Green Lake Phosphorus Management Plan for the 2016 Alum Treatment

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Presentation Outline

- Background on how alum works and the effects of past Green Lake alum treatments
- Alum dose calculation
- Alum application specifications
- Environmental concerns
- Water quality monitoring plan

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Why Alum?

- Problem:
  - Lake closures from toxic blue-green algae blooms
- Solution:
  - Proven effectiveness
  - Long-term control
  - Environmentally safe
  - Low cost

1990 Water Quality Improvement Plan

Goals to manage summer algae growth:

- Water clarity > 2.5 meters (> 8.2 feet)
- Total phosphorus < 30 µg/L (revised to < 25 µg/L in 1995)

Plan Components:

- **Alum treatment**
- Stormwater treatment
- Canada geese management
- Dilution with drinking water
- Milfoil harvesting
- Monitoring and education

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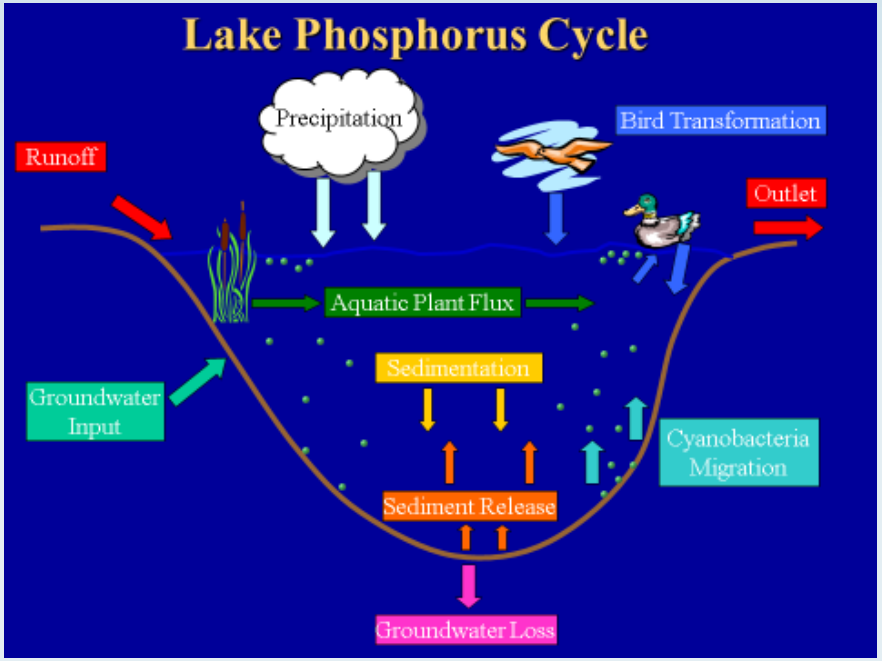
Alum Inactivates Phosphorus

- Al^{3+} permanently binds with PO_4^{3-} to starve algae of an essential nutrient
- Short-term stripping of water column phosphorus
- Long-term inactivation of sediment phosphorus release
- Effective if low external phosphorus sources from watershed runoff, direct precipitation, and ground water
- 88% of summer P from sediment release in 1980



Past Alum Treatments

1991

Alum dose = 8.6 mg Al/L

Effective for about 4 years

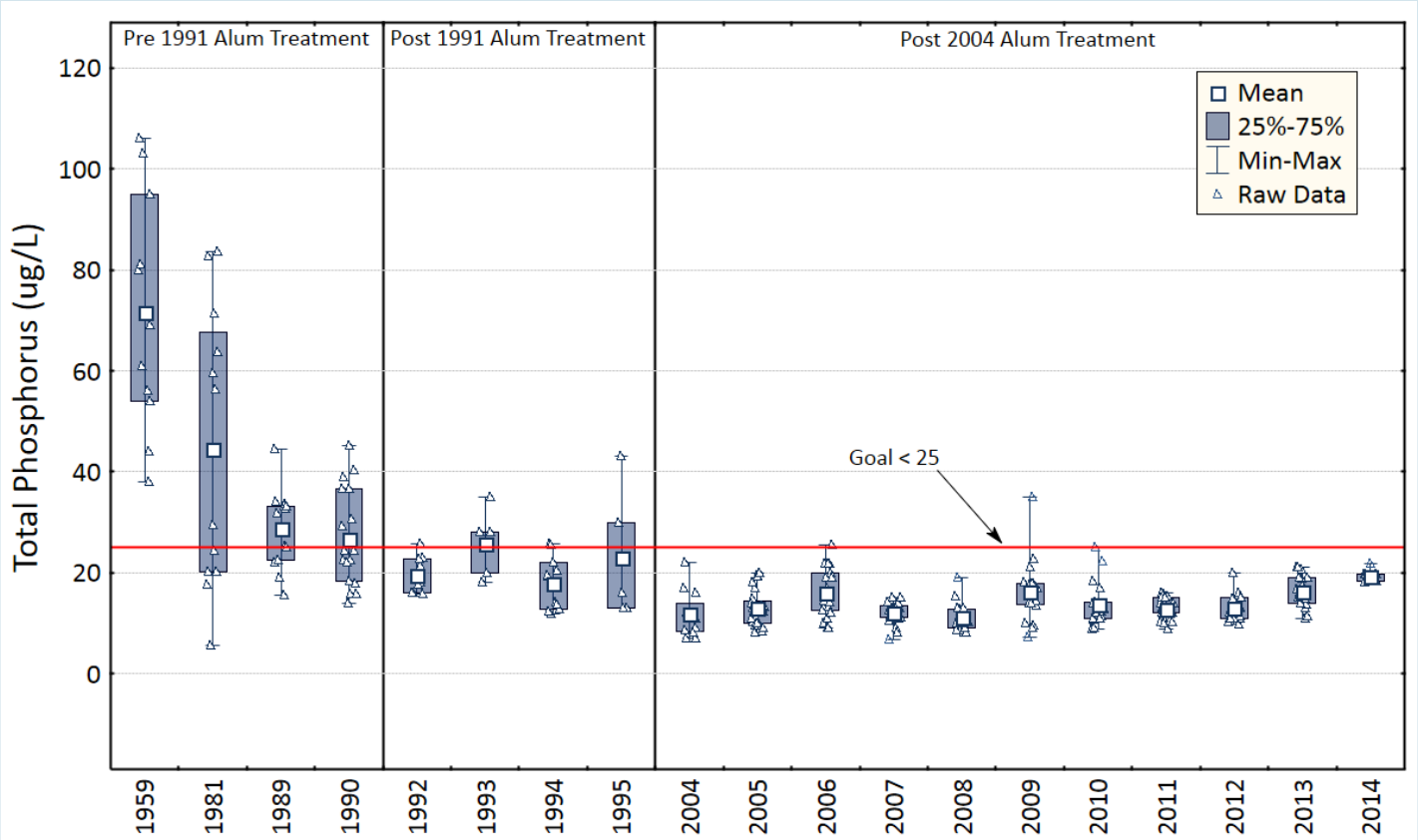
2004

Alum dose = 23 mg Al/L

Effective for 10+ years

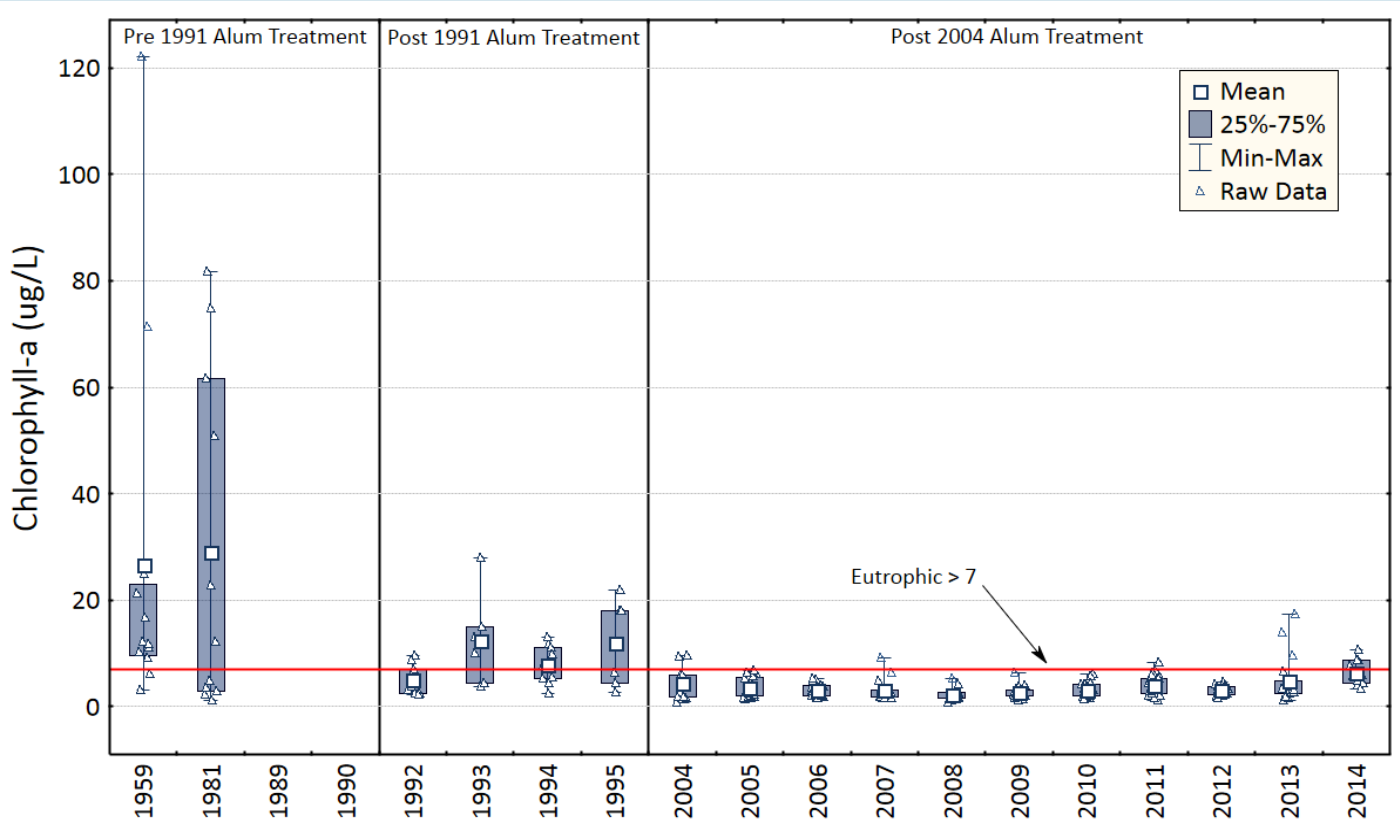
Total Phosphorus

- Significant decrease after 1991 treatment and again after 2004 treatment
- Significant increase since 2004 treatment



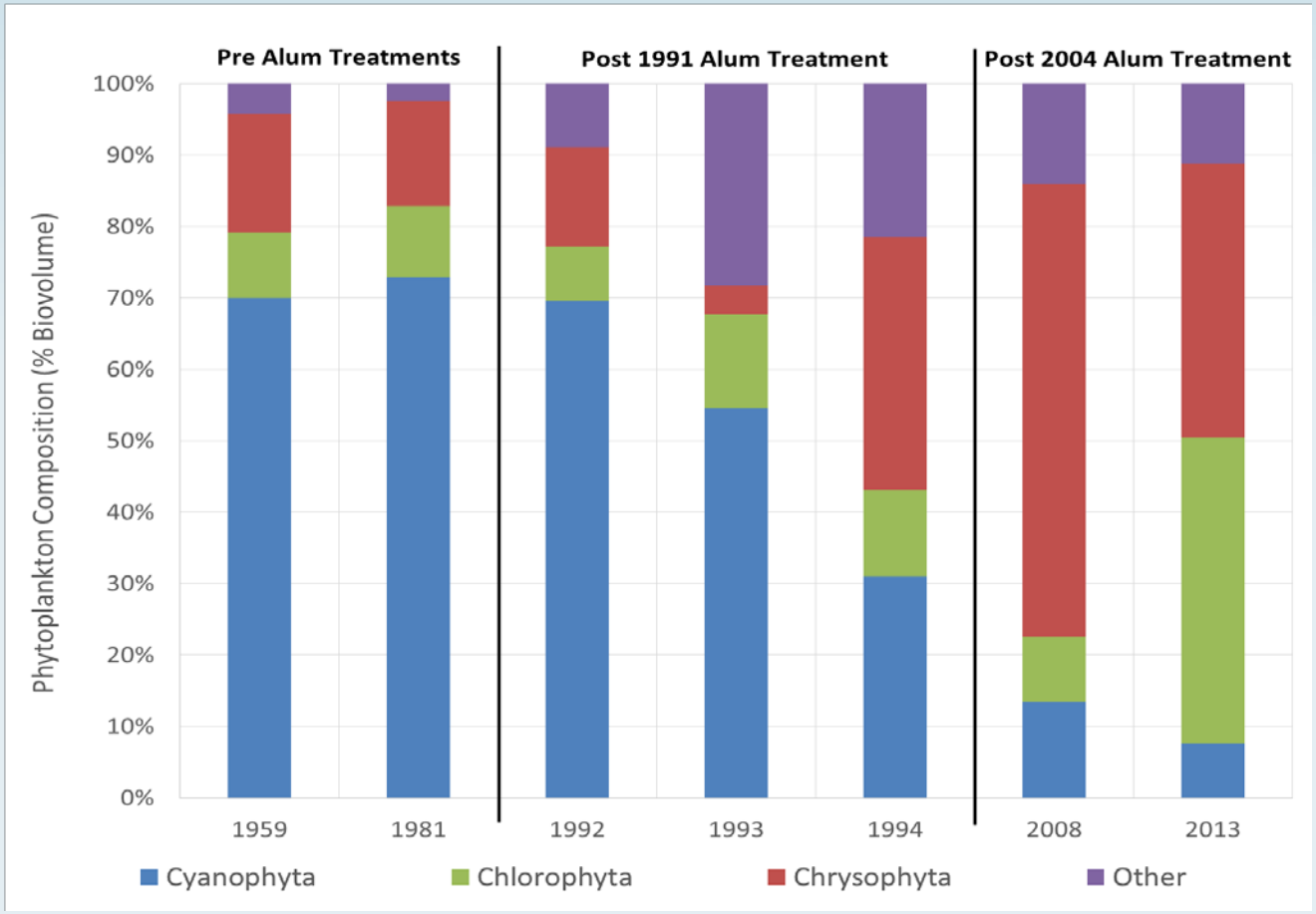
Algae Biomass as Chlorophyll

- Significant decrease after 1991 treatment and again after 2004 treatment
- Significant increase since 2004 treatment



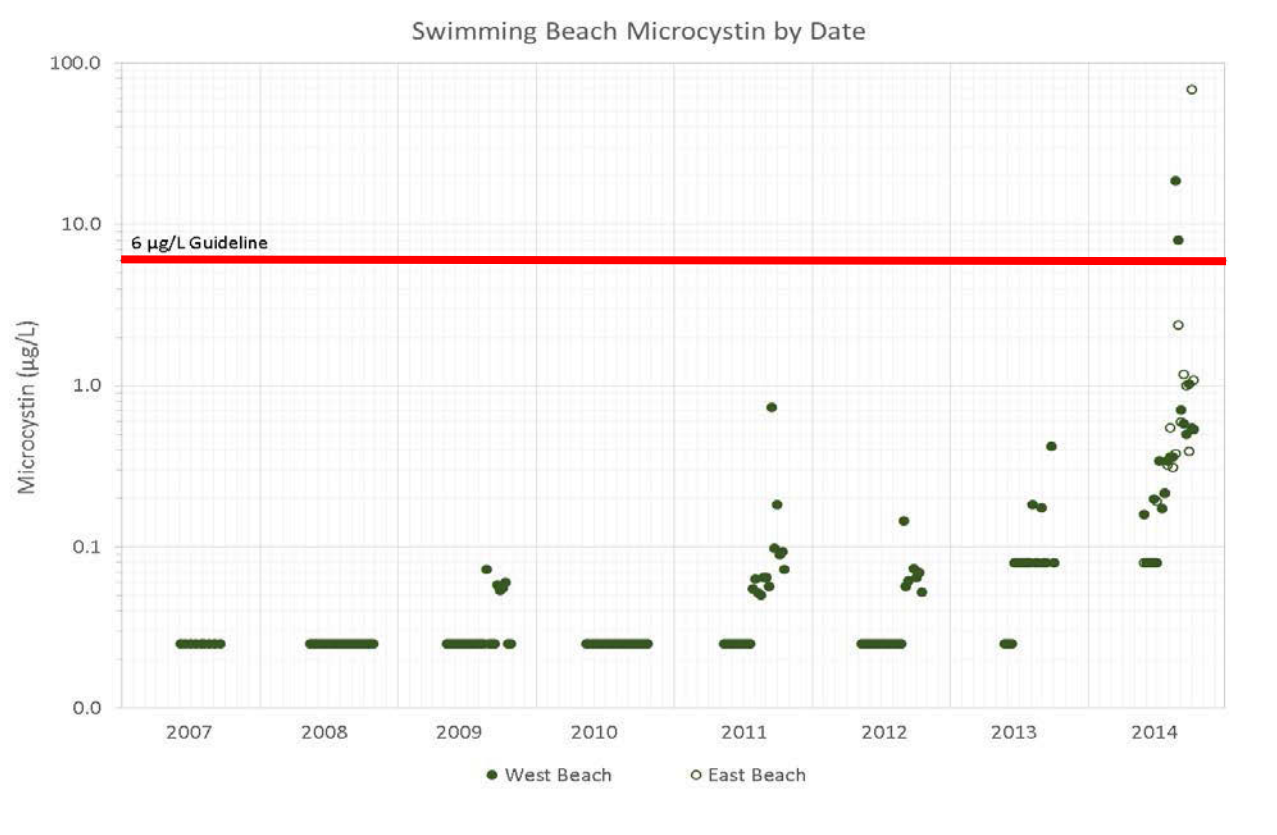
Algae Composition

- Cyanobacteria (blue-green algae) decrease after 1991 and 2004 treatment



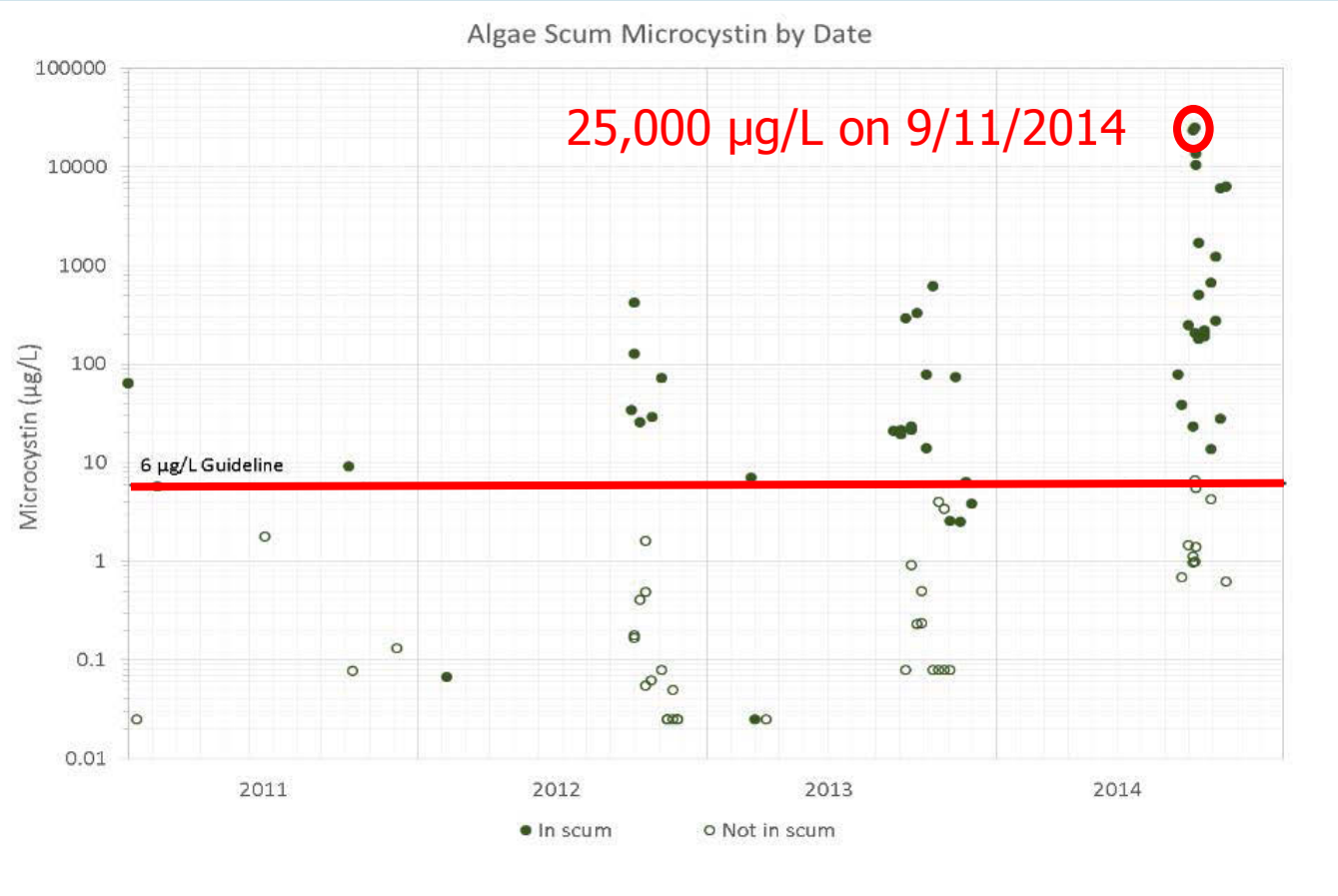
Microcystin at Beaches

- Blue-green algae produce the toxin microcystin that increased above state public health guideline of 6 µg/L in 2014



Microcystin in Shore Scum

- Public health risk high in scum but not outside scum



2016 Phosphorus Management Plan

Goals to manage summer phosphorus and cyanobacteria:

- Water clarity > 2.5 meters (> 8.2 feet)
- Total phosphorus < 20 µg/L (reduced from < 25 µg/L)
- No lake closures due to toxic cyanobacteria for 10 years

Plan Components:

- Evaluated 10 alternative management methods
- Continue with alum treatment
- Calculate alum dose and prepare specifications
- Continue monitoring and education

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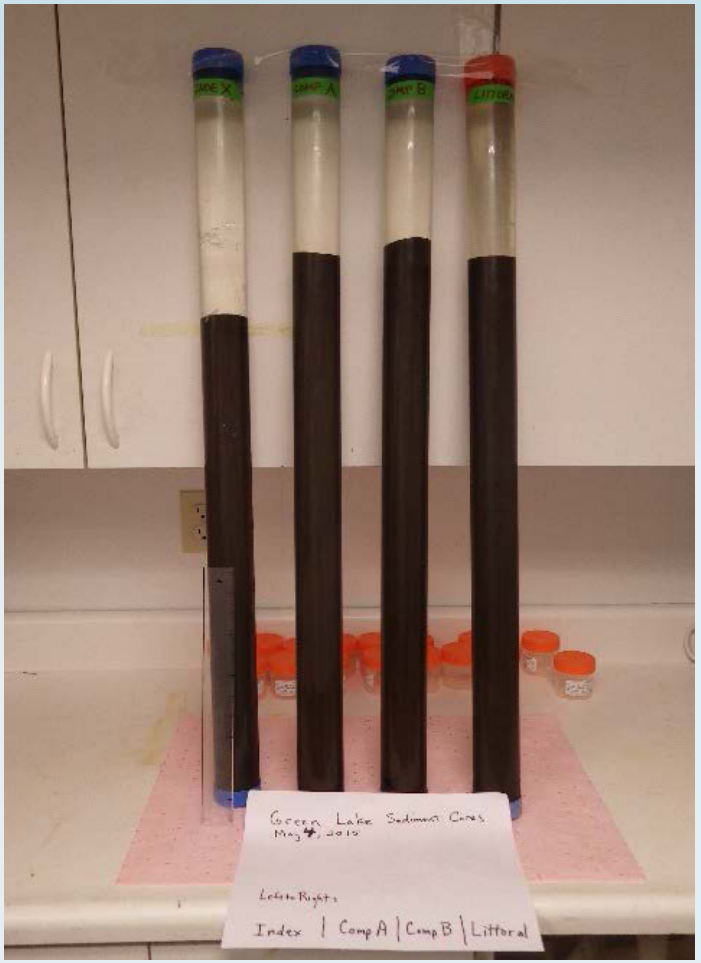
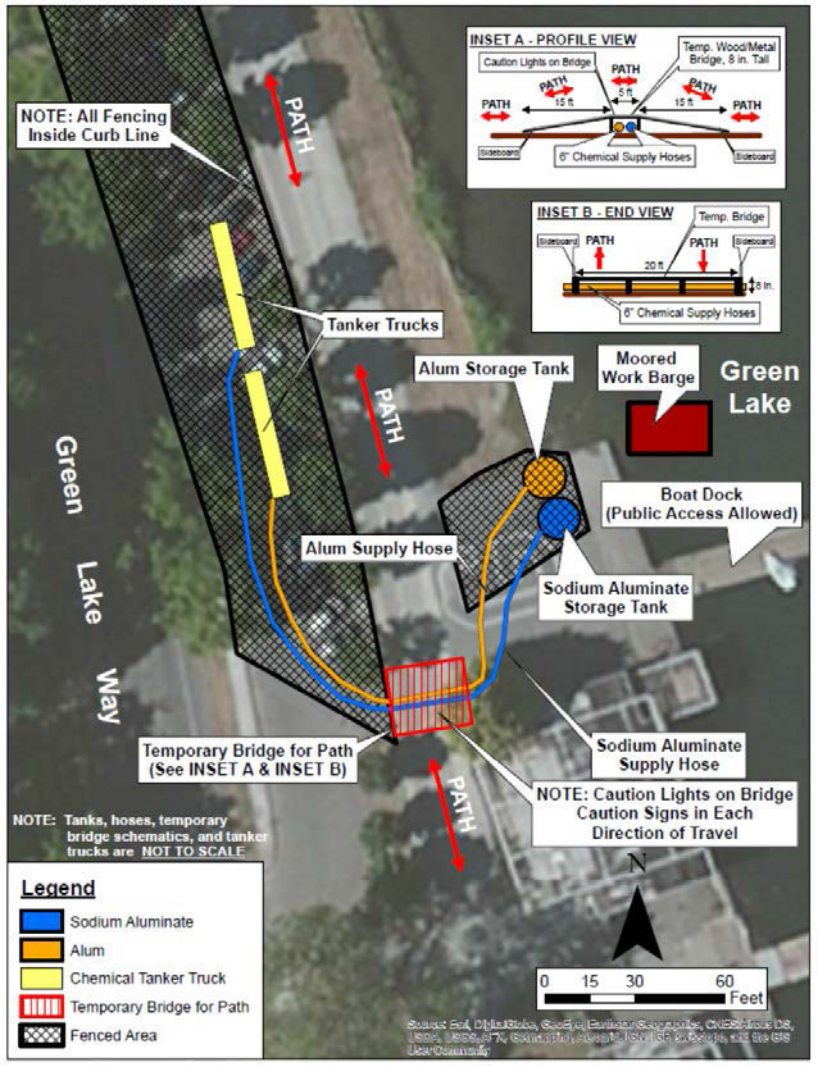
2016 Alum Treatment Dose

- Sediment cores show low mobile inorganic phosphorus due to 2004 alum treatment
- Inactivate both mobile inorganic and active biogenic phosphorus to 20 cm depth
- Apply 8.2 mg Al/L over entire lake:
  - Similar to 1991 dose (8.6 mg Al/L)
  - Much less than 2004 (23 mg Al/L)



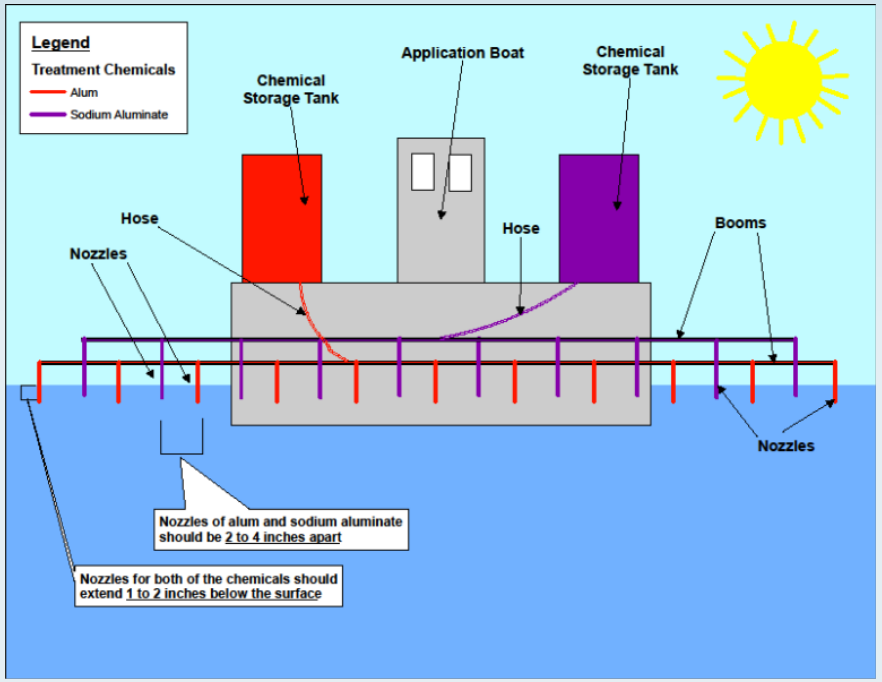
2016 Alum Treatment Specifications

- Contractor experience with alum treatments at 2 lakes (>100 acres) in past 5 years
- Load barge from trucks and tanks at Small Craft Center
- Close parking lot for trucks
- Ramp over hoses across path for uninterrupted use
- Fence truck and tank areas
- Spill control and health and safety plans



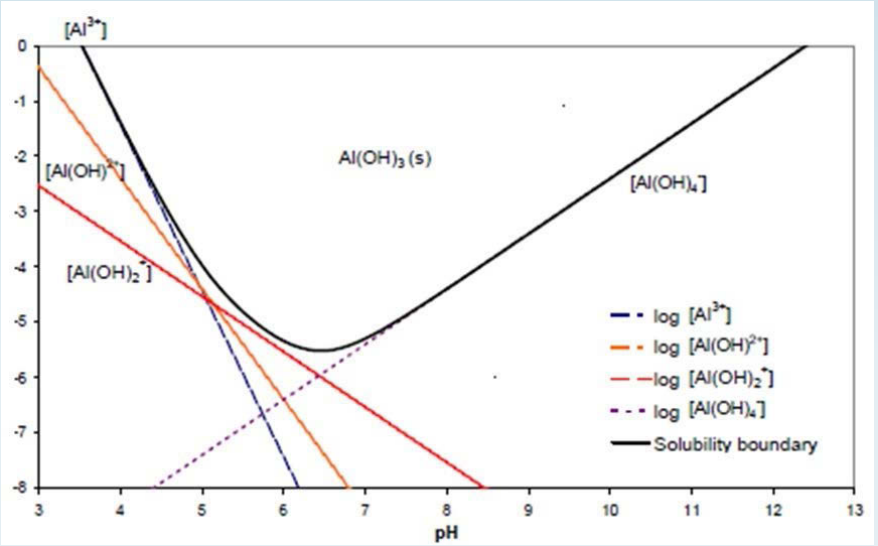
2016 Alum Treatment Specifications

- 81,680 gallons of aluminum sulfate (alum)
- 40,840 gallons of sodium aluminate (buffer)
- Drinking water grade
- Apply in ~6 days in April when:
  - Water temperature >10 °C
  - Low milfoil interception
  - Low recreational activity
- Inject liquids below water surface with alum/buffer nozzles <4 inches apart
- Vary alum amount with water depth and boat speed



Environmental Concerns

- No human impacts or recreation restrictions
- Aluminum (Al^{3+}) toxicity to fish at pH <6
- Apply 1 part buffer to 2 parts alum by volume to insure pH >6
- Small fish kills have occurred when buffer not properly applied (not in Green Lake)



Water Quality Monitoring Plan

- Full-time contractor oversight and lake monitoring
- Initial jar test (adjust ratio)
- Treatment monitoring (pH 6.0 to 8.6)
- Short-term impact monitoring (all parameters before, 2 days after, and 2 weeks after)
- Long-term impact monitoring (summer routine for 10 years)

Green Lake alum jar test on 2/20/16 at 82 mg/L (left) and 8.2 mg/L (right)

Questions?

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