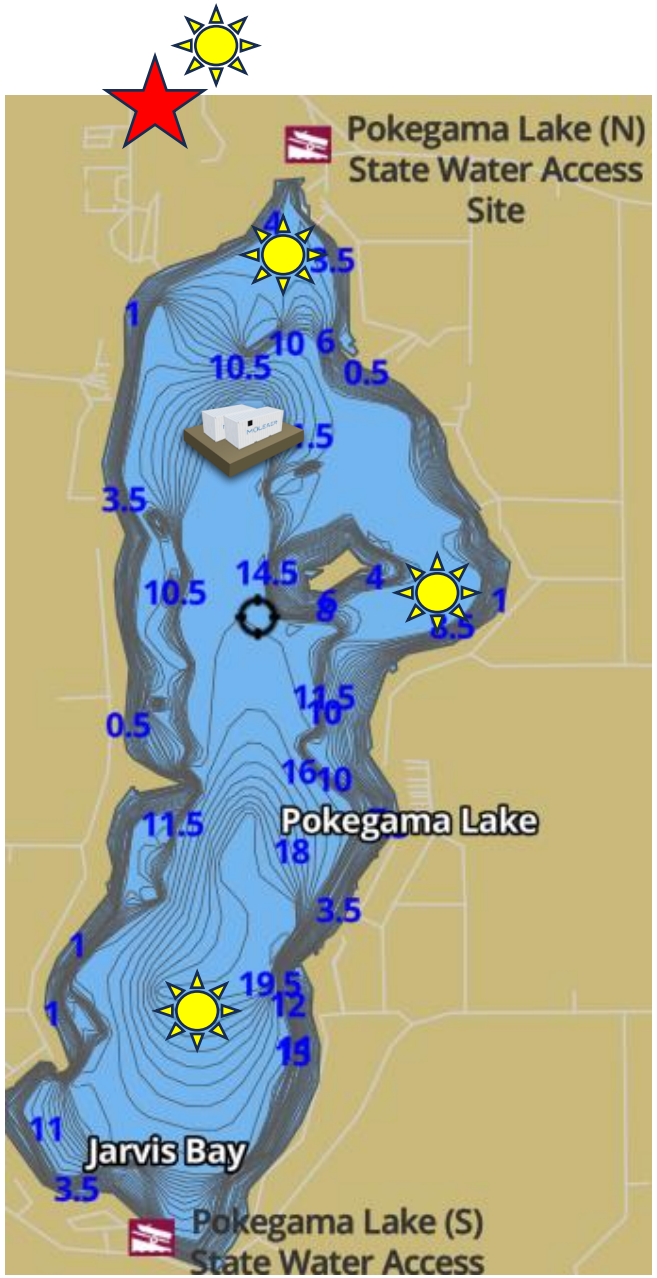
2 Treatment Locations

Moleaer Trinity NBG4 Container
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8 Barge
- 4,500 gpm
- 106 lbs O2/hour

4 Monitoring Locations- 24/7 info

(4) In Situ Monitoring Buoy
- DO, pH, ORP, temp, TSS, Phycocyanin, Chlor-A



Bathymetry Map

Satellite Map

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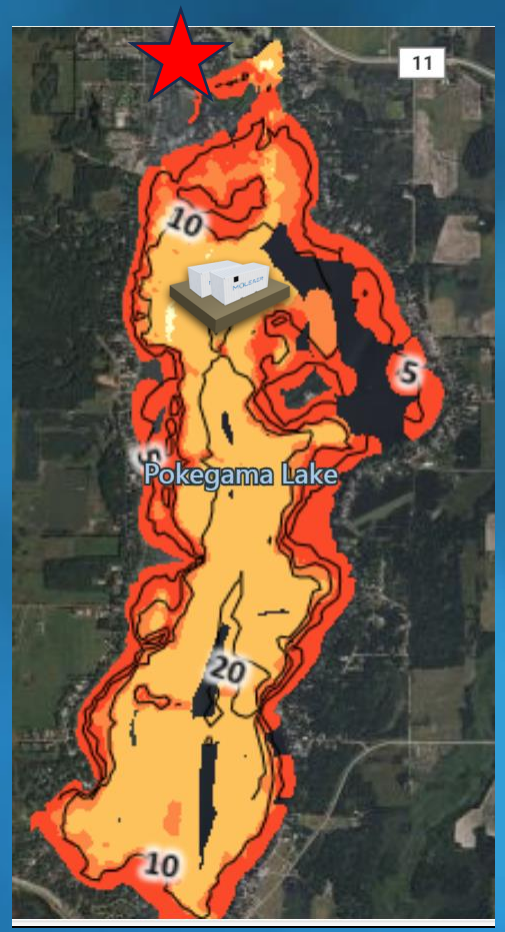
NB Permanent Treatment Monitoring- At Scale



Sediment Mapping and Sampling

Sediment Hardness Mapping

- Annual Mapping to understand sediment composition changes

Core Sampling/Nutrient/SOD Analysis

- Goal of Annually for first 2 years

*Frequency and number of mappings/ samples subject to budget and grant access

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Permanent NB Solution Options

At Scale Treatment Locations

Moleaer Trinity NBG4
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8
- 4,500 gpm
- 106 lbs O2/hour

Benefits of At Scale NB Treatment Strategy as Foundational Piece to Lake Management Plan

- Treat inflow to provide benefits upstream of main pool
- Treat main pool at point to distribute and carry treatment over majority of the lake.
- Barge Mounted high capacity unit can have North/South installation locations over time
- Smaller container at Pokegama Creek Inlet can be moved periodically to other location to supplement over time.
- Sized to balance cost/time/mobility/cap ex $/ op ex $

Moleaer Nanobubble System-Land Based Examples

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Moleaer NBG8 Nanobubble System-Land Based Examples

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Moleaer Nanobubble System-Barge Based Examples

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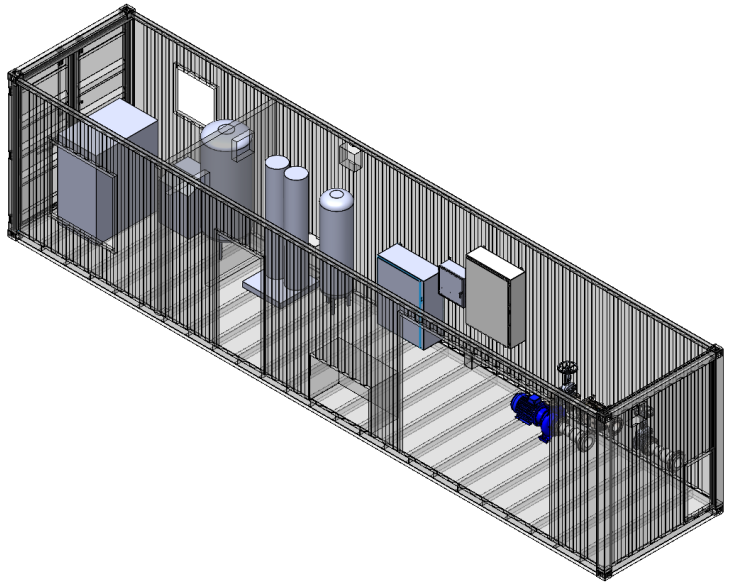
Permanent NB Treatment At Scale *Budgetary* Costs

Moleaer Trinity NBG4
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8
- 4,500 gpm
- 106 lbs O2/hour

Pokegama Lake 2 container permanent plan

Capital Purchase, including	**$ 1,490,000**
NBG4 O2 O3 Container Nanobubble System	
NBG8 O2 Container Nanobubble System	
Barge for NBG8 Container System	
Dock for NBG4 O2 O3 Piping	
Monitoring BuoyS	
Signage, buoys, fencing, markers	



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Permanent NB Treatment At Scale *Budgetary* Costs

Moleaer Trinity NBG4
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8
- 4,500 gpm
- 106 lbs O2/hour

Pokegama Lake 2 container permanent plan

Installation, including	**$ 171,250**
Crane-Offloading Containers	
Site work- Gravel, leveling	
Electrical Supply/Construction	
NBG8 Container piping	
NBG4 Container piping	
Moleaer on site commissioning 2 x 3 wks	
Dock- Offloading-Installation	

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Pokegama Lake 2 container permanent plan

Permanent NB Treatment At Scale *Budgetary* Costs

Moleaer Trinity NBG4
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8
- 4,500 gpm
- 106 lbs O2/hour

Operating Costs- 6 months, including	**$ 165,600**
Moleaer-Every 2 months	
Air Sep Parts-season	
Ingersoll Rand-Container Compressor	
Pump Service	
Buoy-Parts,etc	
Container Nanobubble System-Parts	
Monitoring/testing	
Sediment Mapping	
Install/Removal-Seasonal	
Electric Service	

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Permanent NB Treatment At Scale *Budgetary* Costs

Pokegama Lake 2 container permanent plan				
NBG4 O2 O3 and NBG8 O2 Container Systems				
Equipment Purchase, Install and 1 yr service			$	1,826,850
Contingency	10%		$	182,685
TOTAL PURCHASE, INSTALL AND 2 YRS SERVICE			$	2,009,535

Moleaer Trinity NBG4
- 1,000 gpm
- 6 lbs O2/hour

Moleaer Trinity NBG8
- 4,500 gpm
- 106 lbs O2/hour

Thank You

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