NanoBubbles Test Data 2025

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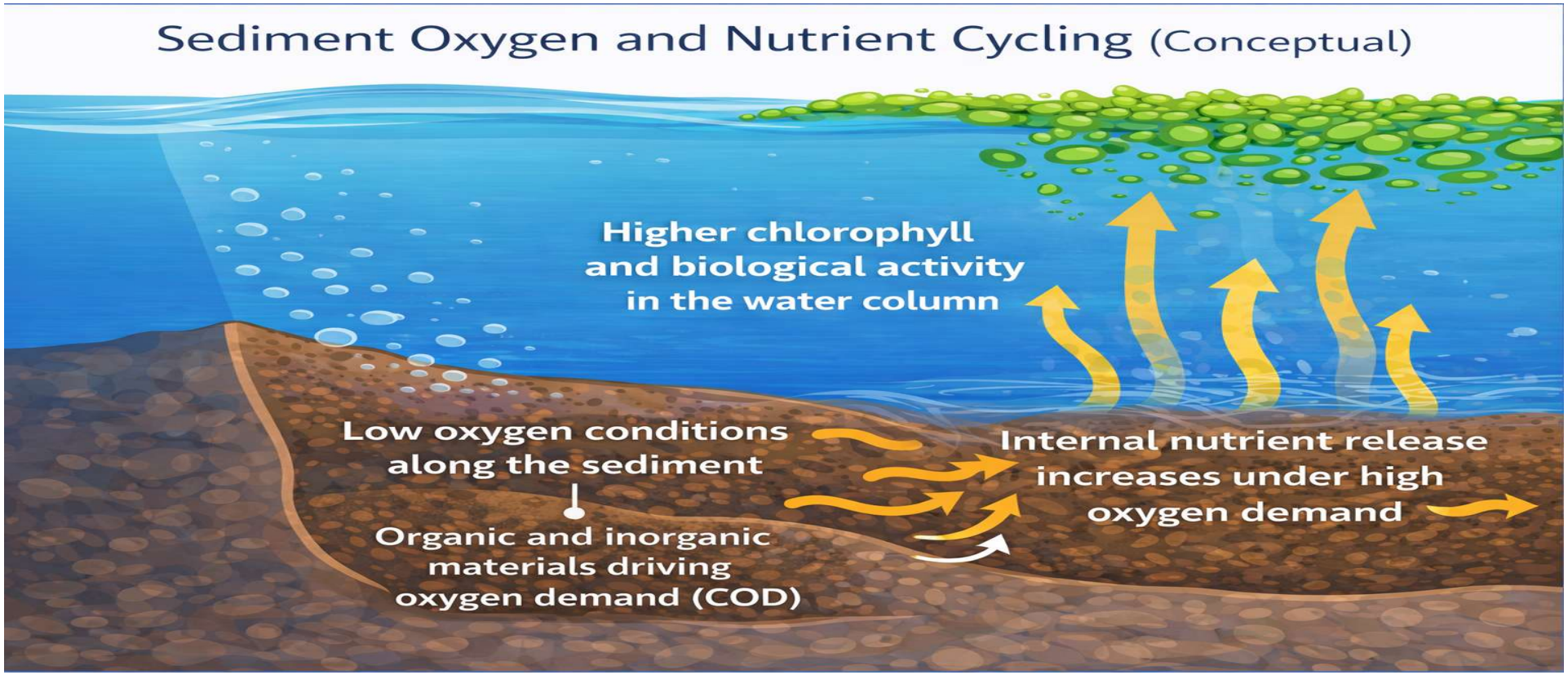
Disclaimer:

- *The intent for data as presented is for subjective reference only.*
- *Testing purpose was to evaluate the effectiveness of NanoBubbles technology and identify an aeration technology which has promise to impact efforts to clean up and rehabilitate Mead Lake.*
- *The program ran for 4 months. The time period is inadequate to form conclusions on effectiveness of the technology.*
- *A final WDNR evaluation in 2026 will identify statistically significant changes to biologic communities, water chemistry, and sediment composition. Note: Biologic community data is incomplete*
- *All results will be applied to guide future, science-based lake management decisions and other adaptive management plans for water quality improvement of Mead Lake.*

Summer heat and poor water circulation limit the movement of oxygen from the surface down into deeper water.

Algae growth is fueled by release of phosphorus and other nutrients due to low oxygen in muck.



NanoBubbles Technology was evaluated for:

Potential to reduce levels of Muck

- Increase levels of Oxygen in the water
- Which will reduce intensity of algae blooms
- Reduce frequency of algae blooms.

Test Site Experiences
Frequent Algae Blooms

NanoBubbles Technology exhibited Positive and Neutral Results

General Takeaways.

POSITIVE:

- NanoBubbles circulation did maintain livable Oxygen at the test site.
- NanoBubbles circulation can have influence for later algae blooms and reduced duration
- NanoBubbles circulation appears to support stabilization of sediment to release lower levels of internal nutrients

NEUTRAL:

- NanoBubbles circulation moderated Oxygen levels but was not definitive in short term silt reduction
- Wind blown weed mats clogged the test bay surface at different times in the season
- The test bay still experienced algae blooms

Observations

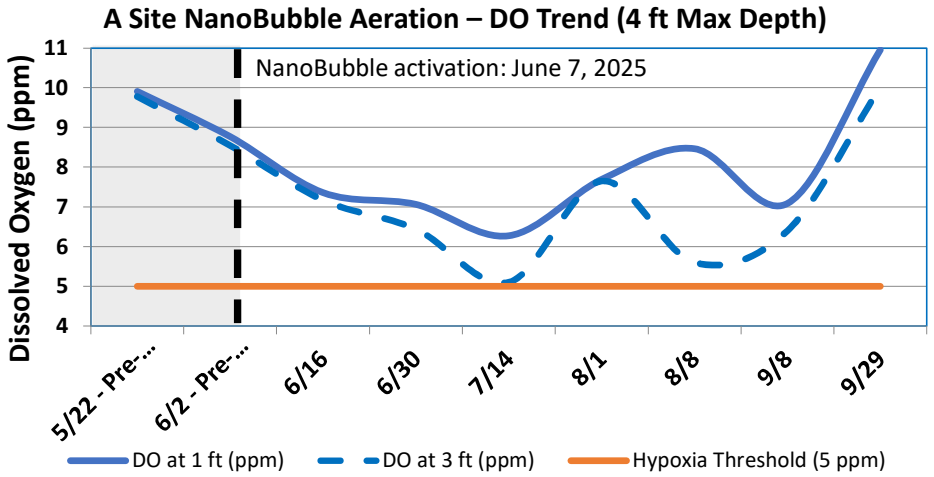
- NEGATIVE - Machinery operation was interrupted 5-6 times due to power outages and brown outs around the lake.
  - Machinery had to be manually restarted
  - Implications to need for a machinery manager.
- NEGATIVE - Surface weed conditions required weekly checks and clearing of water inlet screen and biweekly cleaning of the internal filter screen.
  - Implications to need for a machinery manager.

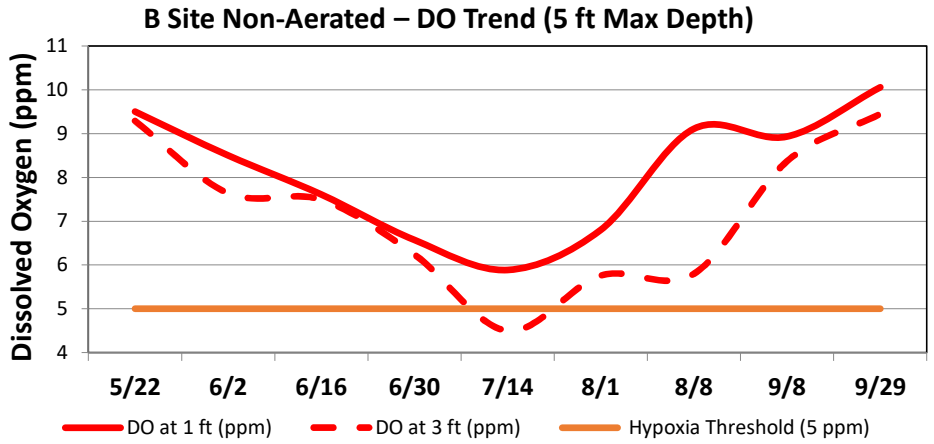
NanoBubbles Circulation Increased Oxygen Levels

Dissolved Oxygen below 5.0 ppm is un-inhabitable for fish and other invertebrates

- Site A – NanoBubbles: Maintained habitable Oxygen levels at the bottom all season.

- Site B Control: Oxygen level went anoxic mid-summer at the bottom



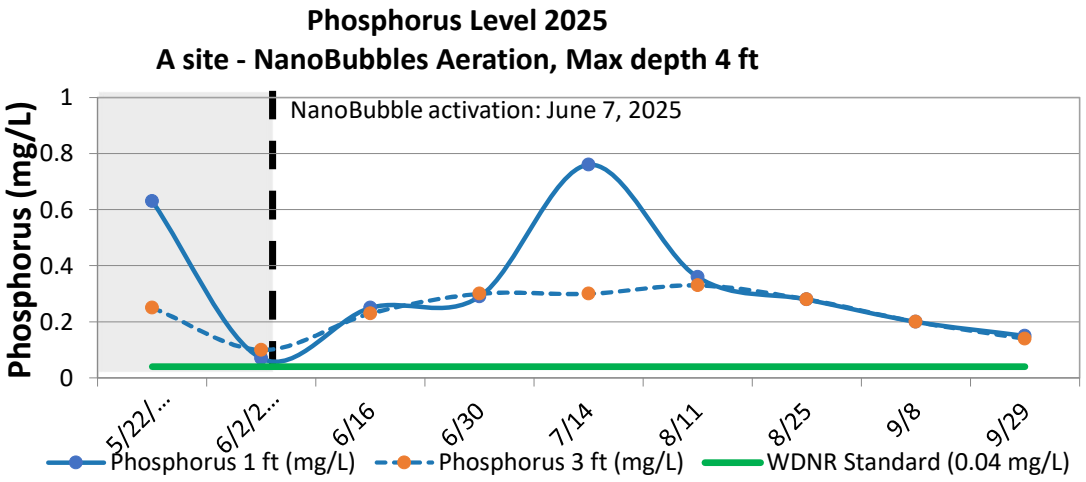


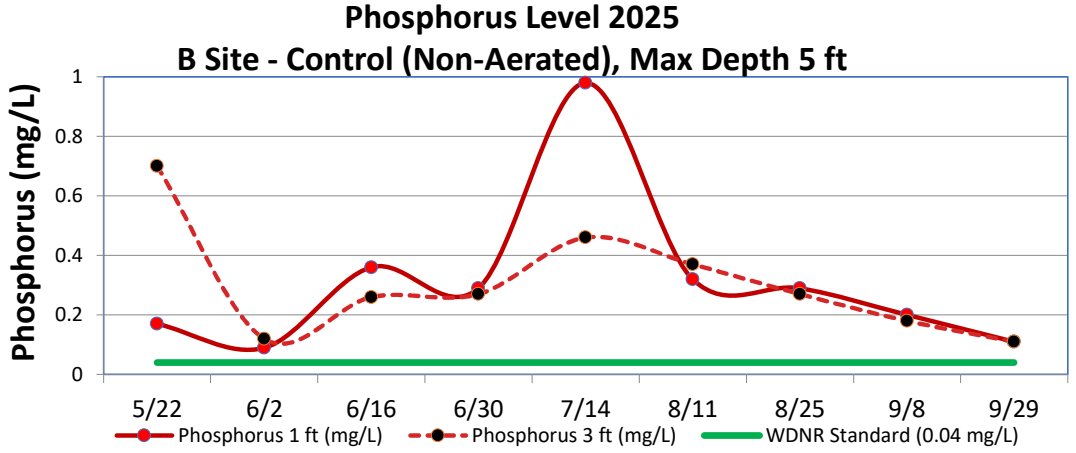
Phosphorus levels still exceed standards

Both sites exhibited similar surface and bottom Phosphorus patterns prior to June 7

- A Site – NanoBubbles: Exhibited equilibrium in surface and bottom concentrations in Phosphorus levels in late season.
- A Site – Mid season bottom Phosphorus level was suppressed.

- B Site – Control: exhibited wider fluctuations and higher Phosphorus levels.





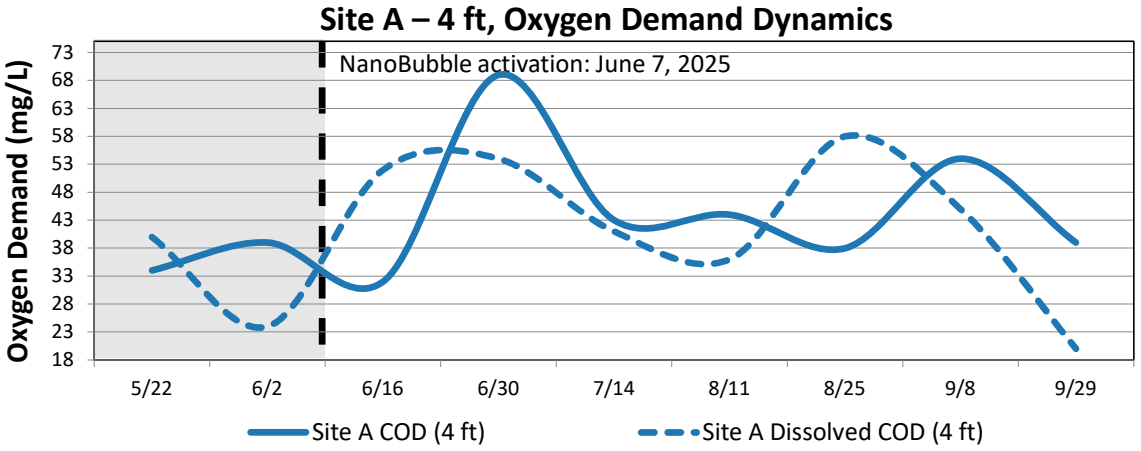
Algae and Sediments Consumed A lot of Oxygen

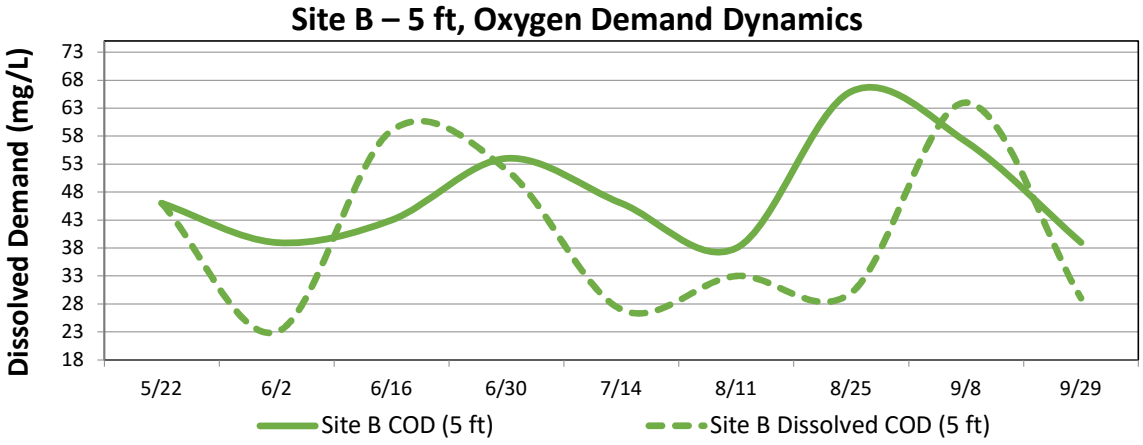
COD (Chemical Oxygen Demand): A measure of how much oxygen is being used **in the water** by decaying organic matter (Algae) and other substances.

Dissolved COD: The portion of oxygen demand coming from the **lake bottom and sediments**—where oxygen is actively being consumed.

- Site A, Nanobubbles: Total and dissolved COD show reduced mid-summer volatility.
  - Suggesting oxygen addition may be buffering sediment-driven oxygen demand during peak activity.

- Site B, Control: Without aeration, both COD measures exhibit larger seasonal swings and sharper peaks.
  - Consistent with stronger sediment oxygen demand and less buffering during mid-summer conditions.

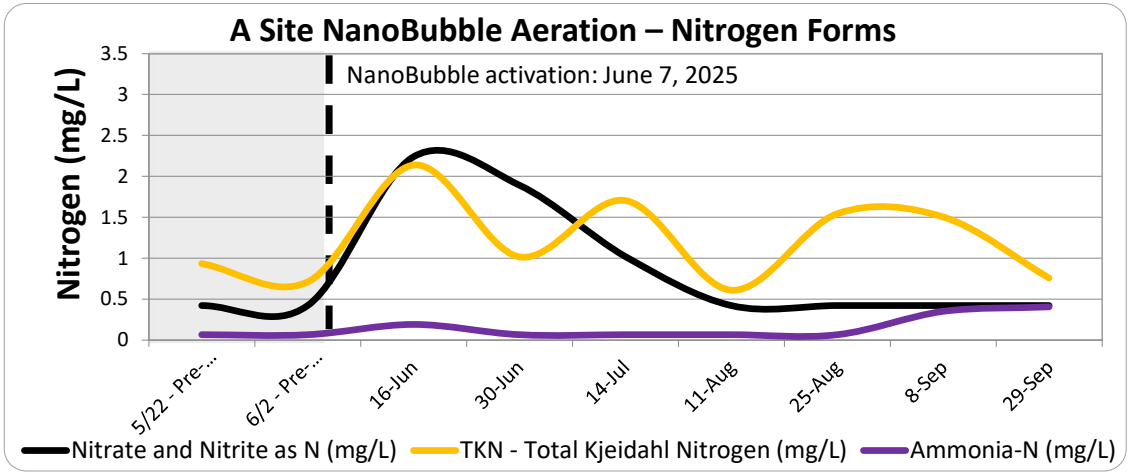




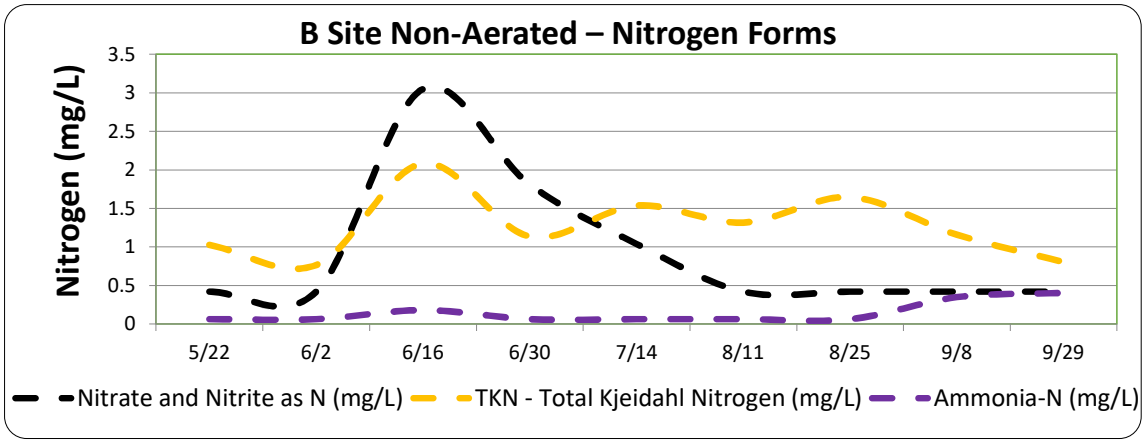
Background Nutrients Helped Fuel Algae Blooms

Nitrogen, Ammonia, Nitrates and Nitrites are background nutrients

- Site A – NanoBubbles: Exhibited a minor positive with drop of nitrates/nitrites in the early season.



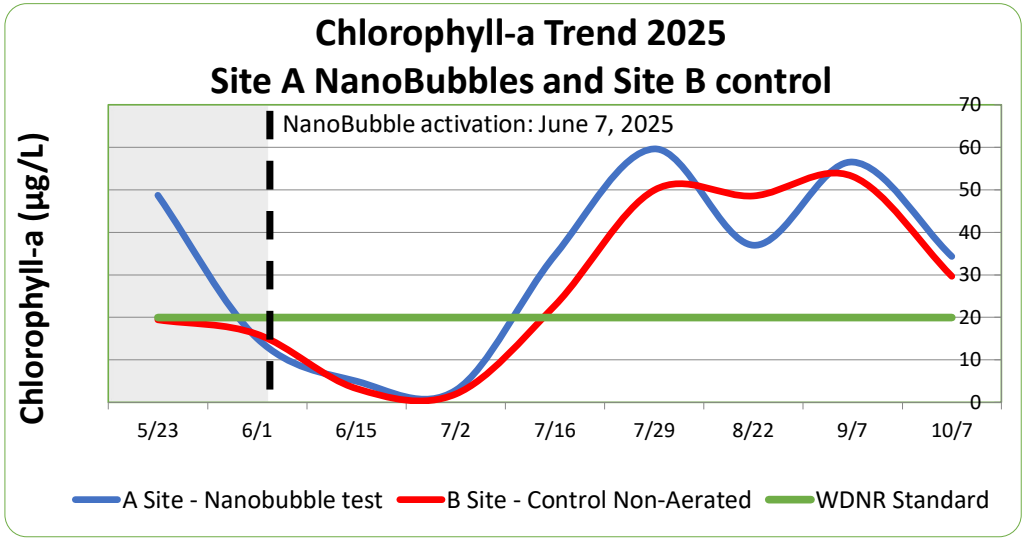
- Site B Exhibited similar seasonal patterns as Site A in Ammonia and TKN level.



Chlorophyll-a Levels Followed Mid to Late Season Temps

Both sites were 3X over state standard.
Chlorophyll-a tells how much algae is present.

- Strong seasonal influence at both sites
- NanoBubble aeration may influence bloom duration rather than elimination
- Earlier and higher mid-summer peaks occur at site A.
  - Wind blown weed mats covered the bay

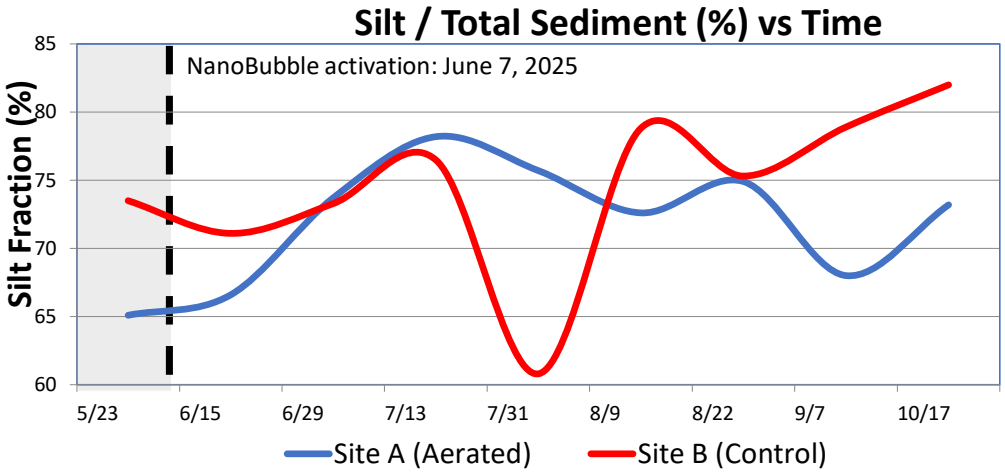


Silt Dominates the Muck Content

The Site A Test area and Site B Control area have similar muck/ sediment make-up.

- **Both sites are mostly fine silt and clay — like soft mud — rather than coarse sand**

- A Site NanoBubble: July - Oct - **No major change in silt reduction**
- July separation between sites, suggests Nanobubble circulation supports stabilization with Oxygen
  - **But it is not a definitive reduction of silt / muck.**
- B Site Control: Silt effects appear to accumulate or intensify later in the season



Similar Trends-of-Change Were Evident

- Pre NanoBubbles activation.
  - Base line testing showed both test sites exhibited similar patterns and levels of different chemistries.
    - Season Start. May-June 6
    - The NanoBubble machine was activated on June 7.
- June, July – post activation of NanoBubbles
  - Both sites exhibited similar trends of change in fluctuation in chemistry levels.
    - Site B, Control - experienced wider fluctuation in chemistry levels.
    - Site B, poor circulation limits movement of oxygen
    - Site A, NanoBubbles – experienced moderated, milder fluctuation in chemistry levels.
    - Site A, maintained adequate Oxygen through the season
- August, September - Both sites exhibited similar trends of increase or drop in changes of chemistry levels.
  - Site B, Control – showed a greater differential between patterns of surface and bottom chemistry
  - Site A, NanoBubbles – showed closer alignment or flat difference between patterns in surface and bottom chemistry
- July - Oct - **No major change in silt reduction**

- Water samples were collected 2 times each month, from a test site A and a control site B, over 5 months.
- Chemistries tested: Oxygen, Phosphorus, background nutrients and sediment content.
- Biologic Communities tested: Zooplankton and Algae enumeration data analysis is underway by WI state Lab of Hygiene.
  - Data are not yet sufficient for interpretation or presentation.

Working for solutions to change:

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