Lake Elsinore In-Lake Nutrient Reduction Alternatives Analysis

Presentation to the TMDL Task Force

August 27, 2024

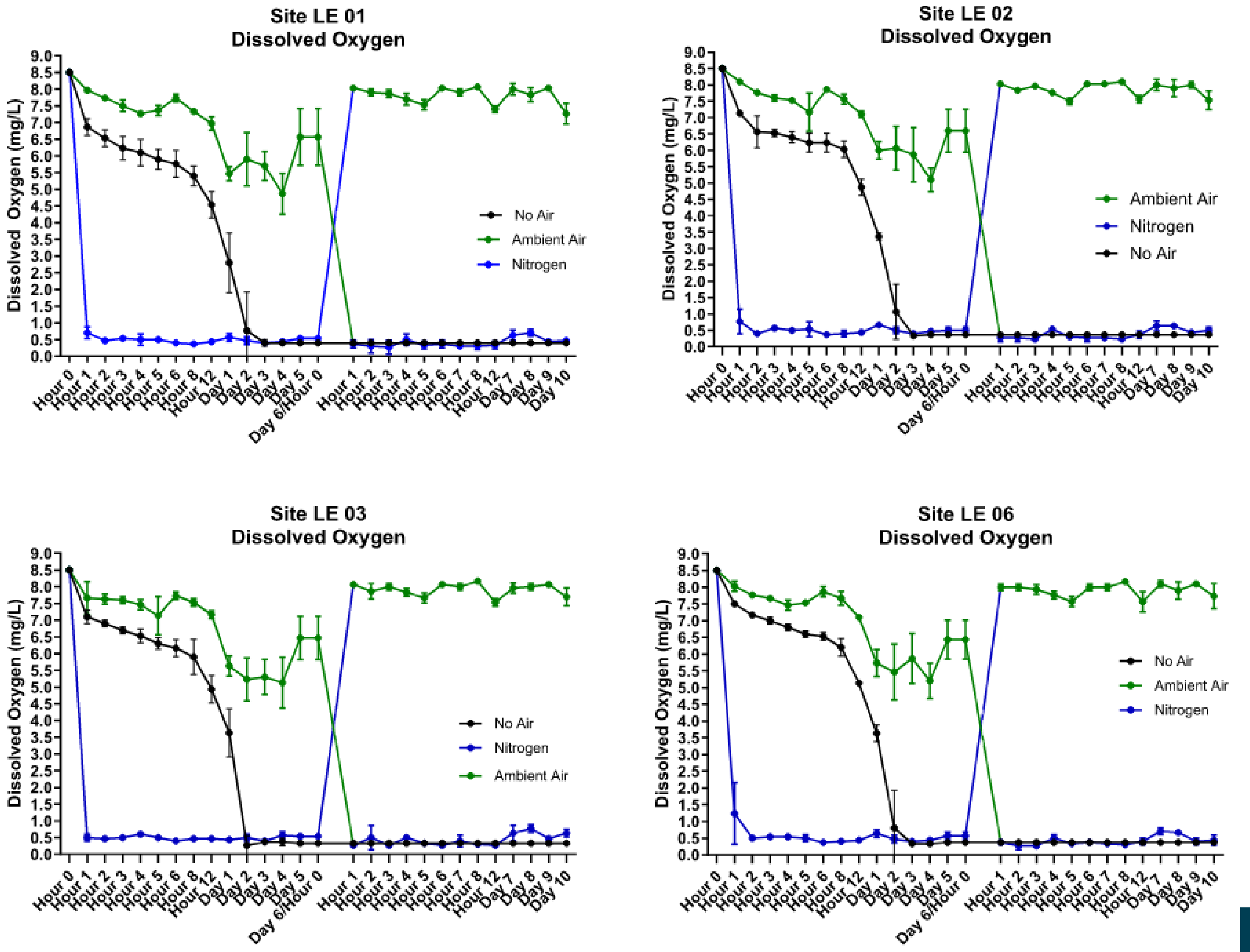
Presentation by Steve Wolosoff, GEI Consultants

Agenda

- Sediment Study Update
- In-Lake Options Update
- Current Operations

Sediment Study

- Sediment samples collected and intact cores extracted on July 29
- Controlled incubations were initiated July 30
- Preliminary charts for DO to validate sizing assumptions for oxygenation system options
- Nutrient analysis will involve longer turnaround time



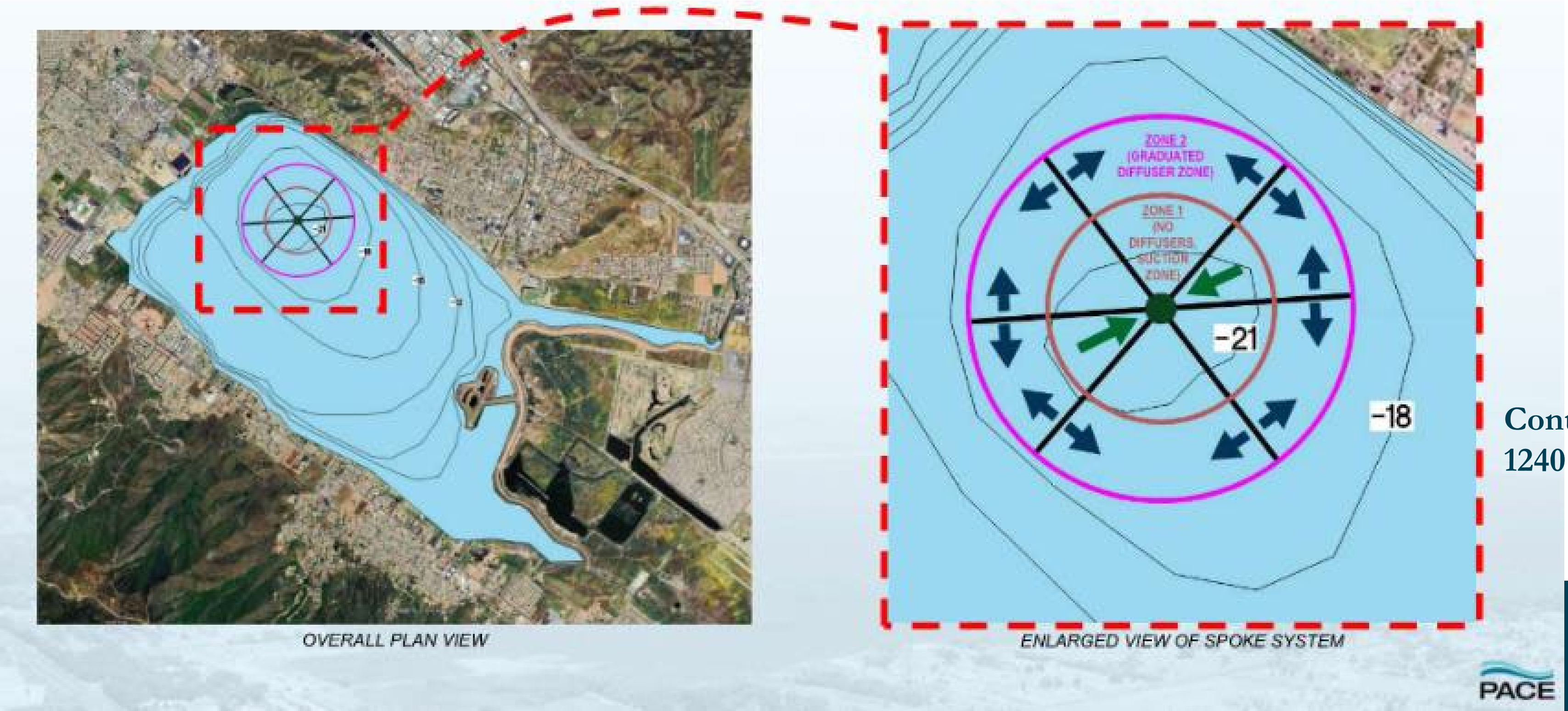
Comparison of Performance Effectiveness of Options

- Differing effectiveness between options for nutrient removal and in-lake water quality
- Quantitative load reduction estimates under development
- Qualitative ratings based on BPJ
  - ● Highly effective
  - ◐ Effective by indirect processes
  - ○ Not effective

Option	Phosphorus	Nitrogen	Algae	DO
Oxygenation	●	◐	◐	●
Recirculating Wetland	◐	●	◐	◐
Algae Biomass Removal	●	●	●	◐
Chemical Treatment	●	○	●	◐

Oxygenation Delivery

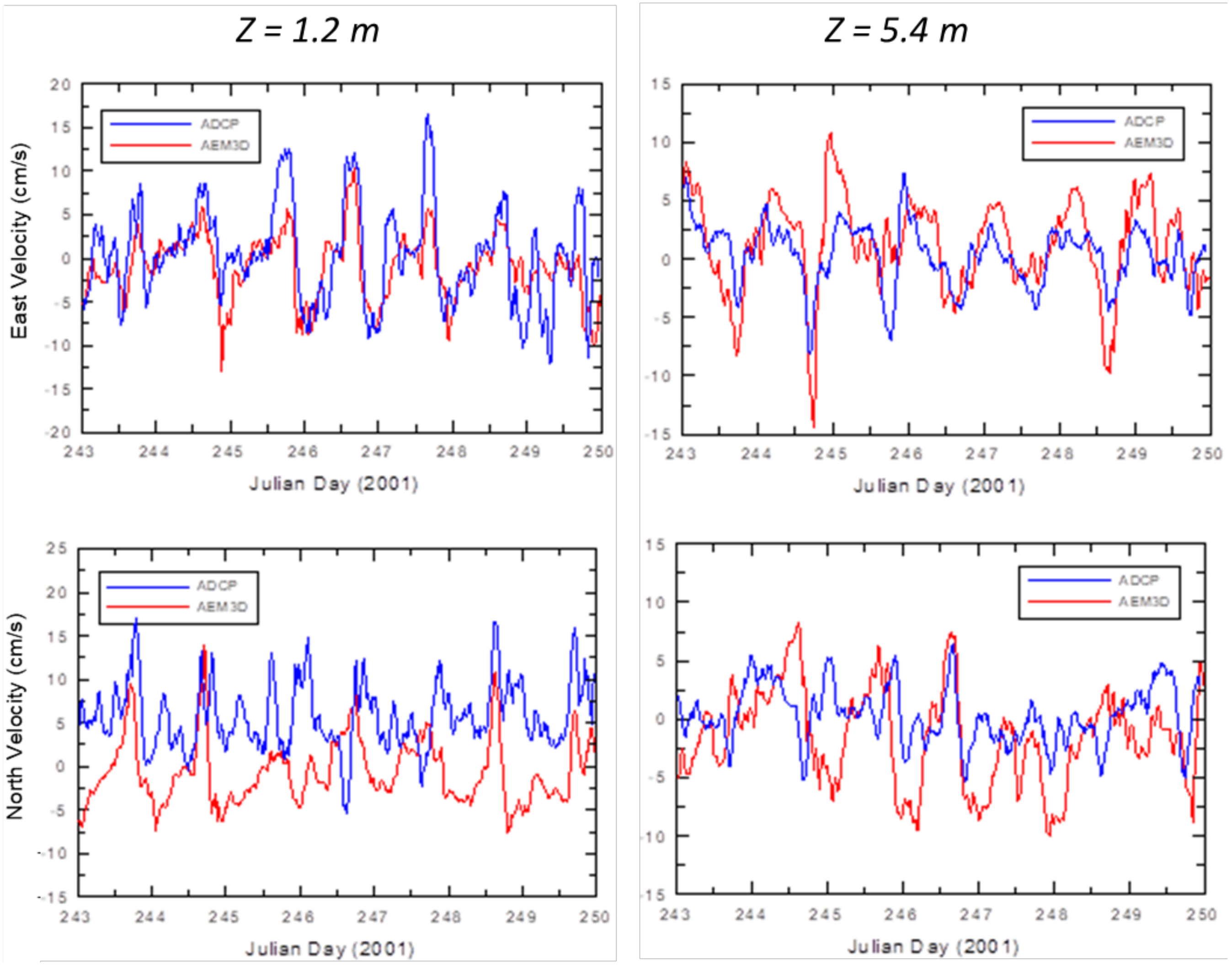
- Suction inflow of low DO water near bottom of deep hole
- Distribution through spoke system with graduated diffusers designed for equalized distribution of oxygenated water near the lake bottom



Contours show depth below 1240 ft target water level

Oxygenation and Lake Mixing

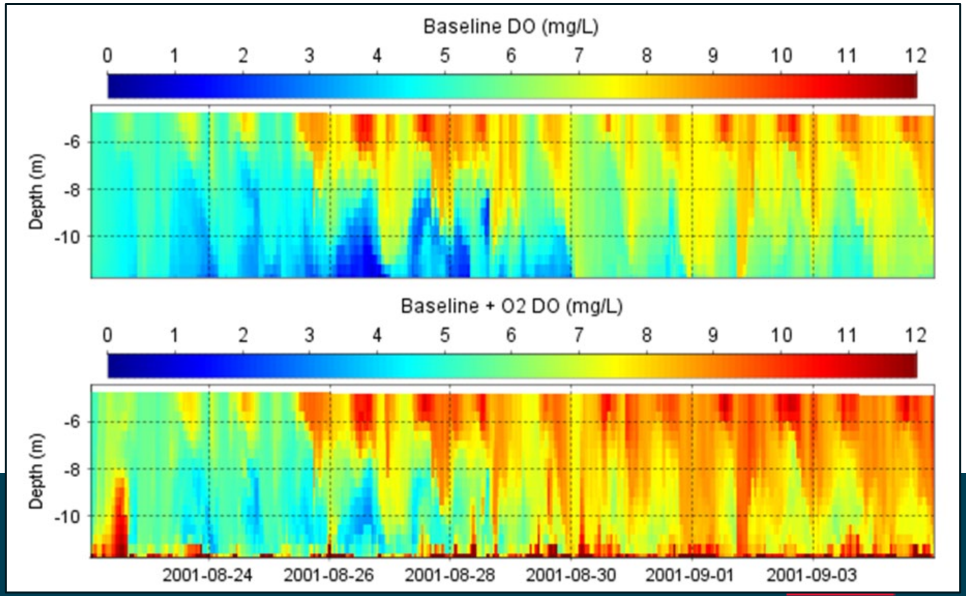
- Velocity measurements (summer 2001) showed significant wind driven lateral mixing and diurnal pattern driven by afternoon winds - used to calibrate a 3-D model
- ADCP - acoustic doppler current profiler (i.e. measured current)
- AEM3D – Aquatic Ecosystem Model (i.e. modeled current)



Oxygenation and Lake Mixing

- Scenario tests mixing of 15,000 lbs/day DO into the deepest part of the lake using a large “spoke” diffuser is predicted to increase bottom water DO levels, with dynamic bottom water currents rapidly redistributing DO across the lake

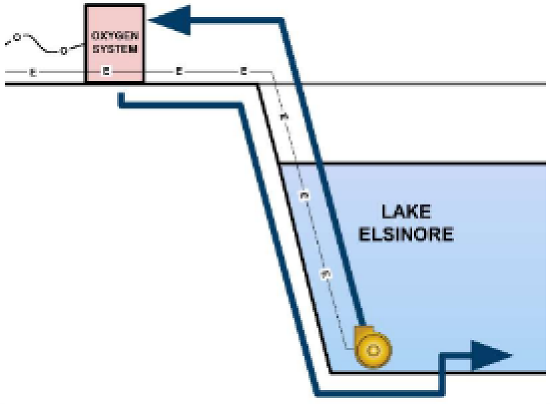
Vertical profile results at deepest point of lake



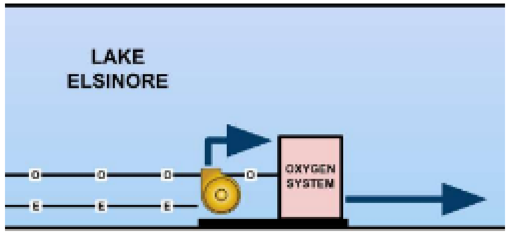
Oxygenation System Configurations

- Four methods developed with varying facility cost, energy demand, reliability, ease of maintenance, aesthetics, and compatibility with different O2 systems
  - Options 1 -3: Full flow of 60 MGD through oxygenation systems
  - Option 4: Partial flow (9 MGD) in high pressure oxygenation systems (P1), 90 MGD carrier water (P2)

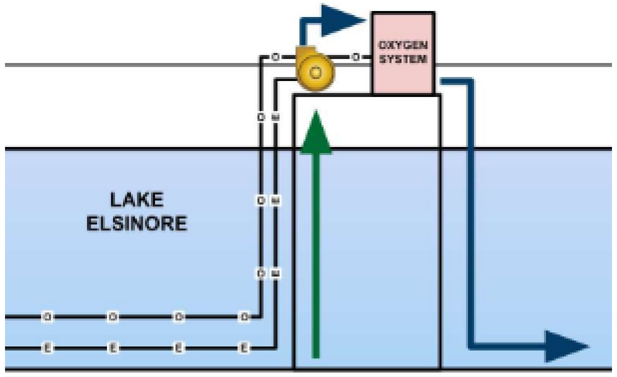
1. Shoreline



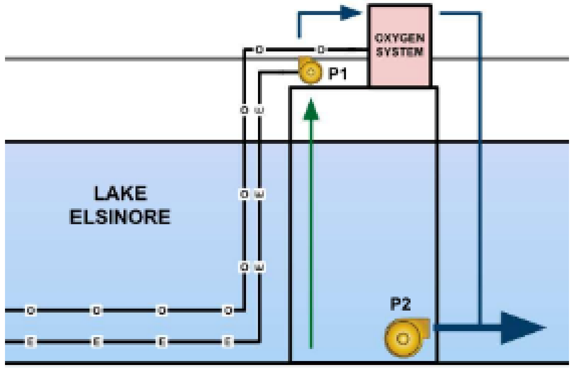
2. Submerged



3. Crib (Full Flow)

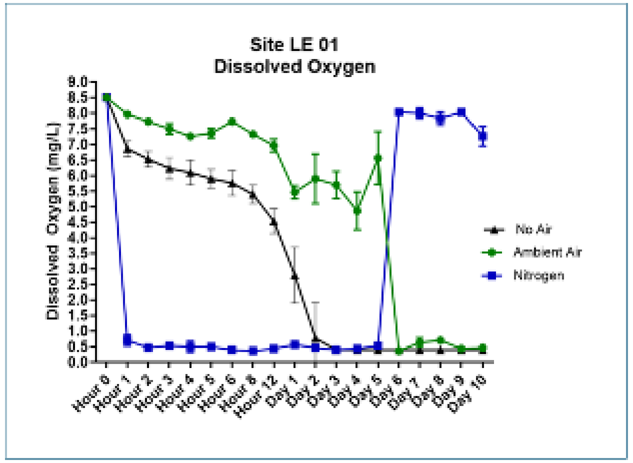


4. Crib (Two-Stream)



E = Energy; O = Oxygen

Oxygenation Systems



- Multiple technologies available to add oxygen to water
- Estimated delivery of 15,000 lbs/day system capacity

A SPEECE CONE

B NATURAL LAKE OST

C BLUE-IN-GREEN

D MOLEAR

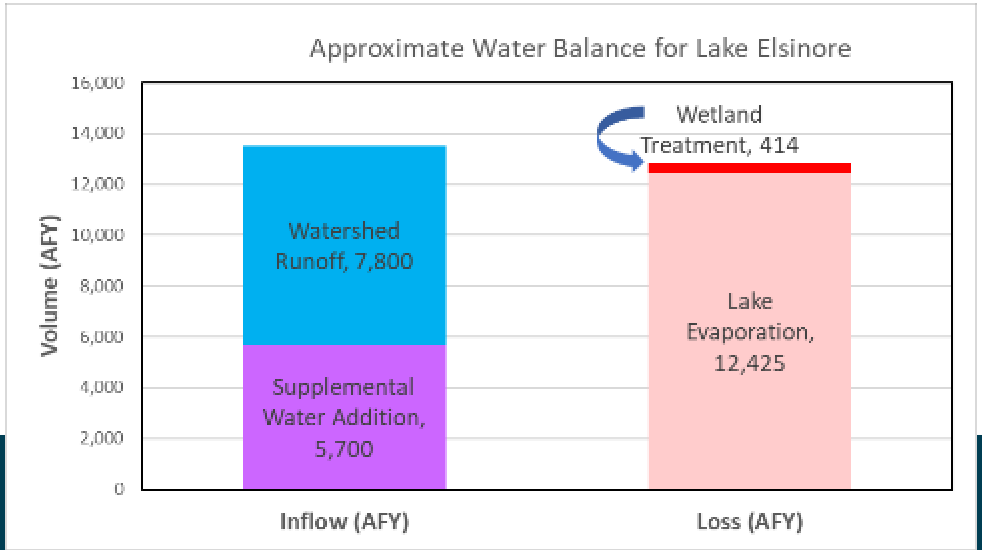
Oxygenation Systems

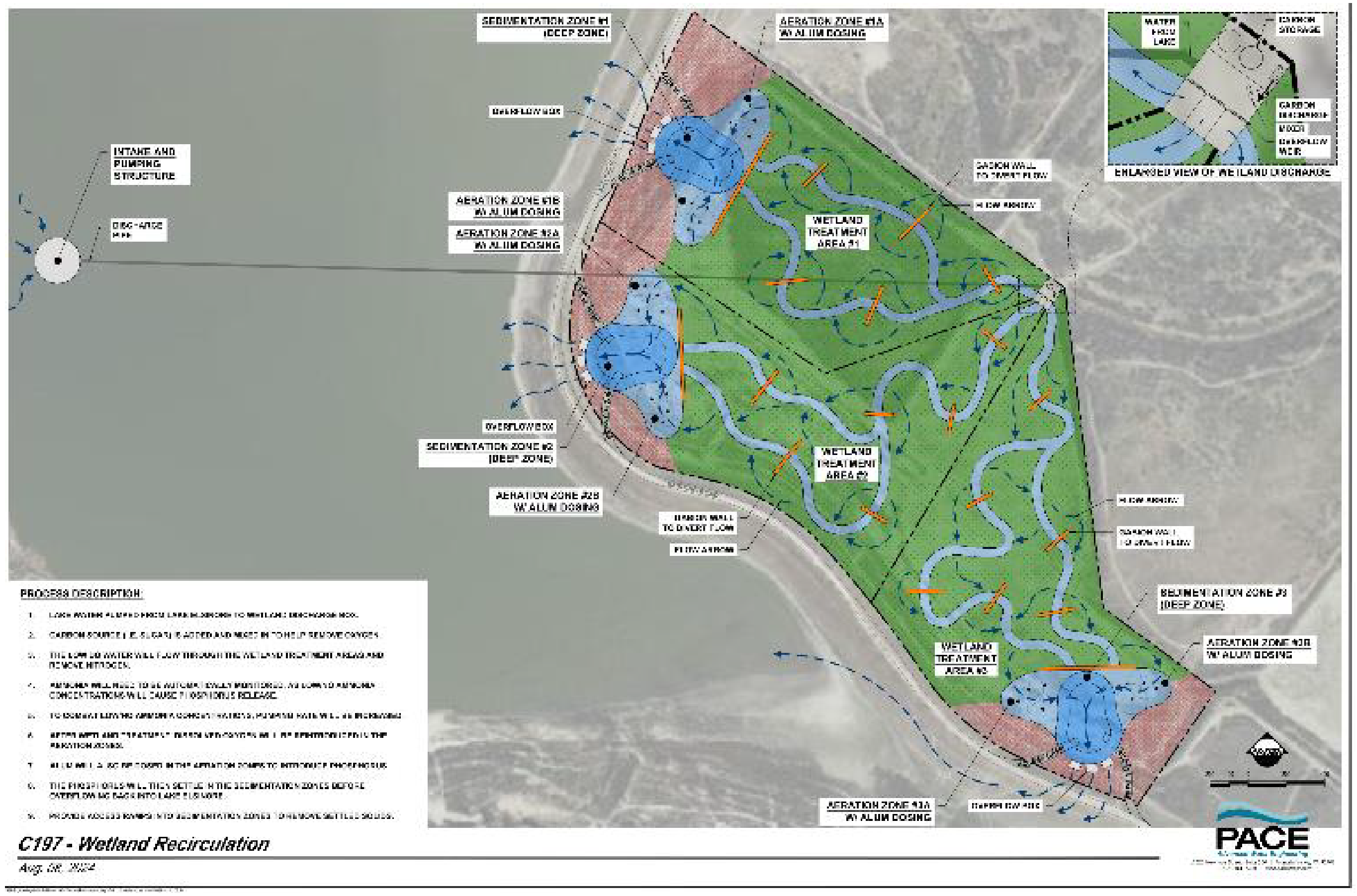
- Units to achieve targeted DO delivery
  - 2 Speece cones, 2 Blue-in-Green, 4 OSTs, or 8 Moleaer
- Compatibility of potential systems

	ECO2 (Speece)	Moleaer (Nanobubble)	GantzerWater (OST)	Blue in Green
Shoreline	♦	♦	♦	♦
Submerged	♦	♦	♦	
Crib (Full-flow)	♦	♦	♦	♦
Crib (Two-stream)	♦		♦	♦

Recirculating Wetland Treatment

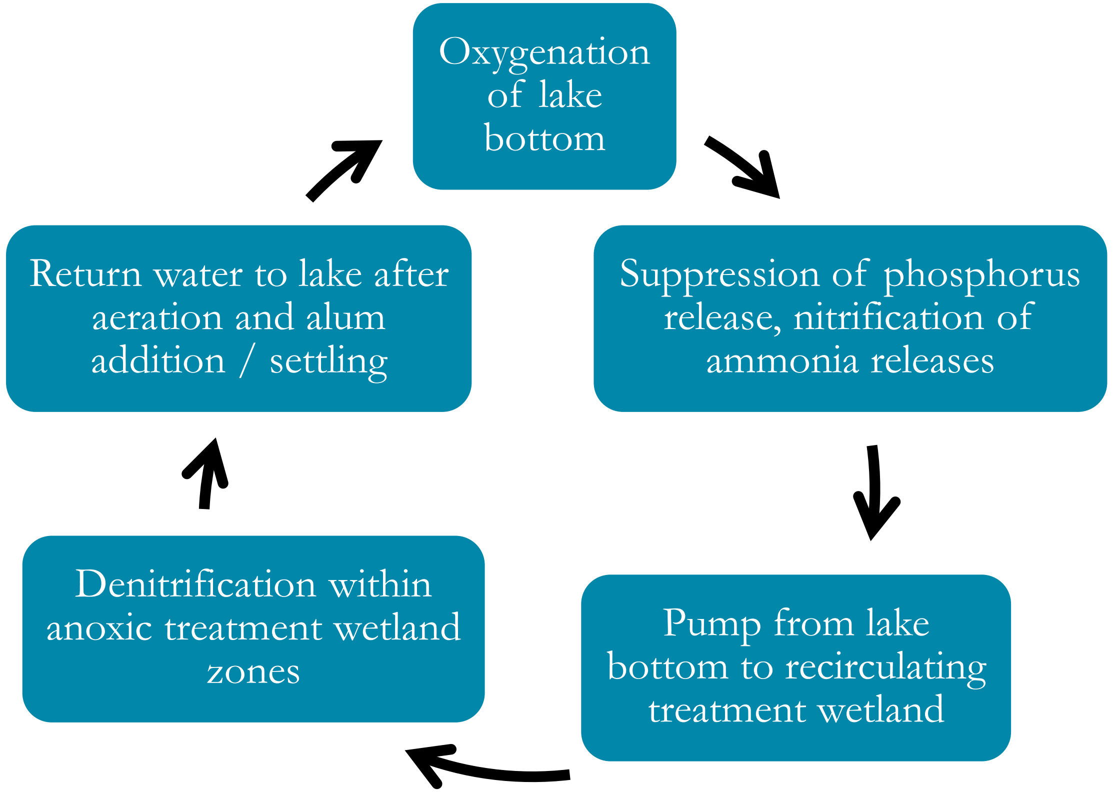
- Preliminary concepts for 150-acre site provide up to 100,000 kg/yr TN removal
  - Downsizing project concept underway
- Additional evaporative loss is < 3 percent relative to whole lake





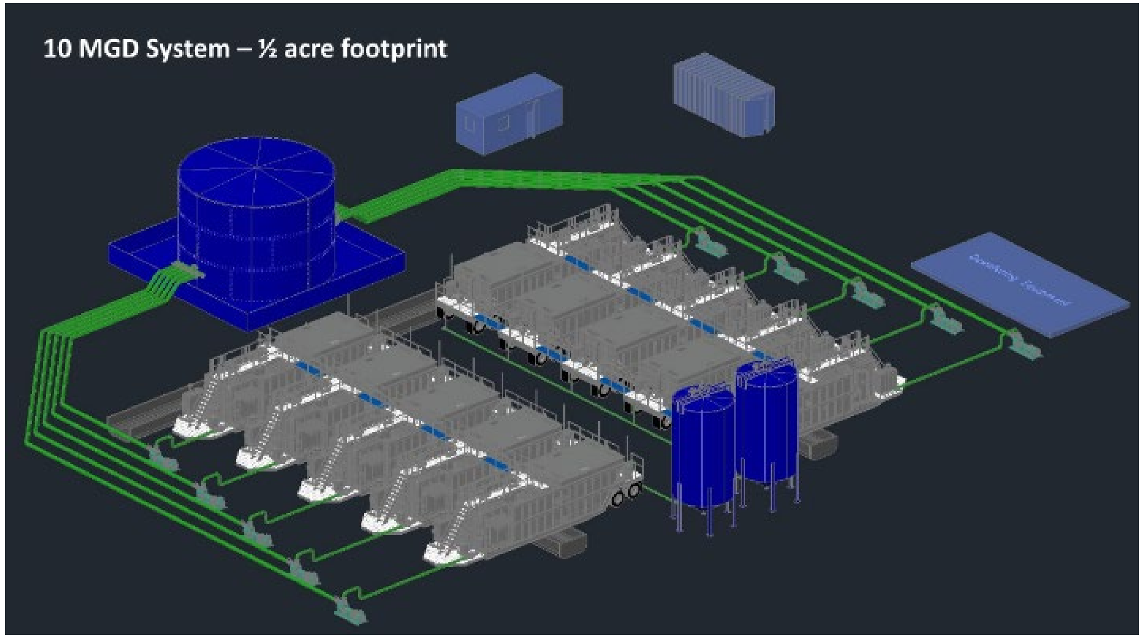
Potential Dual Project Concept

- Oxygenation (for P) plus wetland treatment (for N)
- Optimize nitrogen removal with oxygenation providing nitrification in lake bottom and recirculating wetlands providing denitrification
- Reaeration and alum addition prior to return to lake to remove any new phosphorus that could be released from wetland sediment



Algae Biomass Harvesting

- Mass algae removals with 15 MGD system could generate offsets needed
- Initial concept to reuse harvested algae as biofuel – national legislation may help such efforts in long-term
- For near-term, disposal options for harvested algae solids costly. Test data and experience of future large-scale dewatering of algae float solids are not available at this time.



Chemical Addition

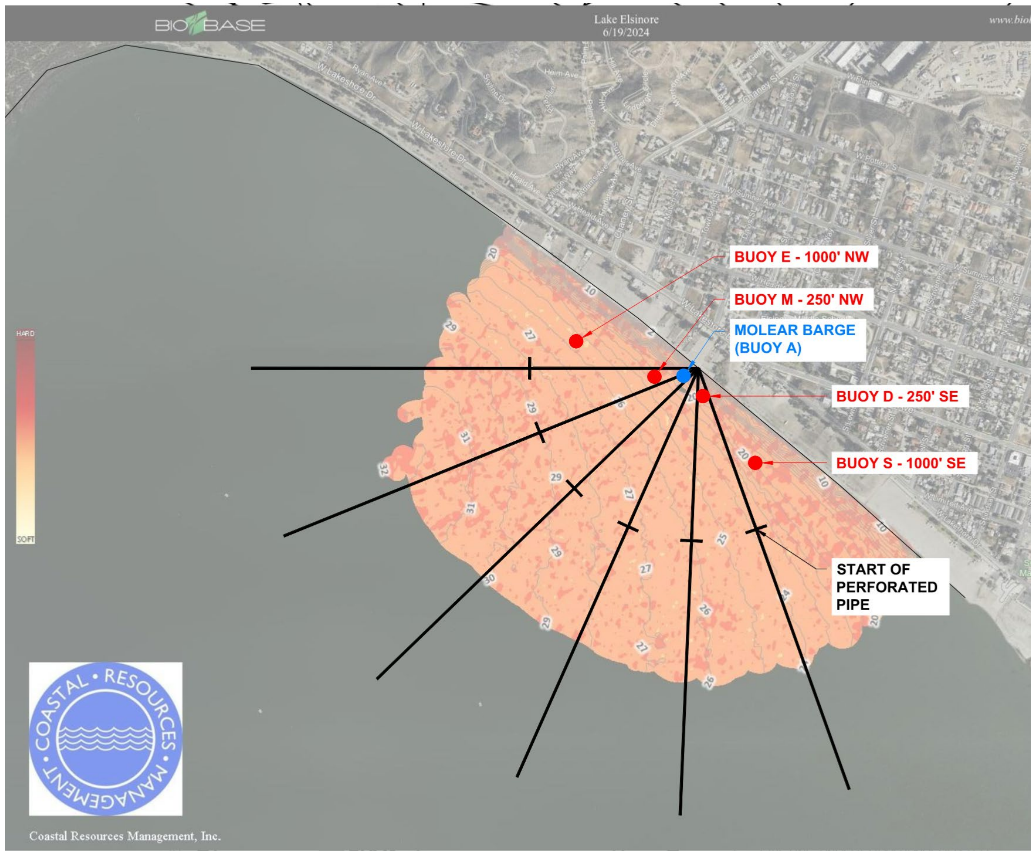
- Sequestration of phosphorus from water column and sediment using lanthanum-based product
  - Effective over a wider range of pH than alum
- Annual dose by surface spreading (similar design of Canyon Lake alum program)
- High annual O&M (mostly material cost) but no capital cost
- Permitting obstacle with the Santa Ana Board – statewide permit for use is currently in development

Vendor Coordination

- Moleaer (Nano bubble)
- Blue-in-Green (Oxygenation at high pressure)
- Gantzer Water - OST (hybrid system for oxygenation)
- ECO2 (Oxygenation with Speece cone)
- Eutrophix (Lanthanum based P sequestration)
- AECOM (Algae harvester)

Current System Operation

- No recycled water addition until August 7
- LEAMS operation since May 2024
- Mixing associated with LEAMS operation not expected to impact the zone of influence of nanobubble pilot



Next Steps

- Develop and finalize evaluation criteria
- Rank alternatives
- Draft report
- Present draft report at November 2024 TMDL Task Force
- Final report