

5-17-25

# Cross Lake Nanobubble Implementation Plan



A large, white, rectangular water treatment unit with a corrugated metal door and a vented side panel. The unit is situated outdoors near a body of water, with a grassy area and trees in the background. The brand name 'MOLEAER' is printed in large, bold, blue letters on the side of the unit.

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About Moleaer

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The Problem & Your Goals

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Our Proposed Solution

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Treatment Strategy

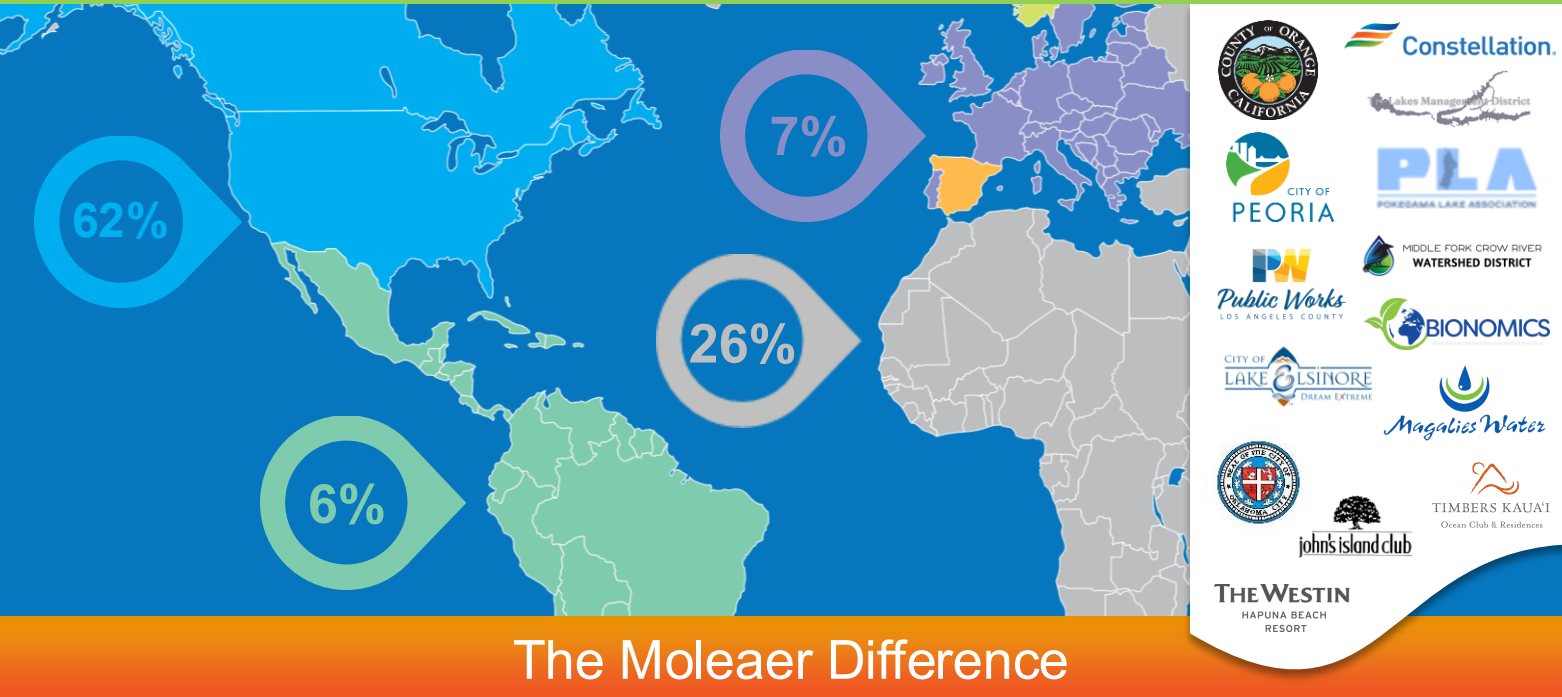
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Project Budget

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# Over 4,000 Nanobubble Installations

650+ Nanobubble Installations in Waterbodies & Waterways



## The Moleaer Difference

- Leader in nanobubble science and it's applications
- Largest R&D and Application Development teams with over 15 PhDs:
  - Investigating nanobubbles and their impacts in various applications
  - Applying prescriptive solutions with robust monitoring plans
- Largest NB treatment installation and customer base globally

## Surface Water Team



**Dr. Denise Devotta**  
Senior Limnologist



**Shane Hoyt**  
Limnologist



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Global Director of  
Surface Water



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Sr. Marketing Manager



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Business Development  
Manager, Western US



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Business Development  
Manager, Central US

# Your Waterbody: Cross Lake

## Challenges

- Extraordinary high rates of anoxic release rates (2014 TMDL Table 5 pg. 35 Cross Lake Management Plan )
- Very high Internal loading
- Phosphorus levels consistently exceeding MPCA water quality standards ( Standard <40 ug/l current average 104 ug/l)
- High levels of algae leading to limited water clarity and odor, which limits recreation
- Lake residents noticing declining water quality, fishing is worse over past few years and hurting property values

## Details

Surface Area: 938 acres

Littoral Area: 456 acres

Shore length: 13 miles

Volume:

Average Depth: 14 ft

Max Depth: 32 ft

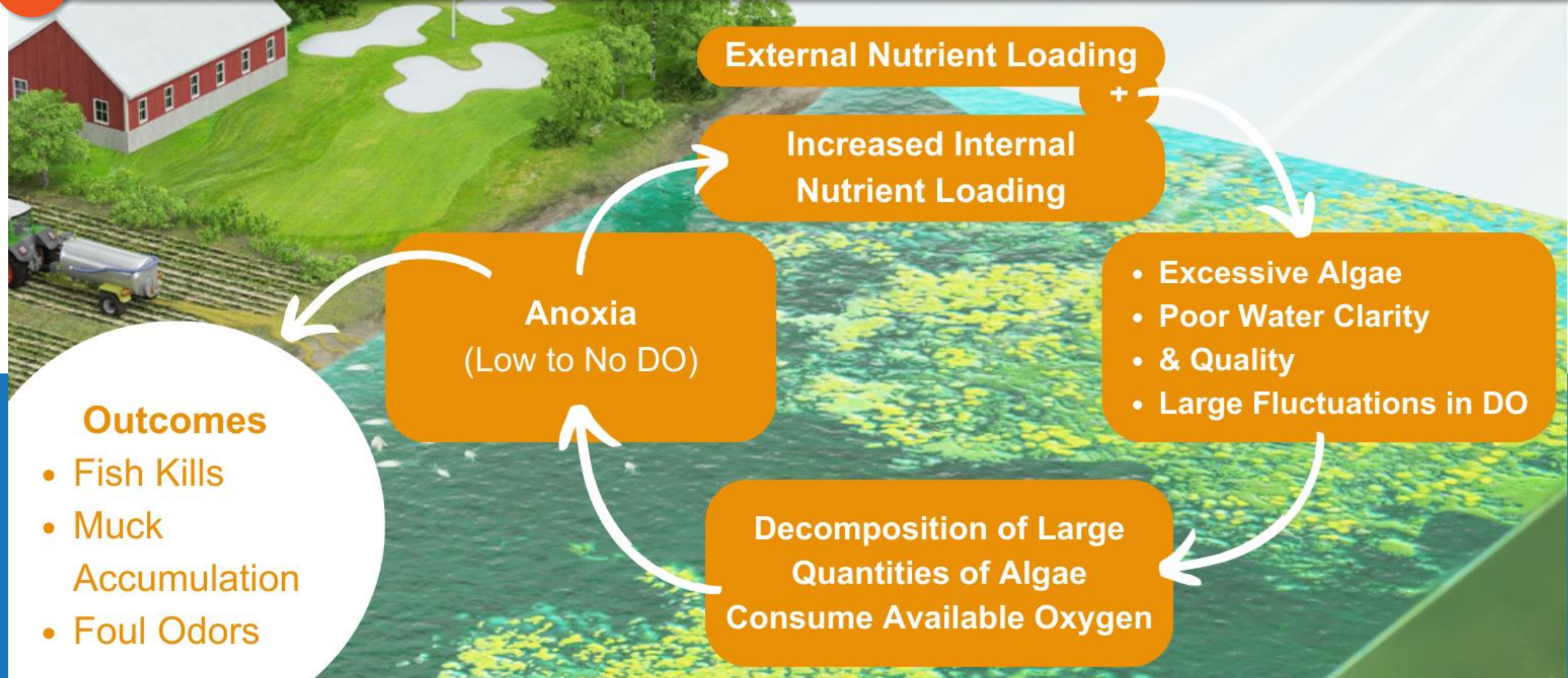




# The Problem: Nutrient Loading & Anoxia Fuel Waterbody Impairment



50% of Waterbodies Globally are Impaired, Impacting Communities & Aquatic Ecology



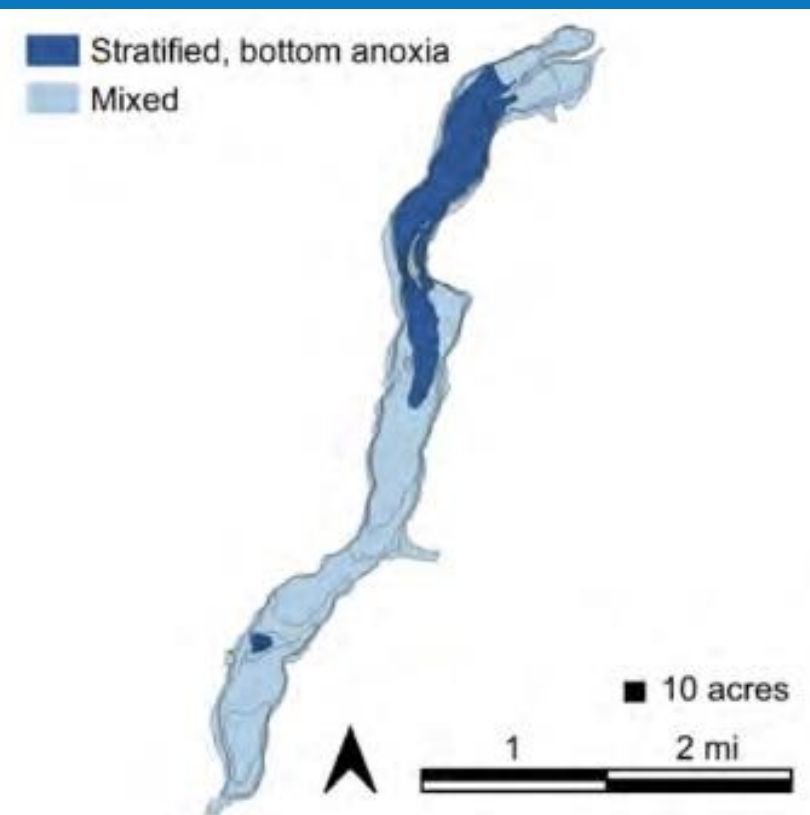
# Your Waterbody: Cross Lake

## Goals

1. Reduce internal loading
2. Reduce number of algae blooms
3. Improve water clarity
4. Improve lake recreation

## Success Indicators

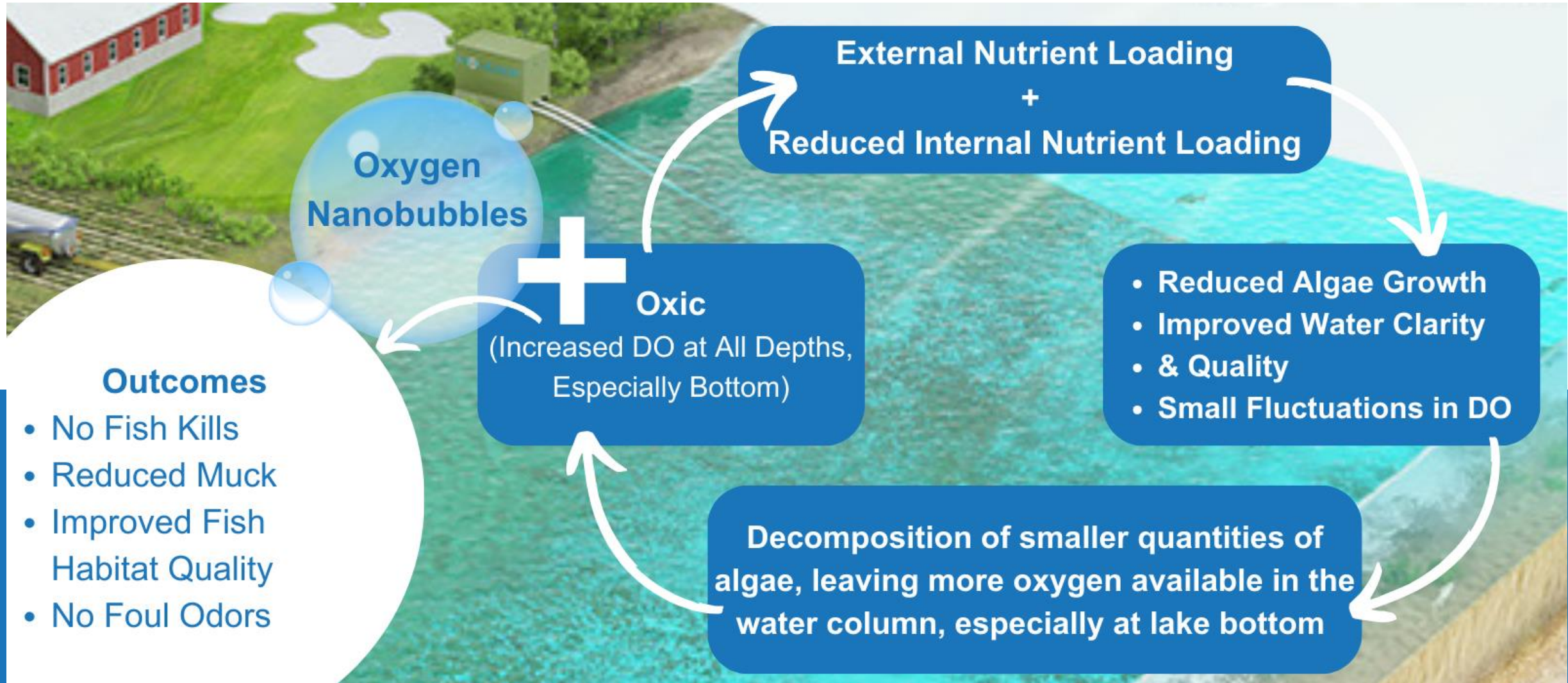
- ✓ Increased oxygen levels and ORP in areas of anoxia fig. 18.
- ✓ Increased secchi disk readings
- ✓ Reduced muck thickness measured via sludge judge and harder sediment composition measured via Biobase
- ✓ Reduced phosphorus concentrations in water column



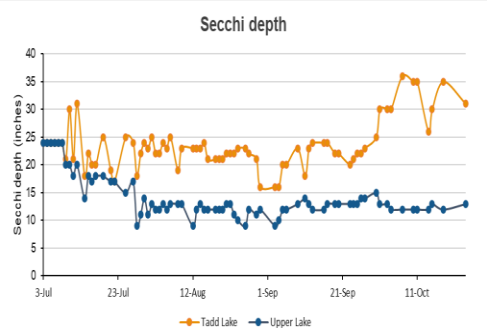
*Fig. 18. Estimation of areas on Cross Lake that seasonally stratify and might be classified as dimictic. Areas marked "mixed" likely act as polymictic zones.*



# The Solution: Moleaer Nanobubble Treatment Enhances Oxic Conditions & Increases Resiliency to Restore Waterbodies



# Visible & Data-Driven Results in Diverse Waterbodies



## Tadd Lake

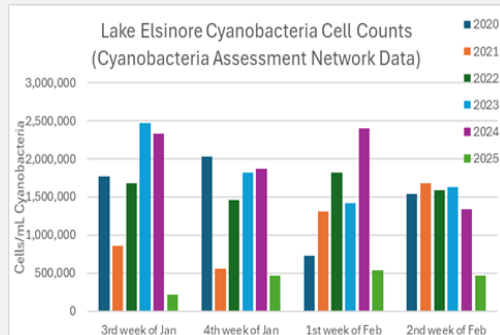
### Problem:

- Algal blooms & odor
- Poor water clarity
- Unable to use recreationally

### Results:

Compared to Control Lake:

- > 2x clearer
- 2x higher over bottom DO
- ~ 4x lower orthophosphate levels
- > 4x less total algae loads



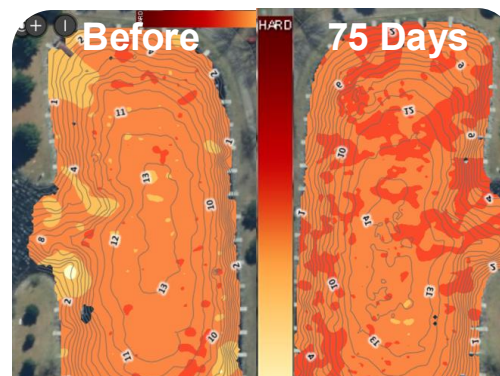
## Lake Elsinore

### Problem:

- Lake closures due to HABs
- Poor clarity & high nutrient loading
- Inefficient, outdated aeration system

### Results:

- 50-90% reduction in early-season cyanobacteria
- Up to 7,000% reduction in turbidity
- Highest water clarity reported



## Lake Arrowhead Marina

### Problem:

- Algal blooms & poor water clarity
- High muck accumulation

### Results:

- DO levels were 50% higher than control
- Reduced muck and increased depth by 1' (30 cm)
- Water clarity improved by 2-3' (61-91 cm) in first 30 days



## Tidal Stormwater Channel

### Problem:

- H<sub>2</sub>S formation causing foul odors & displaced people

### Results:

- Eliminated H<sub>2</sub>S formation and foul odors
- 3000 people returned home
- Increased dissolved oxygen over 15 mile canal





# How Nanobubble Treatment Benefits Waterbodies

## Nanobubbles Create and Enhance Aerobic Conditions, Especially at Depth Enable Natural Lake Processes & Increase Lake Resiliency

### Accelerate Muck Digestion

- Improve sediment hardness
- Reduce sediment oxygen demand over time
- Reduce need for dredging

### Mitigate Nutrient Levels

- Reduce internal nutrient loading

### Reduce Algae & HABs

- Less nutrients to fuel algae
- Increased ORP which promotes breakdown of algal toxins

### Improve Water Clarity

- Reduce blue-green algae dominance
- Promote increased species diversity throughout aquatic food web

### Reduce Fish Kill

- Improve and sustain dissolved oxygen levels for fish health
- Reduce muck and improves fish habitat quality for spawning and feeding

### Eliminate or Reduce Foul Odors

- Eliminate or greatly reduce H<sub>2</sub>S, MIB and geosmin levels that cause foul odors and off-flavor compounds

### Reduce Coliforms

- Proven to reduce coliform and *E. coli* loads without harsh chemicals
- Reduce potential health risks

# How We Measure Success: Your Monitoring Plan



**Moleaer Staff Taking Water Quality Samples**

## Customized Monitoring Plans to Track Progress

### Up to 30 parameters measured including:

- Real-time water quality sensors
- Vertical profiling
- Depth discrete water and sediment grab samples
- BioBase® Sediment hardness mapping

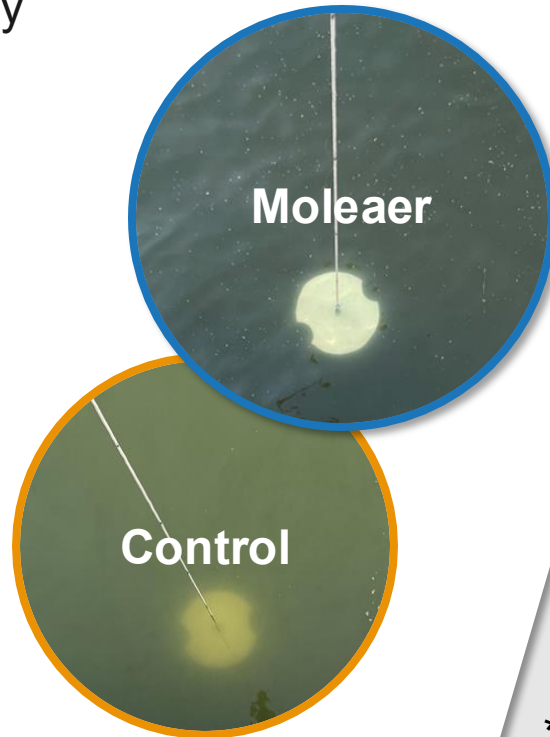
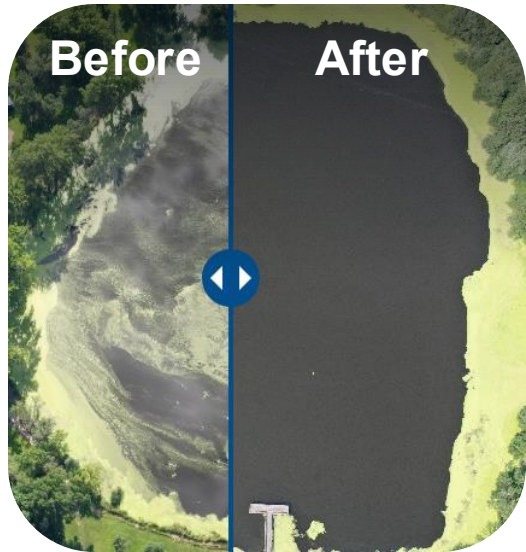
### To track changes in:

- Water and sediment chemistry
- Biology (phytoplankton and zooplankton speciation and enumeration)
- Muck depth and spatial extent
- Sediment nutrient release rates

# Goals: What You Can Expect from Moleaer Nanobubble Treatment

## Short-Term (Within 1-2 months\*)

- Elevated DO and ORP levels
- Improved water clarity



## After 3-4 months\*

Reduction in  
Blue-Green  
Algae Loads

Reduction or  
Elimination  
of Anoxic  
Conditions

Maintained or  
Increased ORP  
Values  
Throughout the  
Water Column

Reduced  
Sedimentary  
Organic  
Matter

Notable  
Reduction in  
Nuisance  
Nutrient  
Release from  
Sediment

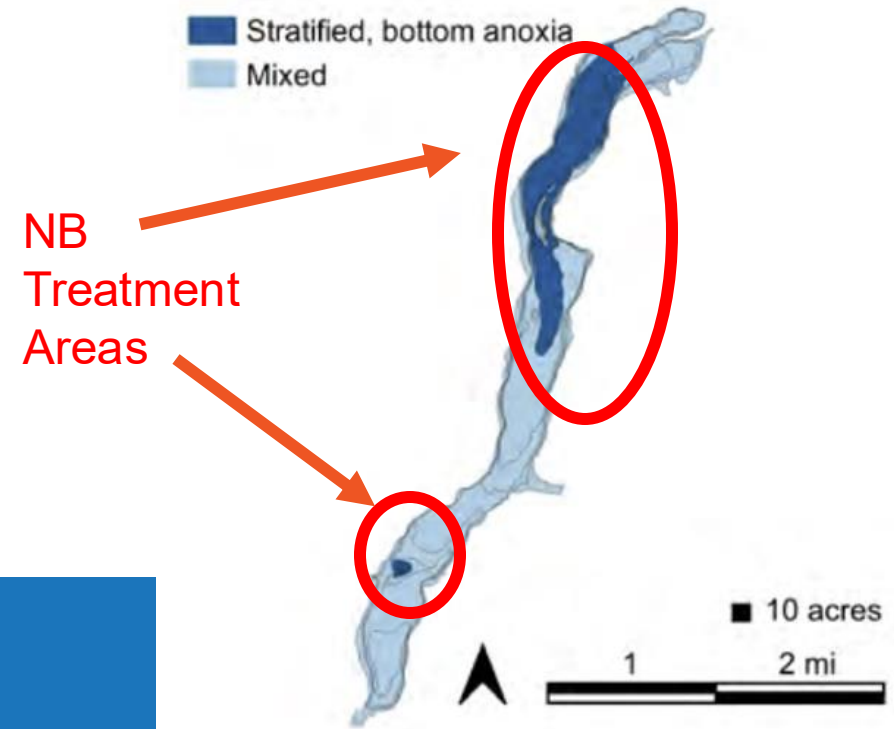
Improved  
Biodiversity  
of the Food  
Web

\*Subject to site conditions



# Cross Lake: Whole Lake Nanobubble Treatment Strategy

- Detail steps and methods for getting this done, including overview of product selection process, installation requirements and proposed monitoring (next slide)
- We chose these treatment locations due to stratified areas of anoxia identified in the Cross Lake Management Plan. Wenck estimated 218 acres of anoxia present in the lake
- The prescribed treatment proposes locating nanobubble generators in two locations to distribute nanobubbles to priority areas



*Fig. 18. Estimation of areas on Cross Lake that seasonally stratify and might be classified as dimictic. Areas marked "mixed" likely act as polymictic zones.*

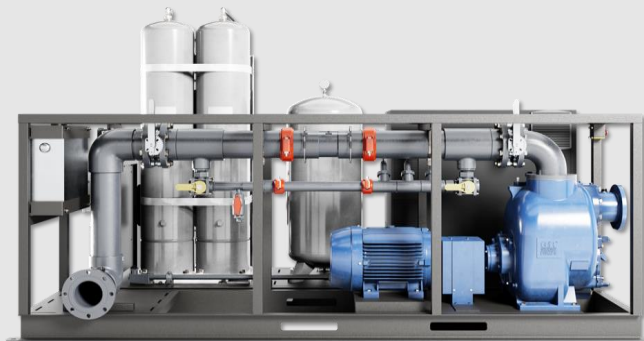
# Option 1: Moleaer Nanobubble Full Lake Treatment

## System(s)



- Shore mounted nanobubble generator systems with dock mounted piping
- 2 x Moleaer container mounted nanobubble systems

## Product Specifications



- 2 x 4500 gpm
- 2 x 106# O<sub>2</sub>/hr
- Moleaer Trinity L6 Nanobubble Generators

## Installation Location(s)

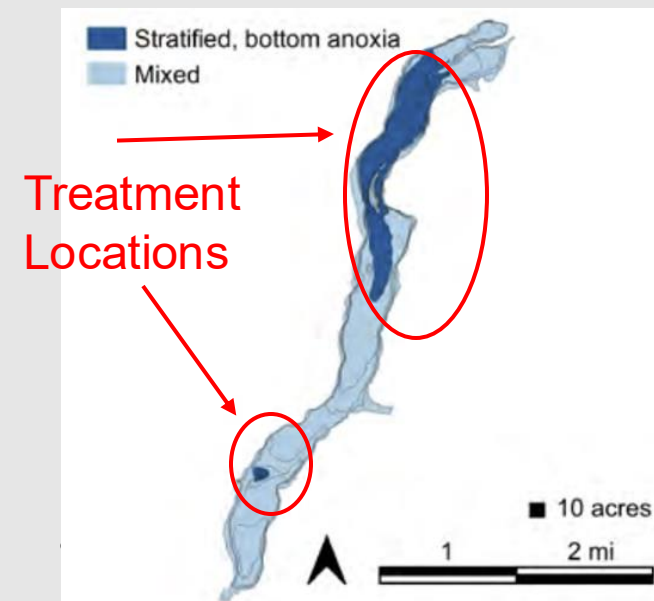


Fig. 18. Estimation of areas on Cross Lake that seasonally stratify and might be classified as dimictic. Areas marked "mixed" likely act as polymictic zones.

# Option 1- Budget- Capital Purchase

## Whole Lake Treatment- 2 systems

- Moleaer and 3rd party finance options
- All costs, including operating costs are eligible for financing

<b>Cross Lake Container Plan</b>				
<b>Trinity L6 O2 Nanobubble System</b>				
Equipment Purchase			\$1,662,000	
Installation			\$ 158,000	
Estimated Annual Service Costs- 1st year			\$ 112,500	
<b>TOTAL PURCHASE, INSTALL AND 1 YR SERVICE</b>			<b>\$1,932,500</b>	
<b>Capital Purchase, including</b>				<b>\$1,662,000</b>
Trinity L6 O2 Nanobubble System	2	\$ 800,000	\$1,600,000	Moleaer- Complete System
Freight In	2	\$ 6,000	\$ 12,000	Estimate
Monitoring buoys	2	\$ 25,000	\$ 50,000	
<b>Installation, including</b>				<b>\$ 158,000</b>
Crane-Offloading Containers	1	\$ 3,000	\$ 3,000	Customer- Budgetary
Site work-	1	\$ -	\$ -	Customer- Budgetary
Electrical Supply/Construction	2	\$ 30,000	\$ 60,000	Customer- Budgetary
Container piping	2	\$ 30,000	\$ 60,000	Estimate
Moleaer on site commissioning 2 tech x 10 days	10	\$ 3,500	\$ 35,000	Moleaer- Budgetary
Labor to install	1	\$ -	\$ -	Customer- Budgetary
<b>Annual Costs</b>				<b>\$ 112,500</b>
Daily Checks			0	Customer
Service Visits	3	\$ 3,500	\$ 10,500	Moleaer- Budgetary
Electrical cost, monthly	6	\$ 17,000	\$ 102,000	customer- Estimated



# Option 1- Budget- Lease to Own

## Whole Lake Treatment- 2 systems

- Up to 60 months lease to own term
- As low as 24 month minimum term
- Can include all installation and operating costs
- Purchase option at any point during lease to own term

<u>BEG OF MONTH</u>	<u>MONTHLY RENT</u>	<u>PURCHASE PRICE</u>
Effective Date	\$45,980	\$1,672,000
1	\$45,980	\$1,644,133
2	\$45,980	\$1,616,267
3	\$45,980	\$1,588,400
4	\$45,980	\$1,560,533
5	\$45,980	\$1,532,667
6	\$45,980	\$1,504,800
7	\$45,980	\$1,476,933
8	\$45,980	\$1,449,067
9	\$45,980	\$1,421,200
10	\$45,980	\$1,393,333
11	\$45,980	\$1,365,467
12	\$45,980	\$1,337,600

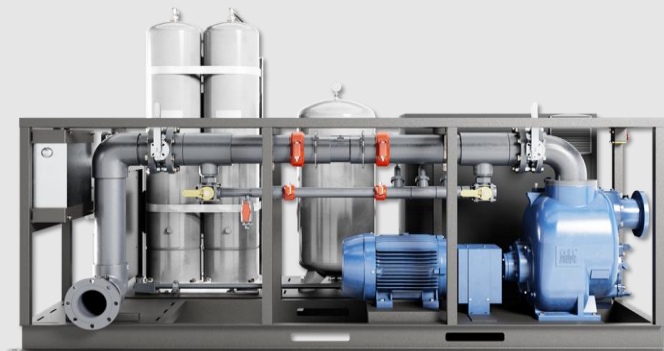
# Option 2: Roadmap Moleaer Nanobubble Lake Treatment

## System



- Shore mounted nanobubble generator systems with dock mounted piping
- Begin with one Moleaer container mounted nanobubble system

## Product Specifications



- 1 x 4500 gpm
- 1 x 106# O<sub>2</sub>/hr
- Moleaer Trinity L6 Nanobubble Generators

## Installation Location(s)

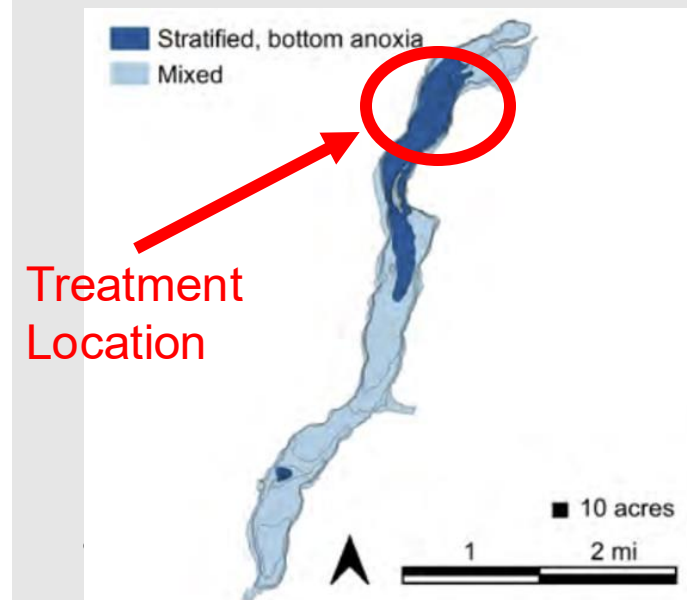


Fig. 18. Estimation of areas on Cross Lake that seasonally stratify and might be classified as dimictic. Areas marked "mixed" likely act as polymictic zones.

# Option 2- Budget- Capital Purchase

## Roadmap to whole lake treatment- 1 system

- This approach looks to phase treatment by installing one container in North Cross Lake and later install in South Cross Lake
- Moleaer and 3rd party finance options
- All costs, including operating costs are eligible for financing

<b>Cross Lake Road Map Container Plan</b>				
<b>Trinity L6 O2 Nanobubble System</b>				
Equipment Purchase			\$ 856,000	
Installation			\$ 80,500	
Estimated Annual Service Costs- 1st year			\$ 61,500	
<b>TOTAL PURCHASE, INSTALL AND 1 YR SERVICE</b>			<b>\$ 998,000</b>	
<b>Capital Purchase, including</b>				
			<b>\$ 856,000</b>	
Trinity L6 O2 Nanobubble System	1	\$ 800,000	\$ 800,000	Moleaer- Complete System
Freight In	1	\$ 6,000	\$ 6,000	Estimate
Monitoring buoys	2	\$ 25,000	\$ 50,000	
<b>Installation, including</b>				
			<b>\$ 80,500</b>	
Crane-Offloading Containers	1	\$ 3,000	\$ 3,000	Customer- Budgetary
Site work-	1	\$ -	\$ -	Customer- Budgetary
Electrical Supply/Construction	1	\$ 30,000	\$ 30,000	Customer- Budgetary
Container piping	1	\$ 30,000	\$ 30,000	Estimate
Moleaer on site commissioning 2 tech x 5 days	5	\$ 3,500	\$ 17,500	Moleaer- Budgetary
Labor to install	1	\$ -	\$ -	Customer- Budgetary
<b>Annual Costs</b>				
			<b>\$ 61,500</b>	
Daily Checks			0	Customer
Service Visits	3	\$ 3,500	\$ 10,500	Moleaer- Budgetary
Electrical cost, monthly	6	\$ 8,500	\$ 51,000	customer- Estimated



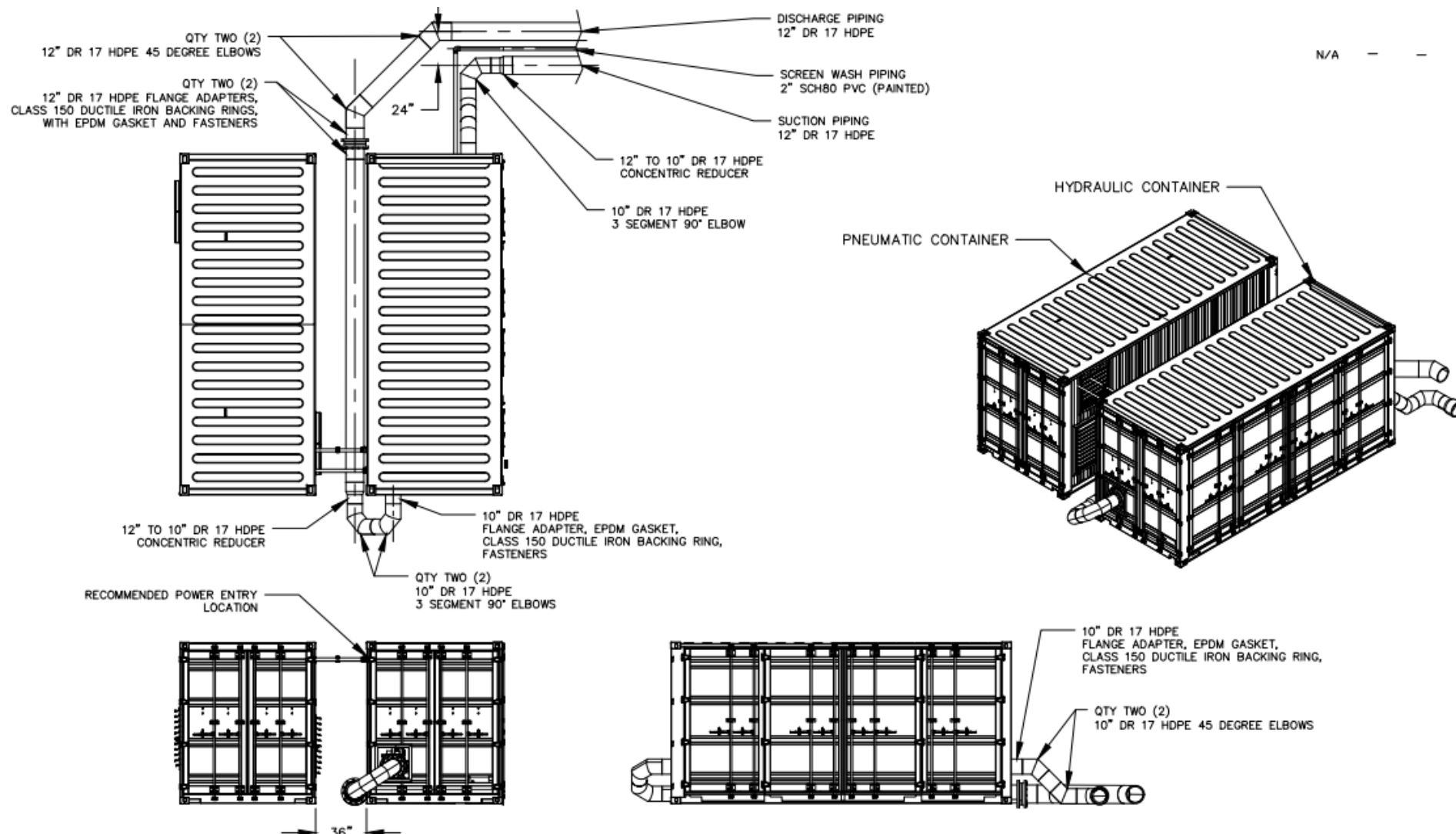
# Option 2- Budget- Lease to Own

Roadmap to whole lake treatment- 1 system

- Up to 60 months lease to own term
- As low as 24 month minimum term
- Can include all installation and operating costs
- Purchase option at any point during lease to own term

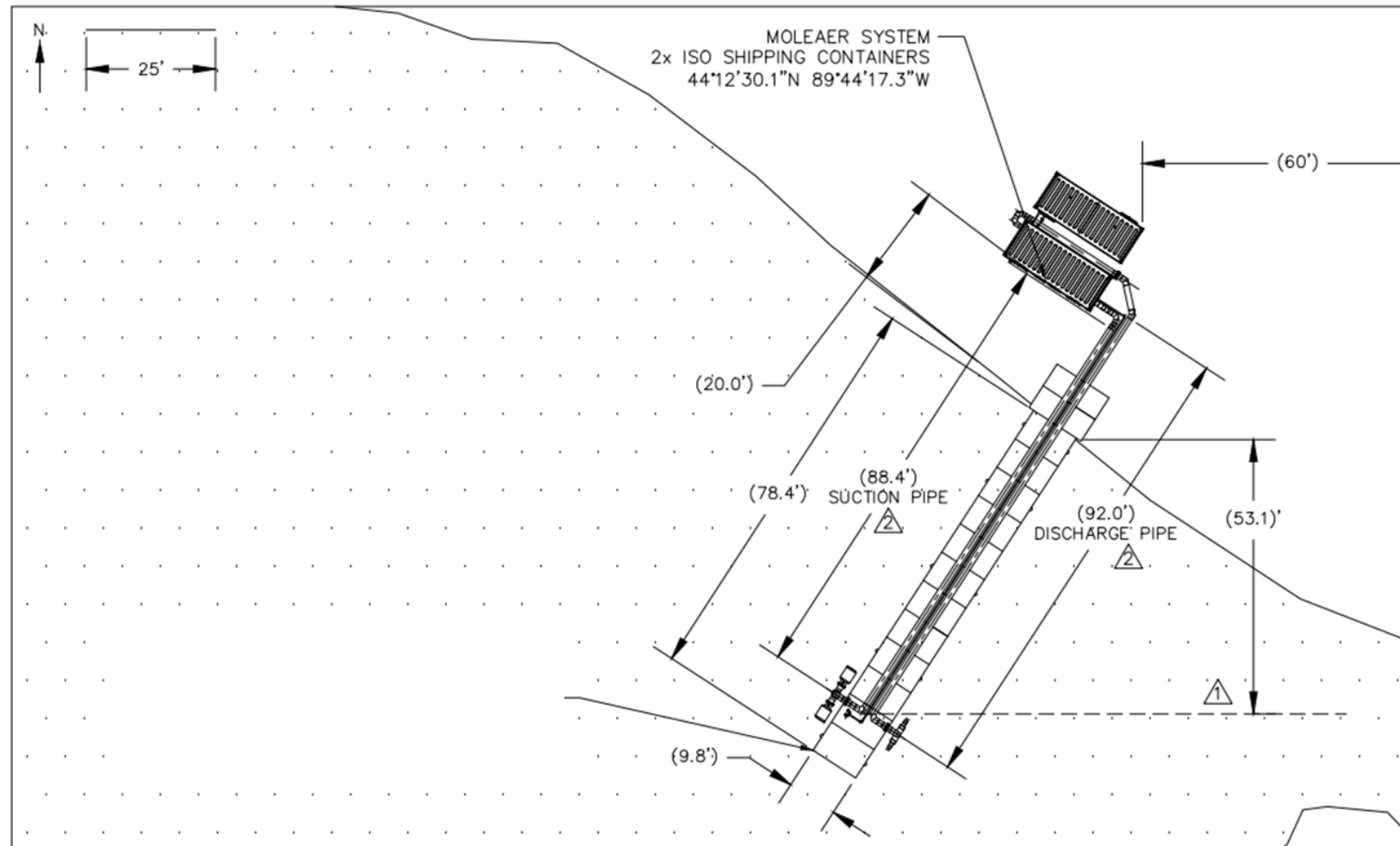
<u>BEG OF MONTH</u>	<u>MONTHLY RENT</u>	<u>PURCHASE PRICE</u>
Effective Date	\$22,990	\$836,000
1	\$22,990	\$822,067
2	\$22,990	\$808,133
3	\$22,990	\$794,200
4	\$22,990	\$780,267
5	\$22,990	\$766,333
6	\$22,990	\$752,400
7	\$22,990	\$738,467
8	\$22,990	\$724,533
9	\$22,990	\$710,600
10	\$22,990	\$696,667
11	\$22,990	\$682,733
12	\$22,990	\$668,800

# GAD (General Arrangement Drawing) Containers



# GAD (General Arrangement Drawing) Piping on Dock

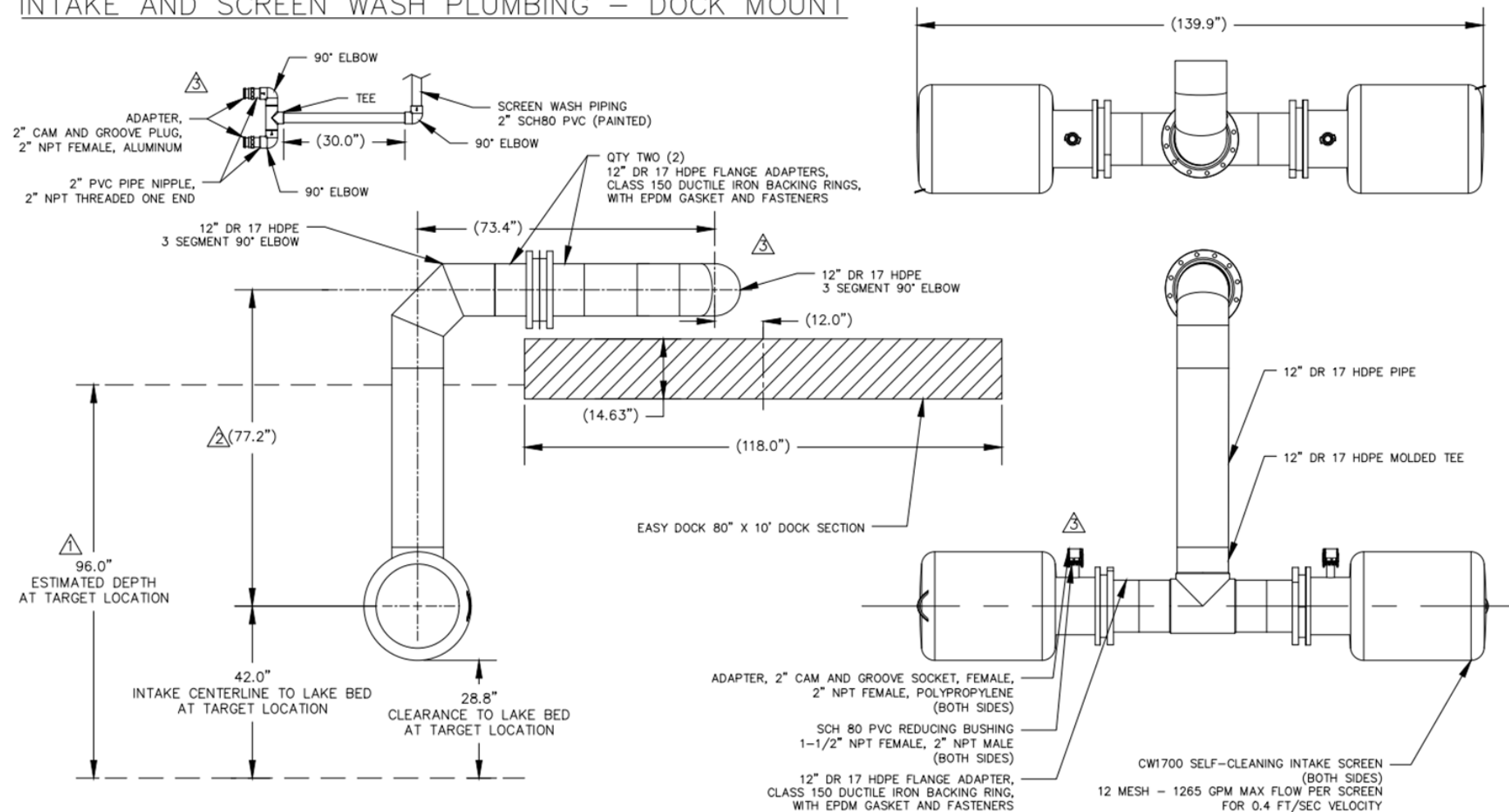
SITE PLAN VIEW – DOCK MOUNT





# GAD (General Arrangement Drawing) Intake Screen

## INTAKE AND SCREEN WASH PLUMBING – DOCK MOUNT



# Finance Options

## Finance Options

- Capital Purchase
  - 3rd party finance options
- Lease to Own
  - Up to 60 month
  - Minimum term of 12 months
  - Can purchase at any point during lease period
- NaaS (Nanobubbles as a Service)
  - Moleaer provides all but electrical
  - No purchase option





# Sustainable, Proven Solution to Solve Your Challenges

## Achieve Your Goals...

**Problem:** Eutrophic lake that is impaired for nutrients, has poor water clarity and excessive toxic algal blooms

**Goals:** Improved water clarity, quality and reduced accumulated organics that will allow for increased recreation and property values

**Solution:** Moleaer nanobubble treatment targeting the anoxic zone and internal loading that is the root cause of the water quality challenges that are plaguing the lake

## ...with the Leader in Nanobubble Technology

- ✓ Largest installation and customer base
- ✓ Dedicated surface water specialists and team for your project
- ✓ Largest R&D and Application Development teams
- ✓ Backed by science through rigorous independent research



CONFIDENTIAL



[www.moleaer.com](http://www.moleaer.com)



Thank You!

**MOLEAER®**





# Appendix



# Case Studies

# Lake Elsinore, California

## From Closure to Clarity

### About the Waterbody

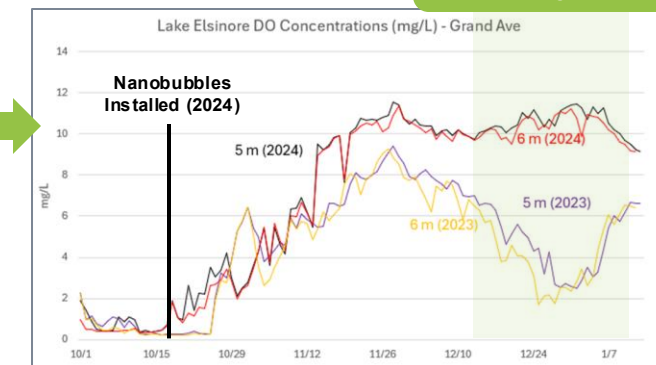
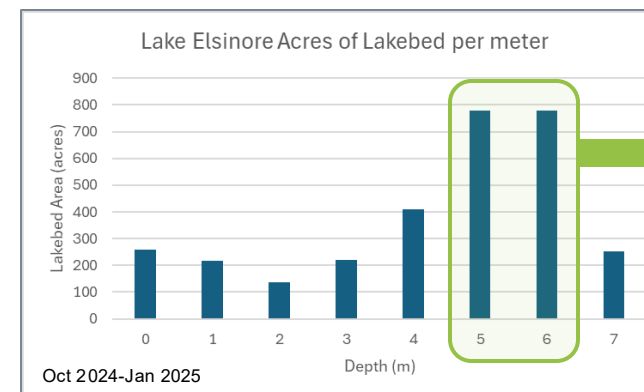
- Surface Area: 3,311 acres (1334 ha)
- Max Depth: 24 ft (7.3 m)
- Volume: 30K acre-feet (37 million m<sup>3</sup>)
- Receives 6.5M GPD (24k m<sup>3</sup>) of treated effluent

### Challenges

- Recurrent lake closures due to HABs
- Poor clarity & high nutrient loading
- Economic impacts for community
- Inefficient, outdated aeration system

### Results: (1) 2,400 GPM (545 m<sup>3</sup>/hr) & (2) 4,500 GPM (1022 m<sup>3</sup>/hr) Nanobubble Barges

- Significant reduction (50-90%) in early-season cyanobacteria levels
- Up to 7,000% reduction in turbidity (highest water clarity reported in 2 Years)
- Elevated DO sustained at critical depth, > 2,000 meters from nearest nanobubble unit



# Tadd Lake, Minnesota

Pilot: Major Improvements Compared to Control

## About the Waterbody

- Surface Area: 10 acres (4 ha)
- Max Depth: 8 ft (2.4 m)
- Volume: 50-acre-feet (61,714 m<sup>3</sup>)
- Terminal lake, connected to Upper Lake (surface area: 25 acres (0.1 km<sup>2</sup>))

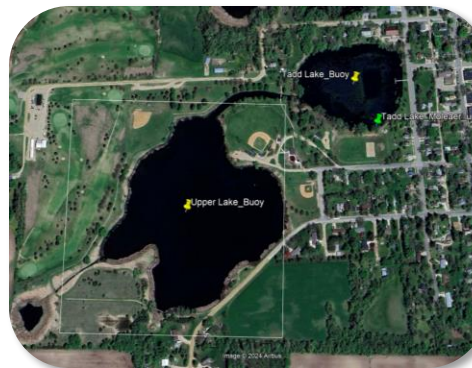
## Challenges

- Poor water clarity
- Excess algae growth and odor issues
- Invasive aquatic plant proliferation
- Unable to use recreationally
- Legacy poor water quality issues

## Results: 1,000 GPM (227 m<sup>3</sup>/hr) Trailer

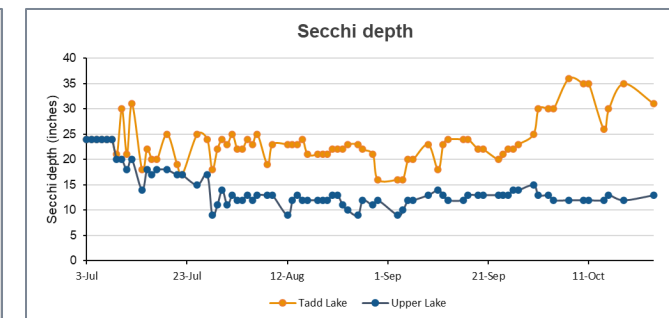
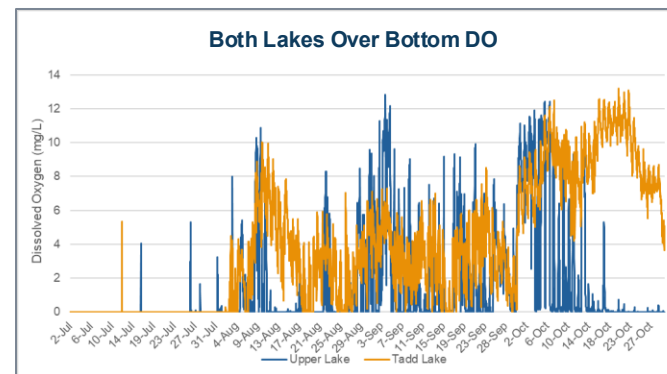
Compared to Control Lake:

- > 2x clearer
- 2x higher over bottom DO
- ~ 4x lower orthophosphate levels
- > 4x less total algae loads

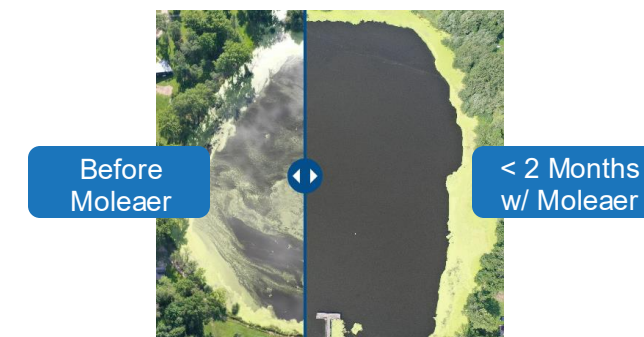


### Nanobubble Pilot:

- July 2 – Oct 24, 2024
- Upper Lake: Control site



	> 3 mg/L (fish struggle)	> 1 mg/L (fish die)
Tadd	65%	88%
Upper	25%	25%





# Lake Arrowhead, Wisconsin

Pilot Marina Shows Remarkable Results in 75 Days

## About the Waterbody

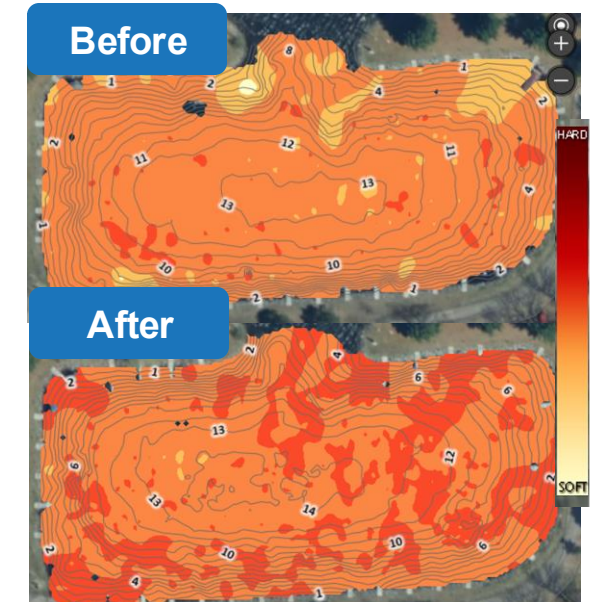
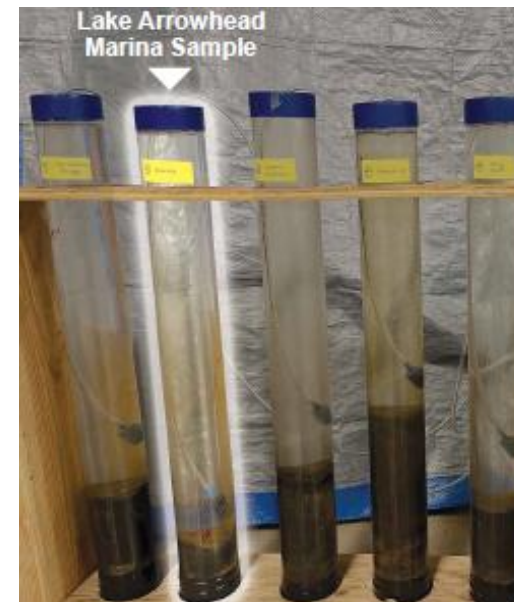
- Marina Surface Area: 2 acres (0.8 ha)
- Lake Surface Area: 300 acres (121 ha)
- Flowing Lake System: 900 acres (364 ha)

## Challenges

- Excessive algae and very poor water clarity
- High muck accumulation
- Stagnant area of lake with poor circulation
- Legacy poor water quality issues

## Results: 1000 GPM (227 m<sup>3</sup>/hr) Trailer

- DO levels were 50% higher than control
- Increased depth by 1' (30 cm)
- Water clarity improved by 2-3' (61-91 cm)



# Hartbeespoort Dam, South Africa

Success in South African Dam Spurs Community

## About the Waterbody

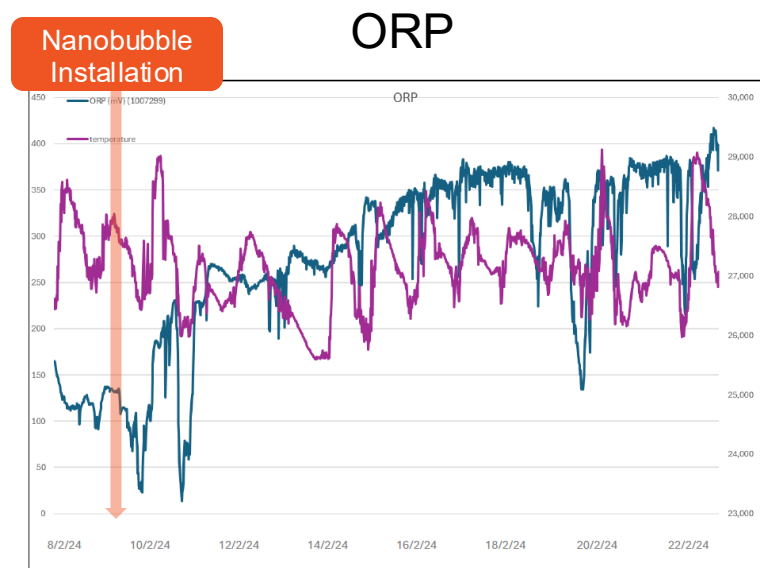
- Surface Area: >2,000 ha
- Max Depth: 30 m (84 ft)
- Average Depth: 9.8 m (65 ft)
- Volume: 192,800,000 m<sup>3</sup> (51B gal)
- Ret Time: 6 mo to 1 yr

## Challenges

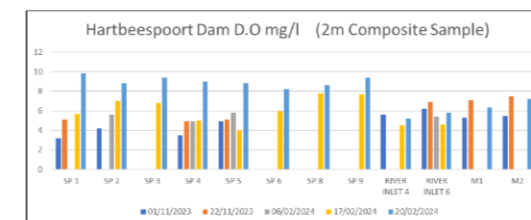
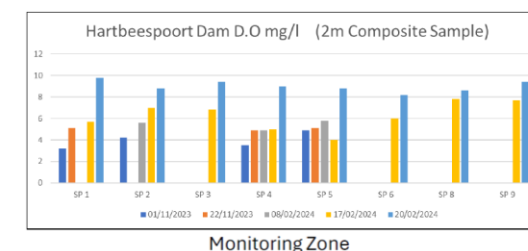
- Poor water clarity and legacy of poor quality
- Excessive algae growth
- Invasive aquatic plant proliferation
- Unable to use recreationally
- Odor issues

## Results: 2,400 GPM (550 m<sup>3</sup>/hr) Trailer

- Nutrient reduction (Ammonium, Orthophosphate)
- COD increase
- Significant bottom muck digestion in treatment zone
- Reduced nutrient flux in treatment zone and outfall
- Improved resilience against incoming nutrient load
- Cyanobacteria, Microcystin & *E. coli* reductions in treatment area & outfall



## Dissolved Oxygen



# Satellite Beach, Florida

## Better Muck Reduction Over Control

### About the Waterbody

- Surface Area: 1.5 acres (0.6 ha)
- Brackish water

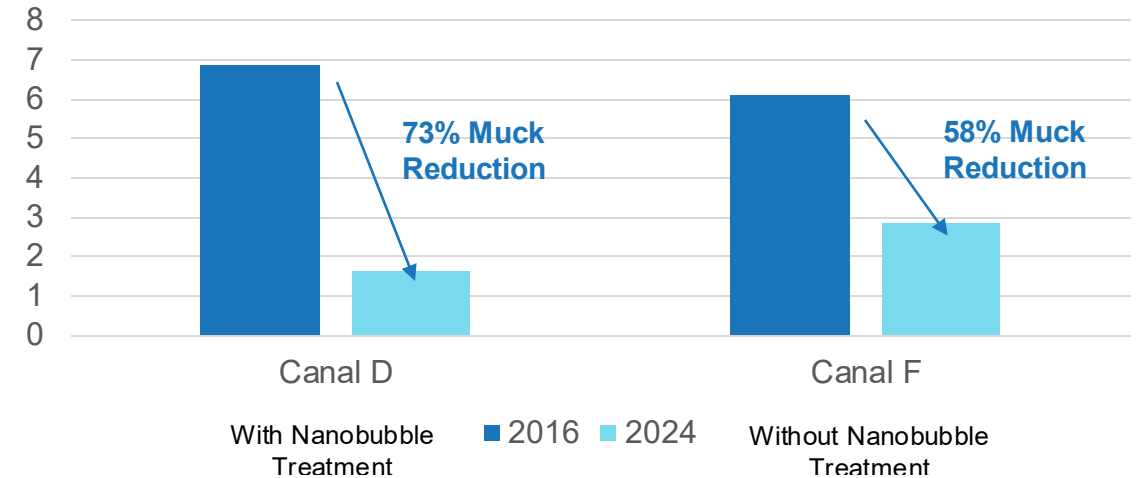
### Challenges

- Thick muck
- Poor water quality

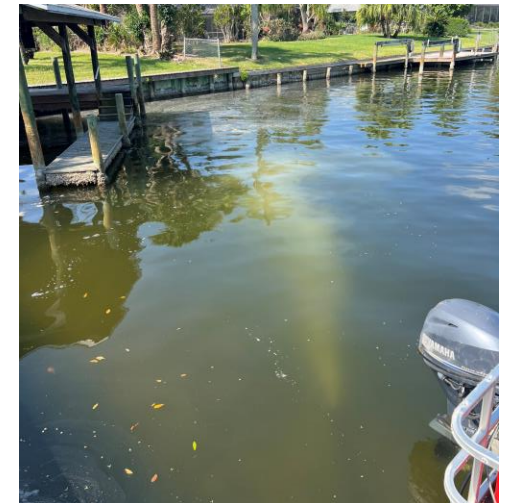
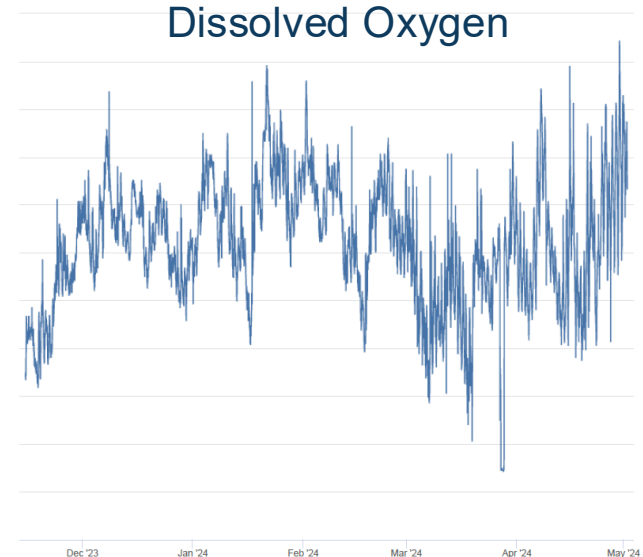
### Results: Clear 150 nanobubble generator

- Average 73% reduction in muck in the pilot canal, a 15% improvement over the control
- Elevated dissolved oxygen in the water column and at the sediment-water interface

Average Muck Thickness



Dissolved Oxygen





# Tranquility Bay, South Dakota

Significant Algae Reduction = Happy Locals

## About the Waterbody

- Surface Area: 5.92 acres (2.4 ha)
- Long, narrow bay, part of Big Stone Lake (+12,000 acres, ~4900 ha)

## Challenges

- Excess algal blooms and aquatic weeds
- Poor clarity

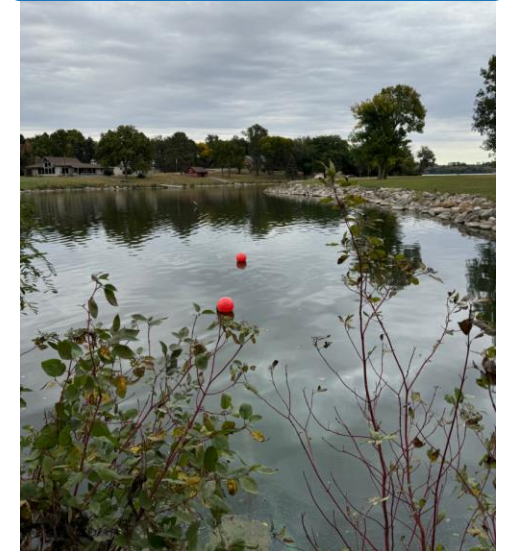
## Results: Neo nanobubble trailer

- Significant water clarity improvements
- Visibly reduced algal blooms
- Reduced aquatic weed growth
- Better fishing for locals

BEFORE MOLEAER



AFTER MOLEAER





# Tidal Stormwater Channel, California

3,000 Locals Return Home in Urban Community

## About the Waterbody

- 15.7-mile (25 km) brackish, tidal stormwater canal apart of 133 sq mile (344 sq km) watershed

## Challenges

- Low oxygen levels in water channel
- Hydrogen sulfide ( $H_2S$ ) gas production
- Rotten egg smell, displayed 3,000 ppl

## Results:

- Eliminated  $H_2S$  formation, foul odors and people returned home
- Increased dissolved oxygen
- Digested organics (i.e. “muck”)



2022 Water Project of the Year Distinction

- 50,000 GPM (11k m<sup>3</sup>/hr) treatment capacity equaling 60M gallons (227M liters/day) of water per day treated
- Dates of Treatment: October 2021 – March 2022



# Greenways Golf Course, Soet River, South Africa

## Odor Elimination for Local Community

### About the Waterbody

- Length: 300 m (984 ft)
- Depth: 51 cm (20 in)
- River with tidal influence

### Challenges

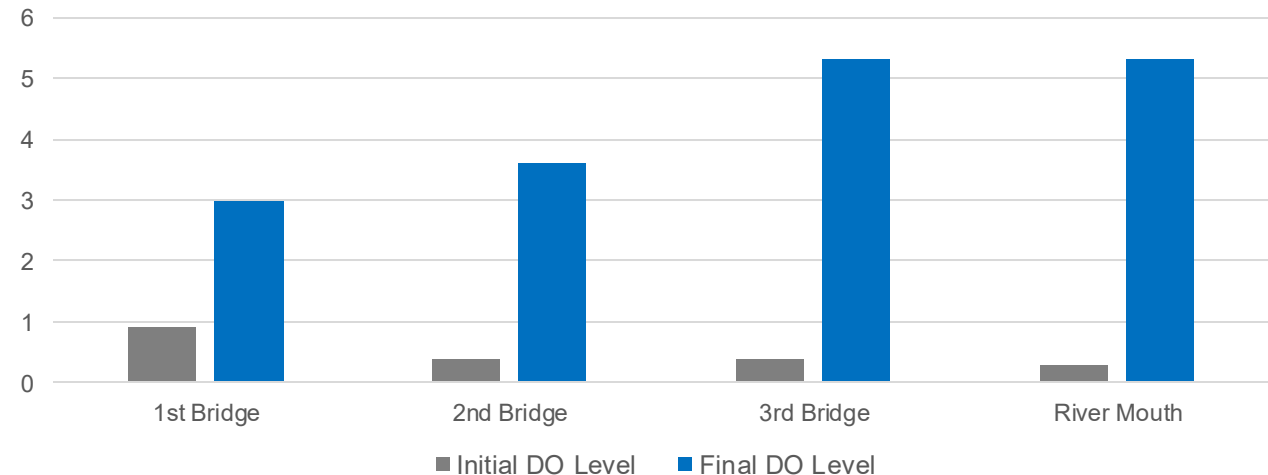
- Incoming river flow with high levels of pollution
- Foul odors from hydrogen sulfide (H<sub>2</sub>S) formation
- High turbidity

### Results: (2) Clear nanobubble generators

- Increased DO by up to 1600%
- Increased ORP levels to 220 mV
- Reduced water turbidity by 89%
- Decreased COD by 68%
- Eliminated foul odors from H<sub>2</sub>S



DO Levels (mg/L)



# Community Lake, Florida

Significant Reductions in Nutrients that Fuel Algae

## About the Waterbody

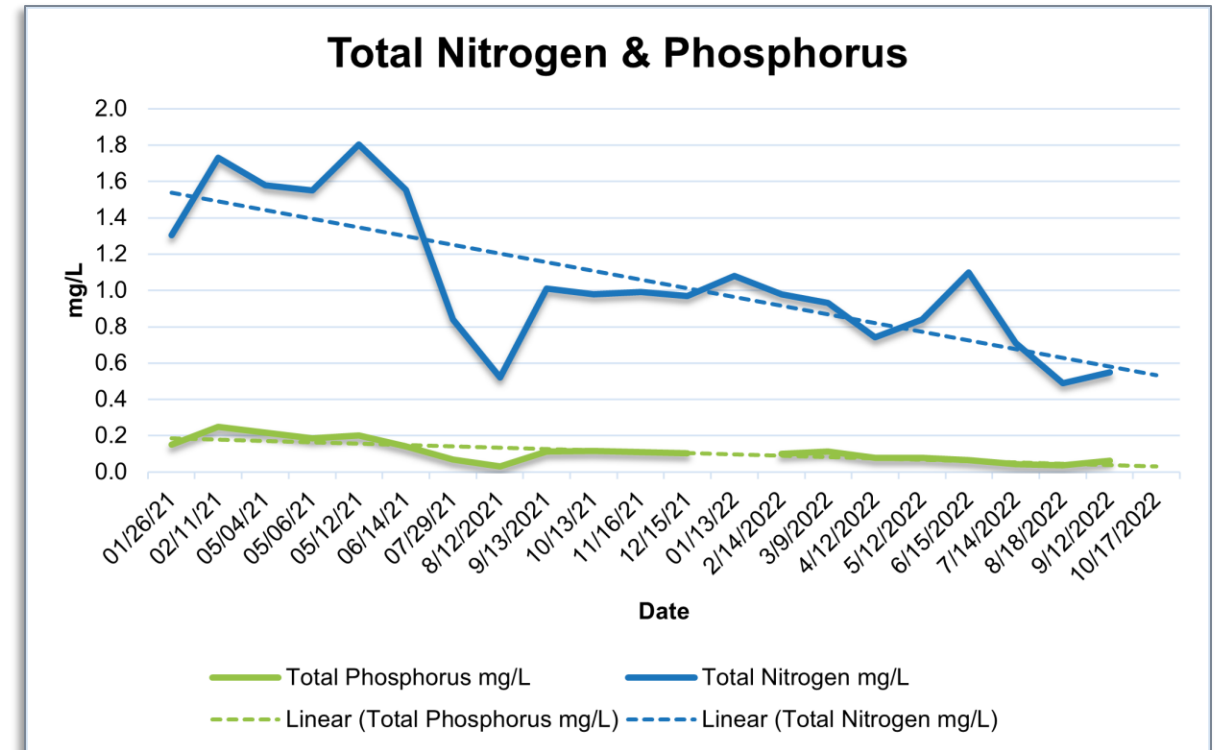
- 1.1 acres (0.45 ha)
- 6-acre feet (7,401 m<sup>3</sup>)

## Challenges

- High nutrients, eutrophication
- Algae and poor clarity

## Results: Clear 150 nanobubble generator

- Reduced Total Nitrogen (-96%) and Phosphorus levels (-59%)
- Improved water clarity
- Less maintenance effort





# Westin Hapuna Beach Resort Koi Pond, Hawaii

Tranquil Koi Pond Remains Key Guest Attraction

## About the Waterbody

- Koi pond at resort

## Challenges

- Potential for odors
- Poor clarity

## Results: Kingfisher Nanobubble Generator

- Improved clarity
- Better experience for resort guests
- Chemical-free solution
- Improved plant and fish health

*"We have been using Moleaer's nanobubble generator here at the Westin Hapuna Beach Resort since March 2022, and it has been a game changer! We have been absolutely thrilled with the improvements to the health of the plants and fish. After just a short time, the clarity in the pond increased dramatically which has translated into a better experience for our Resort guests, and the fact that it is an all-natural treatment is an added bonus!"*

– Marguerite Heap, Hotel Manager **THE WESTIN**  
HAPUNA BEACH  
RESORT





# Private Quarry Lake, Minnesota

## Algae Control & Muck Reduction

### About the Waterbody

- 30-acre feet (37,004 m<sup>3</sup>)

### Challenges

- Emergency, short-term deployment for algae and muck

### Results: 1,000 GPM nanobubble trailer with oxygen and ozone generators, 3-day turnover

- Improved water clarity within weeks
- Firmer sediment
- Reduced muck and algae

*“Before nanobubbles, the water volume was so full of algae with algae on the top. After a week, the water color changed from green to brown as the algae died and started to decompose.”*

*– Vance Walgrave, Those Blasted Things, Lake Owner*



# Private Golf Club, Florida

## Algae Control on the 19<sup>th</sup> Hole

### About the Waterbody

- 2.87 acres (1.2 ha)
- 14.35-acre feet (17,700 m<sup>3</sup>)

### Challenges

- Excessive algae in golf course ponds
- Foul odors

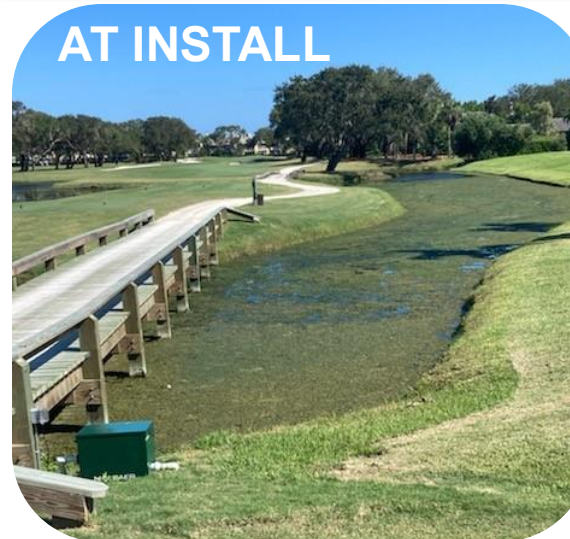
### Results: Clear 150 & Kingfisher nanobubble generators

- Reduced algae growth
- Improved water clarity
- Eliminated foul odors

*“Nanobubble technology is a sustainable and chemical-free tool for lake managers to utilize to restore lake health for our clients. By getting at the root cause of common lake issues, we can naturally improve water quality, allowing our clients to enjoy their lakes and ponds once again.”*

*- Rick Anderson, the owner of Aquatic Balance*

AT INSTALL



AFTER





# The Sands Coastal Community Lake, Fort Pierce, FL

Locals Enjoy HOA Community Lake

## About the Waterbody

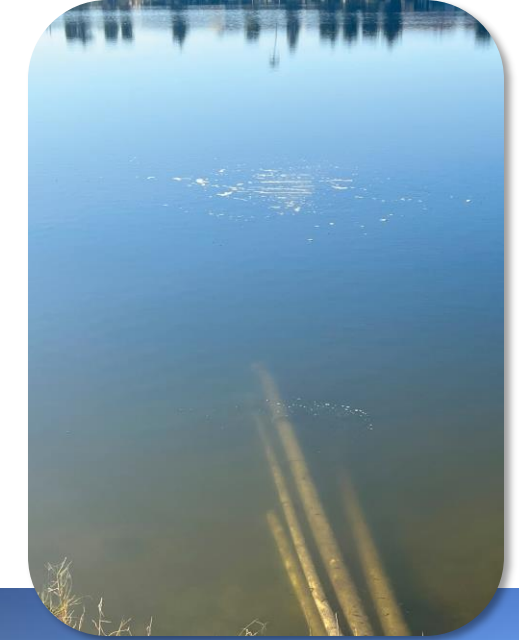
- 15 surface acres (6 ha)
- 150-acre feet (185,022 m<sup>3</sup>)
- Max depth: 20 ft (6 m)

## Challenges

- Fish kill
- Poor water clarity

## Results: Clear 150 nanobubble generator

- Eliminated fish kills
- Reduced midge fly outbreaks
- Better water quality and clarity
- Improved discharge quality into surrounding ecosystems





# Private Trout Pond, Tomah, WI

Healthier Lake for Happy Lake Front Homeowner

## About the Waterbody

- Private pond for recreation and fishing

## Challenges

- Annual algae blooms

## Results: Clear 50 nanobubble generator

- Water clarity improvement
- Algae bloom reduction
- Reduced gill lice parasites in trout

*“The results from the nanobubbles were much faster than I would have expected. As a chemical engineer who specifies equipment as part of my job, I am also impressed with the quality of the design and build of the generator. I am happy with my local technical representative, with Moleaer as a company and with my results. The trout are healthier and the water quality is fantastic. I’m thrilled with all of it. The investment was worth every penny.”*

– Gregory Eirschele, Lake Owner



# Stormwater Basin, California

## Coliform Control in Urban Stormwater Basin

### About the Waterbody

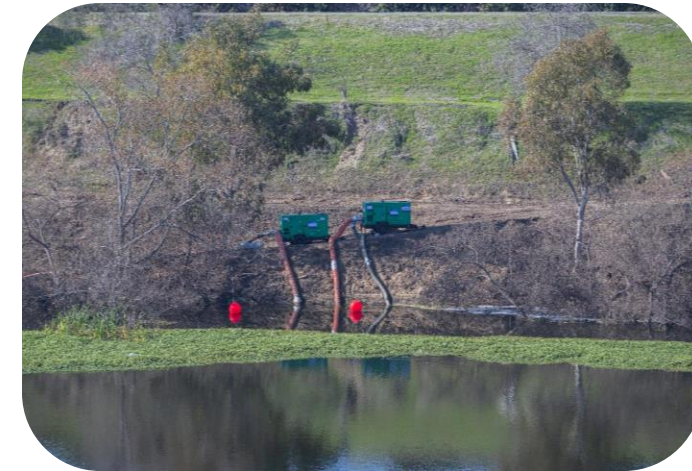
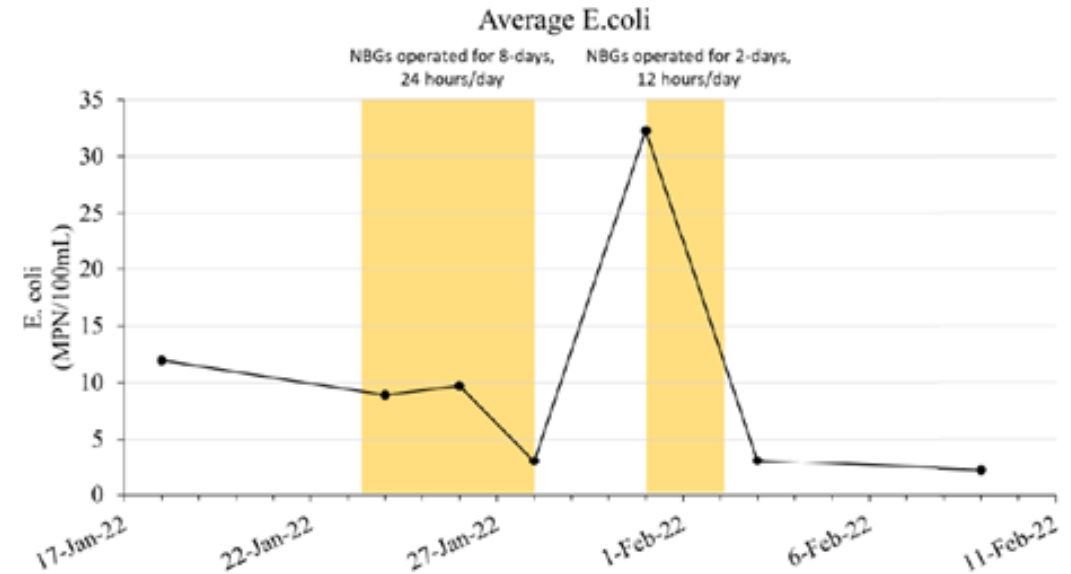
- 25 surface acres (10 ha)
- Max depth: 100 ft (30 m)

### Challenges

- Foul odors
- Microbial contamination
- Poor water quality

### Results

- Increased DO from 0.5 to 4.4 mg/L at sediment
- Increased sediment ORP from -260 to +160 mV
- Reduced coliforms up to 75% in 8 days



# Retention Ponds for Cattle, Canada

## Coliform Control for Better Water Quality

### About the Waterbody

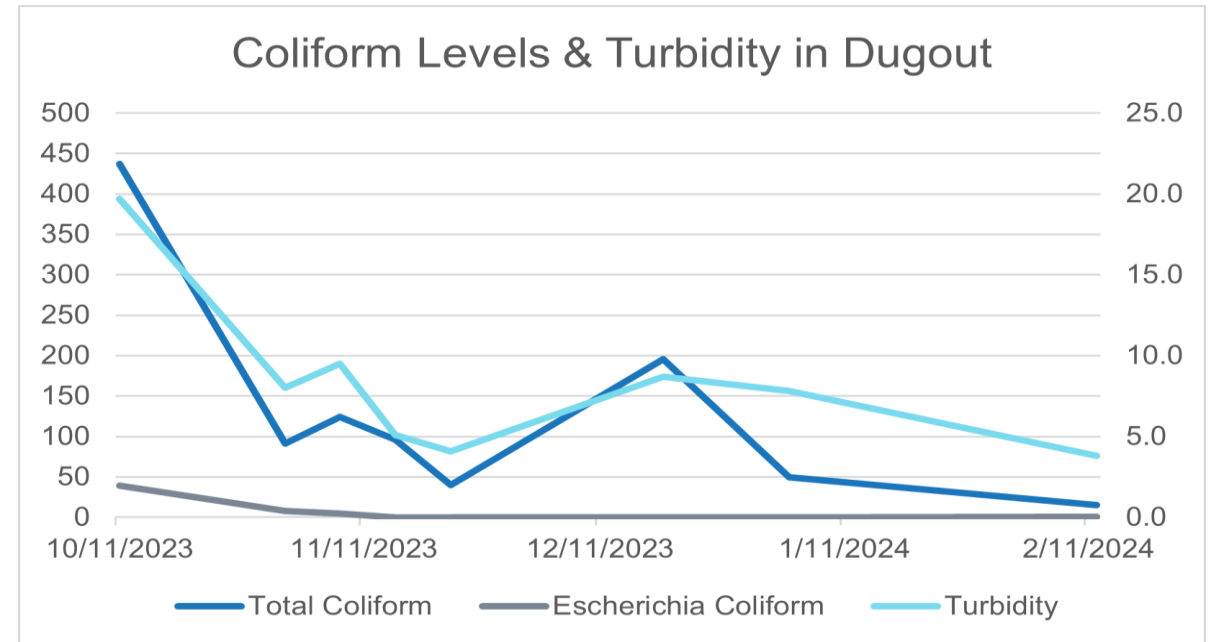
- Ponds called “dugouts” used for cattle drinking water and farmland irrigation

### Challenges

- Microbial contamination
- Poor water quality

### Results

- Significant *E. coli* and total Coliform reductions
- Improved water clarity
- Tangible reduction in cattle ailments (bloating, nervous diseases)







# Supporting Information

# Harmful Algal Blooms are a Growing Concern in Freshwater Bodies

Globally, Over 100,000 Lakes Experienced HABs, More at Risk

## What are HABs?

- Occur when algae grow out of control and produce toxins
- Cyanobacteria (blue-green algae) is most common type of algae that causes HABs

## Impacts

- Animal, fish deaths and human sickness
- Reduced recreation opportunities
- Lake and beach closures
- Tourism and property value deterioration
- Taste and odor issues in drinking water

## Conditions Favoring HABs

- Excess nutrients
- Warm temperatures and stagnant water

## How Nanobubble Technology Reduces HABs & Mitigates Algal Toxin Levels

### Mitigate Nutrient Levels

- Reduce internal nutrient loading
- Less nutrients to fuel algae growth



### Increase & Sustain Elevated DO

- Enhances and maintains oxidic conditions, even when water temperatures rise

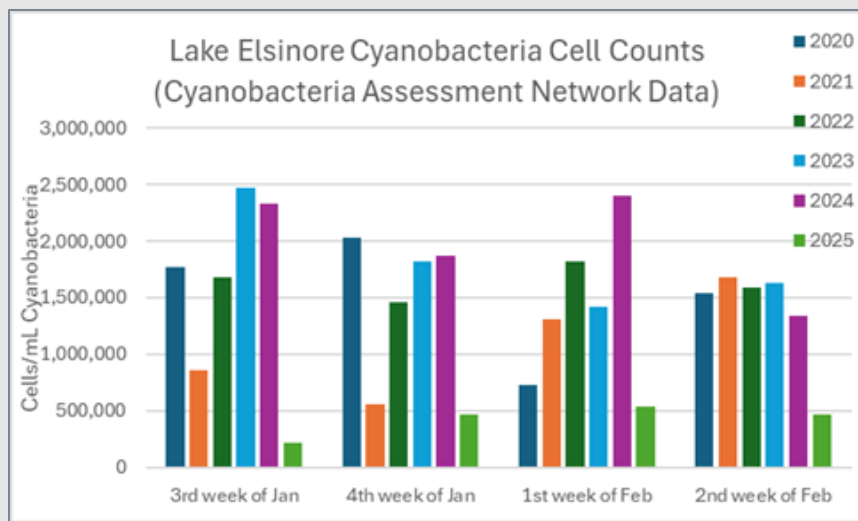
### Increase ORP

- Increased ORP promotes breakdown of algal toxins
- Less toxin load in water and lower potential for toxins to become airborne

# Prescriptive Solutions: Reduced Algae & HABs

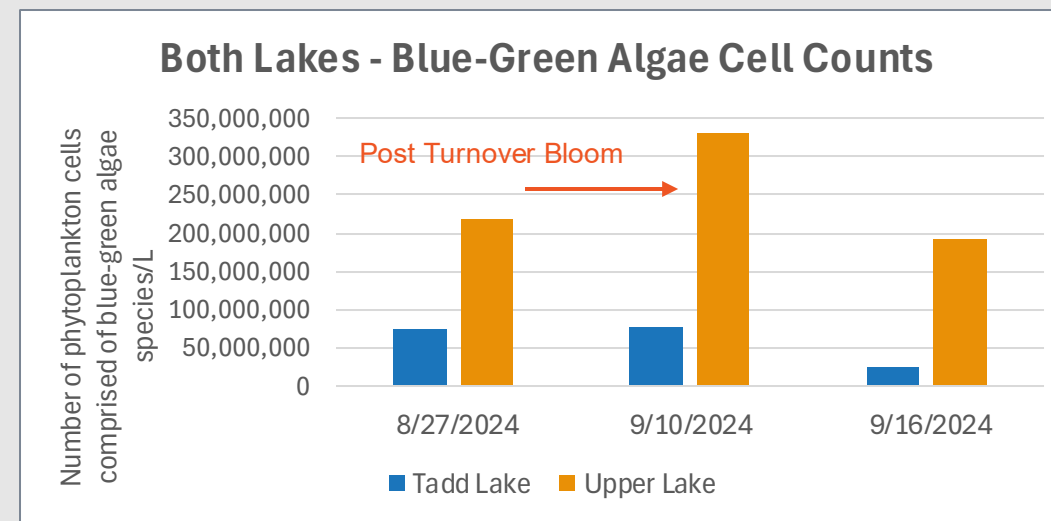
## Cyanobacterial Cell Count Assessments

### Lake Elsinore, CA



- 50-90% reduction in early-season cyanobacterial growth

### Tadd Lake, MN



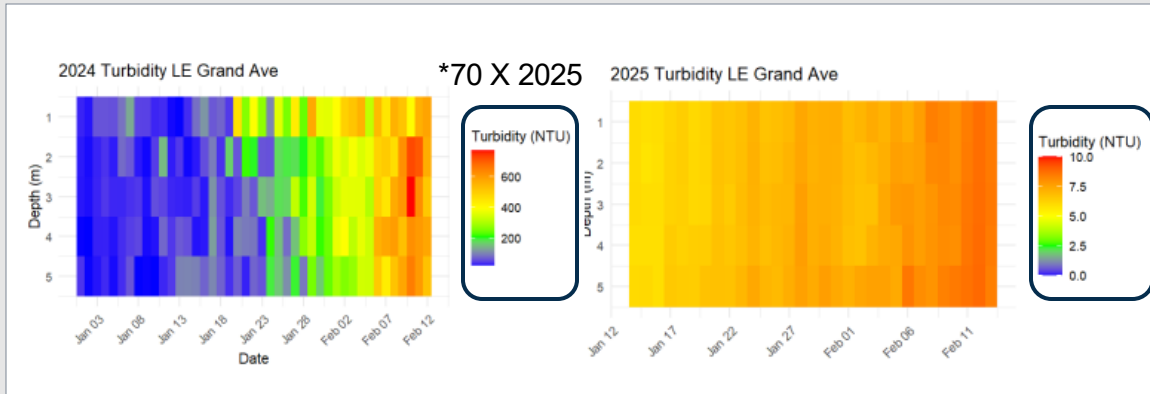
- Tadd Lake > 4x less total algae loads than Upper Lake (control)



# Prescriptive Solutions: Improved Water Clarity

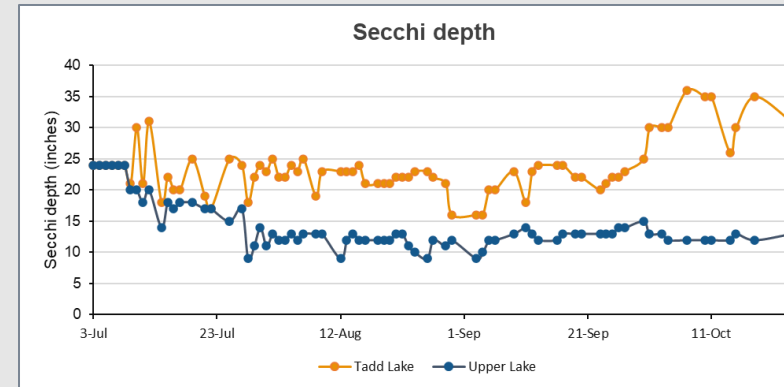
## Secchi Disc Readings & Turbidity

### Lake Elsinore, CA



- Up to 7,000% reduction in turbidity
- Highest water clarity reported in 2 years

### Tadd Lake, MN



- > 2 times clearer than control lake

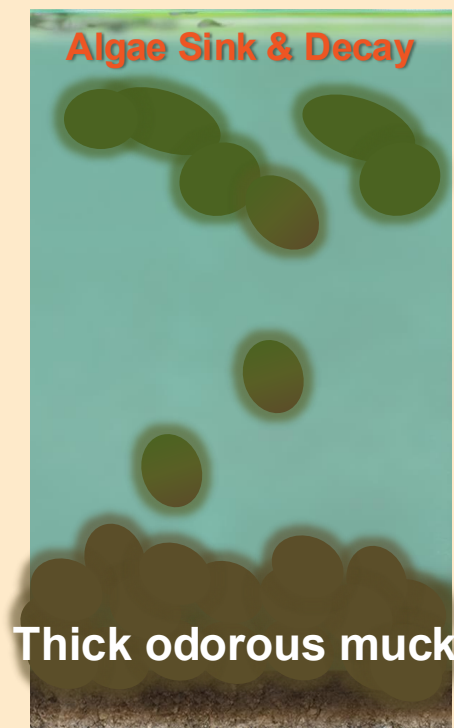
6 Inches Below the Water Surface



# How Moleaer Nanobubble Technology Reduces Muck

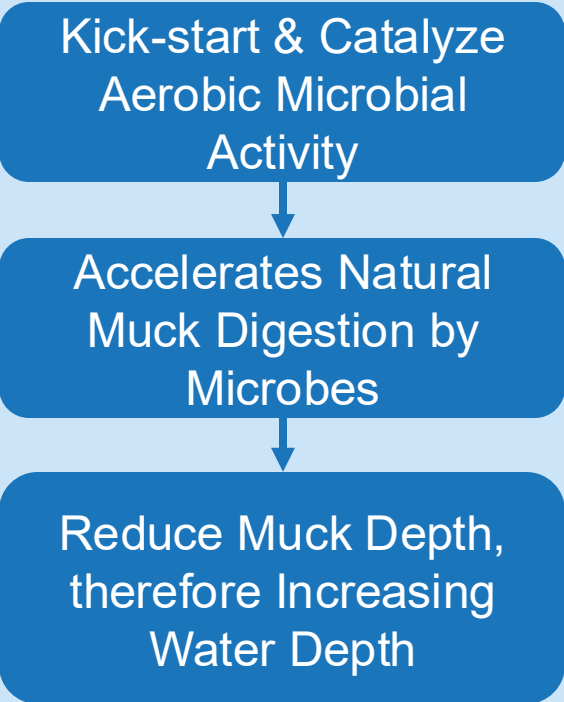
## The Muck Challenge

Anaerobic Conditions Limit  
Aerobic Muck Digestion,  
Resulting in Muck Accumulation



## Enter Nanobubble Technology

Increase Dissolved Oxygen in Water Column & at Lake Bottom

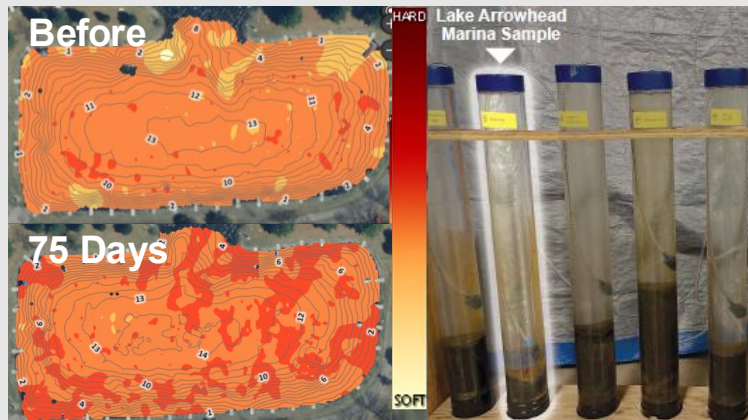


As time elapses with Nanobubble Treatment

# Prescriptive Solutions: Reduce Muck

Results from Biobase® Sediment Hardness Mapping

## Lake Arrowhead Marina, WI



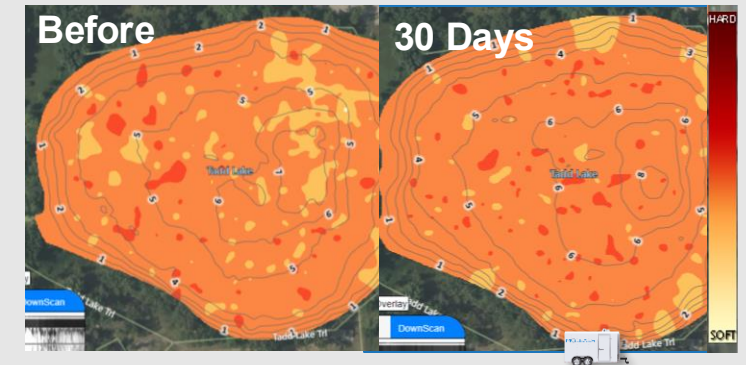
- Increased depth 1 ft (30 cm)
- Water clarity improved by 2-3 ft (61-91 cm)

## Lake Elsinore, CA



- ~ 95% reduction in area occupied by muck at lake bottom
- Water clarity increased by ~ 2 ft (60 cm)

## Tadd Lake, MN



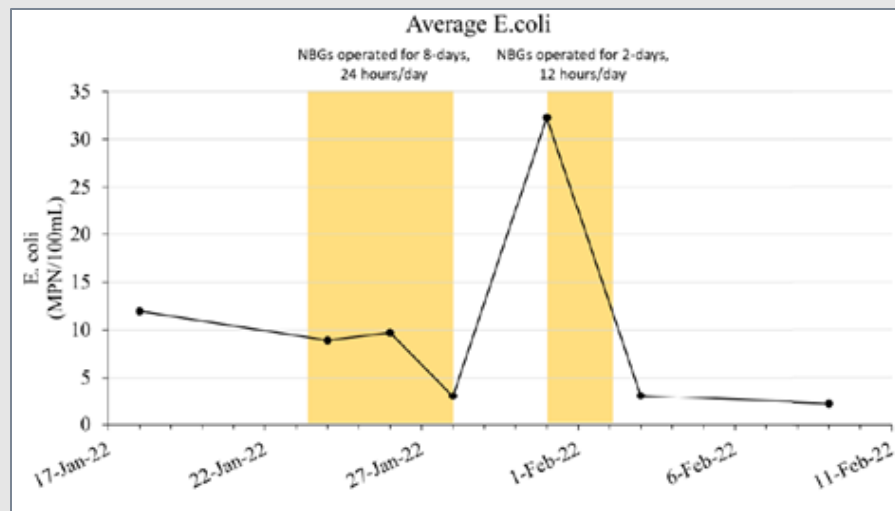
- ~ 90% reduction in area occupied by muck at lake bottom
- 2x clearer water than in control lake



# Prescriptive Solutions: Reduced Coliforms

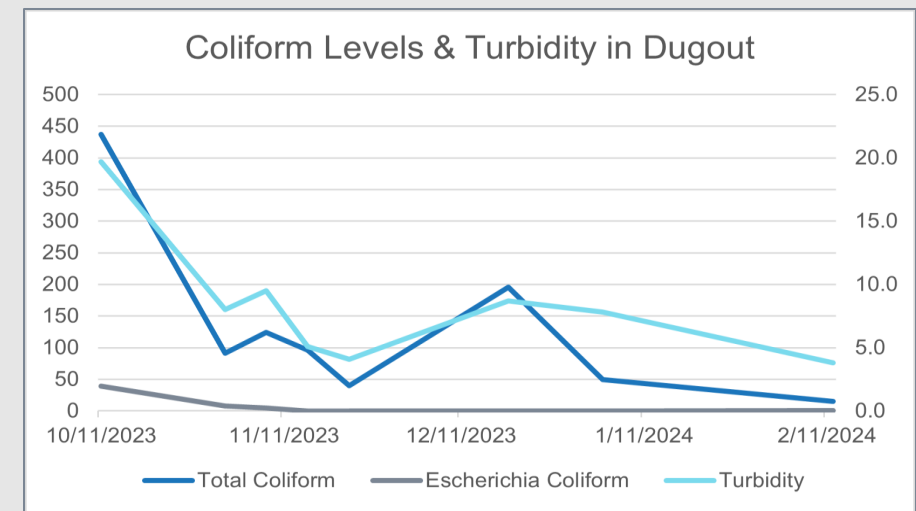
## Results from Coliform Counts

### Stormwater Basin, CA



- Increased DO from 0.5 to 4.4 mg/L at sediment
- Increased sediment ORP from -260 to +160 mV
- Reduced coliforms up to 75% in 8 days

### Cattle Retention Ponds, Canada



- Significant E. coli and total Coliform reductions
- Improved water clarity
- Tangible reduction in cattle ailments (bloating, nervous diseases)

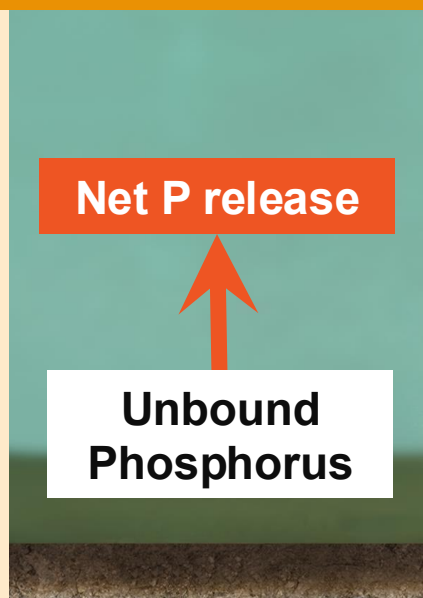
# How Moleaer Nanobubble Technology Mitigates Nutrients

Mainly  
Chemically  
Mediated

## Internal Nutrient Loading

### The Phosphorus Challenge

Under oxic conditions, Phosphorus is bound to iron or manganese in sediments. Under anoxic conditions, these compounds get reduced, releasing Phosphorus



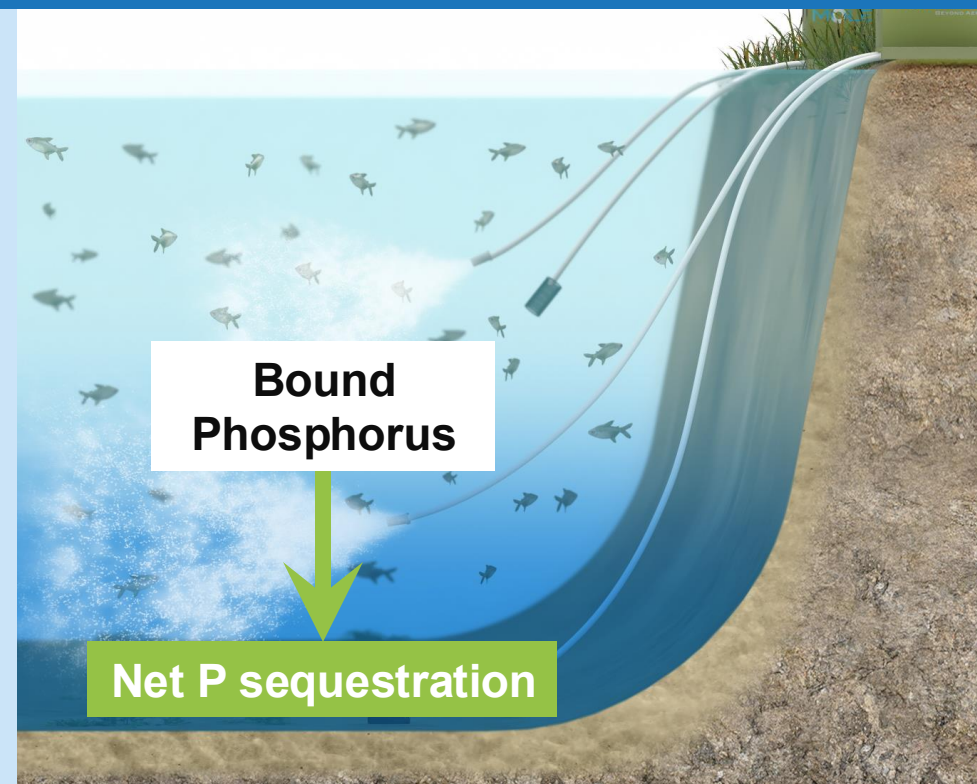
## Enter Nanobubble Technology

Increase Dissolved Oxygen in Water Column & at Lake Bottom, Elevating ORP

Iron or manganese binds with Phosphorus

Phosphorus is sequestered in sediment

Reduced Phosphorus levels in water column



# How Moleaer Nanobubble Technology Mitigates Nutrients

Mainly  
Microbially  
Mediated

## Internal Nutrient Loading The Nitrogen Challenge

Anoxic/Low ORP

Rate of Ammonium production by certain microbes > Rate of Ammonium oxidation by other microbes

Large N release in the form of Ammonium

Decomposition of dead biomass by microbes releases Nitrogen

## Enter Nanobubble Technology

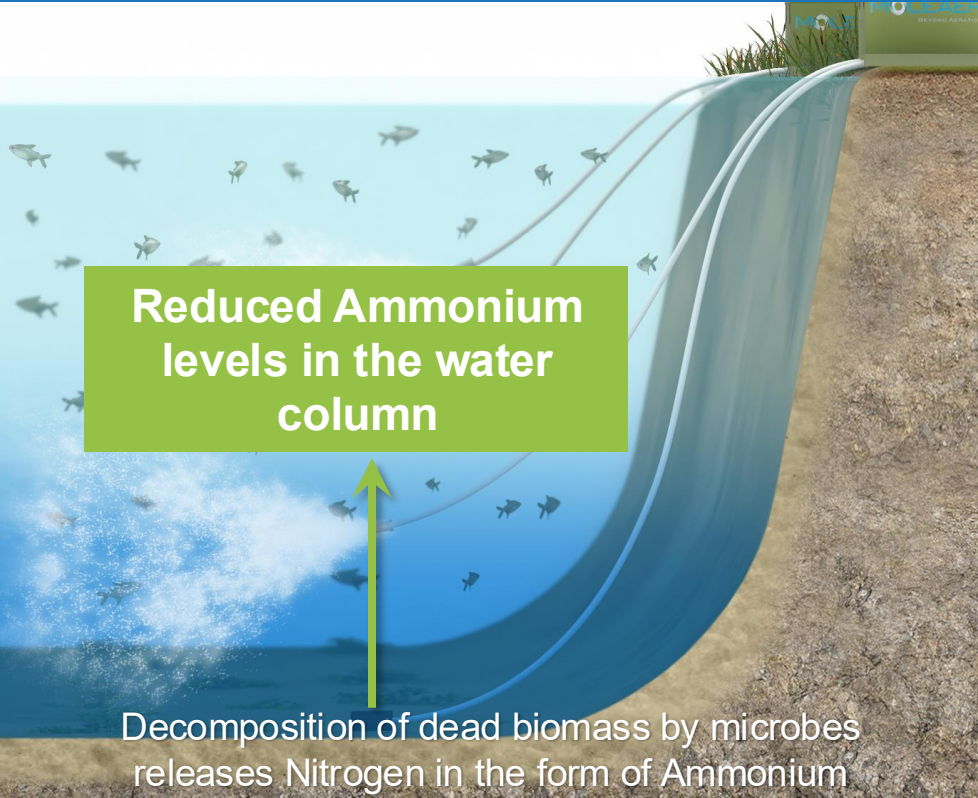
Increase Dissolved Oxygen in Water Column & at Lake Bottom, Elevating ORP

Decomposition of dead biomass by microbes releases Ammonium

Oxic/High ORP

Rate of Ammonium oxidation by certain microbes > Rate of Ammonium production from other microbes

Reduced Ammonium levels in water column





# How Moleaer Nanobubble Technology Mitigates Nutrients

*External Nutrient Loading\**

## The Nitrogen & Phosphorus Challenge

Anoxic/Low ORP (<300mV)

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

More N and P accumulation in a lake

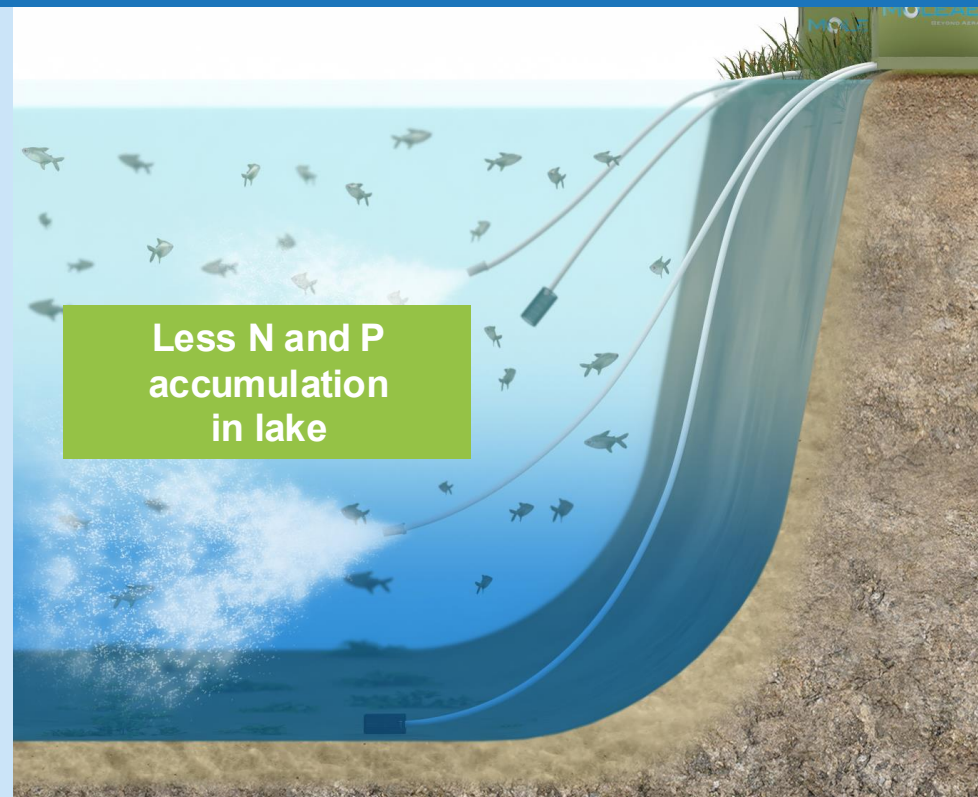
## Enter Nanobubble Technology

Increase Dissolved Oxygen in Water Column & at Lake Bottom, Elevating ORP

Oxic  
High ORP (300-500 mV)

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

Lower N & P Levels in Lake



\*Once external loading enters the lake, recent research suggests NB treatment can lessen the impacts of it

# Other Benefits of Nanobubble Treatment in Drinking Water Sources

## Reduce MIB & Geosmin

- Enhance oxidation and volatilization of MIB and geosmin
- Accelerate microbial activity to naturally degrade MIB and geosmin
- Reduce growth of algae that produce MIB and geosmin

## Reduce Mercury

- Certain anaerobic microbes convert inorganic mercury to bioavailable mercury (methylmercury)
- NBs create aerobic conditions that cause these microbes to become dormant or die off
- This reduces the quantity of bioavailable mercury that enters water column

## Reduce Manganese

- Oxygenate water column to help convert soluble manganese to less soluble form that precipitates out of the water column
- Increase redox potential, minimizing manganese release from bottom sediments into water column

## Improve Water Quality

- Reduce variation in overall raw water quality overall for downstream water treatment
- Reduce costs by keeping influent water quality consistent under external loading nutrient events (e.g. rainfall events), requiring less adjustments to coagulant dosing