Lake Carmi Coordination Team Meeting

April 16, 2024

4:30 – 6:00 pm

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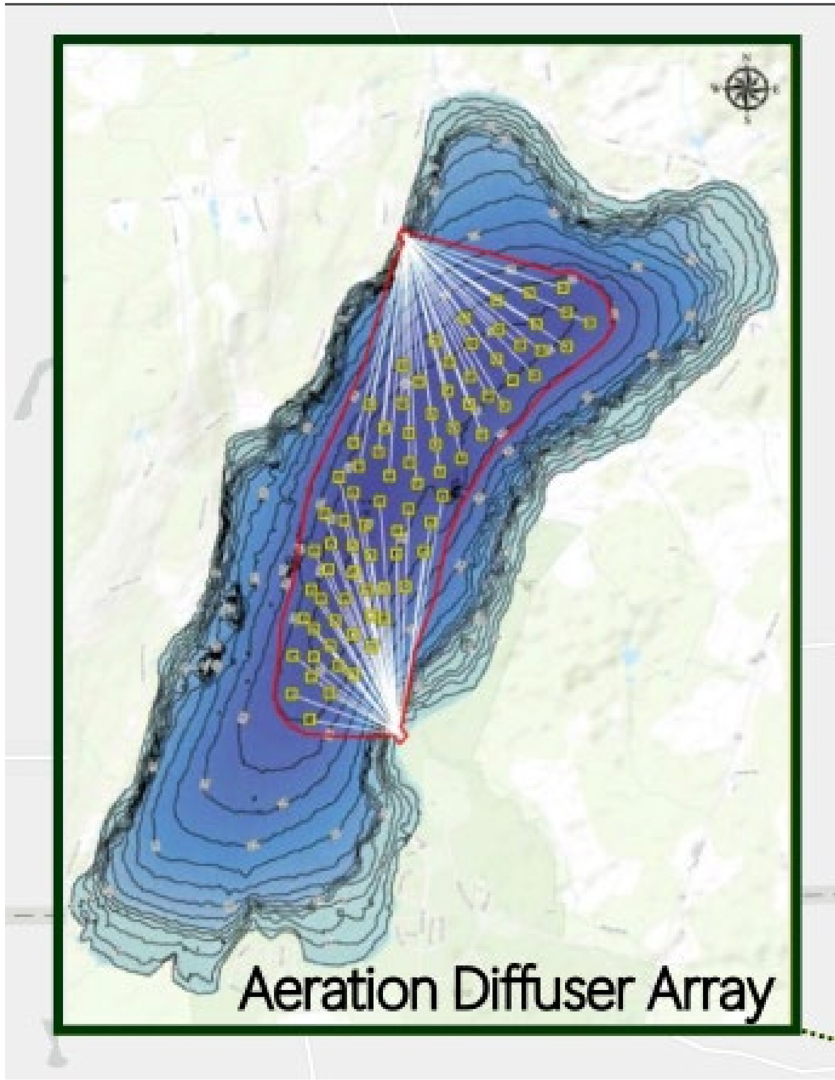
Agenda

1. Welcome – Franklin Watershed Committee (5 minutes)
2. Overview of presentation – Pete LaFlamme and Bethany Sargent, Watershed Management
3. Aeration decision – Peter Isles, Lakes and Ponds Program (15 minutes)
4. Lake Carmi Feasibility Study – Keith Pilgrim, Barr Engineering (15 minutes)
5. Alum treatment permitting process and prospective timeline – Bethany Sargent, Pete LaFlamme (15 minutes)
6. Funding – Neil Kamman, Water Investment Division (10 minutes)
7. Q & A, Other Business

Aeration Decision

- Reviewed water quality data since aeration system was installed and operating
- Determined to cease aeration system operations and remove the system
- Developing a plan to remove the system

Lessons from Aeration in Lake Carmi

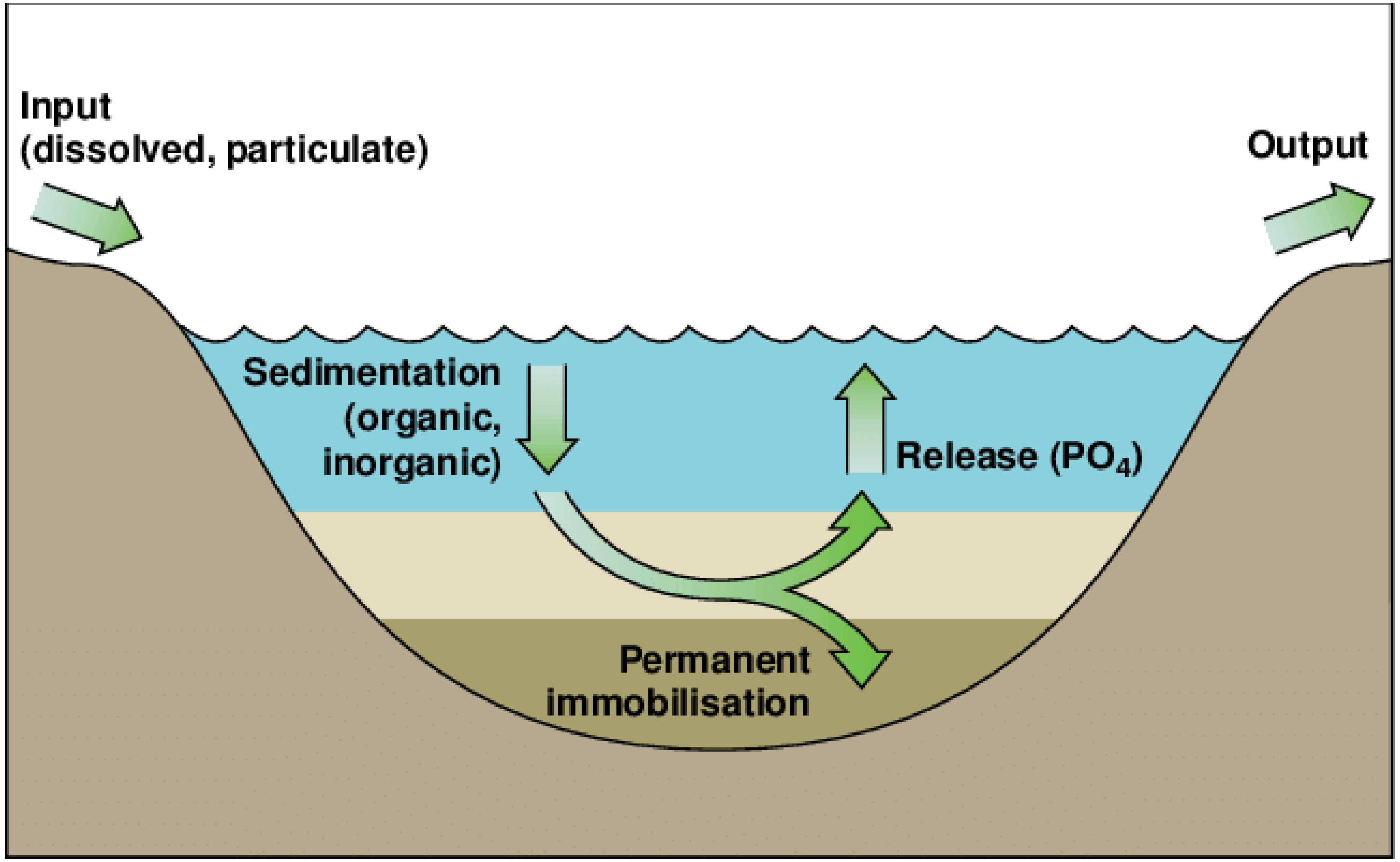


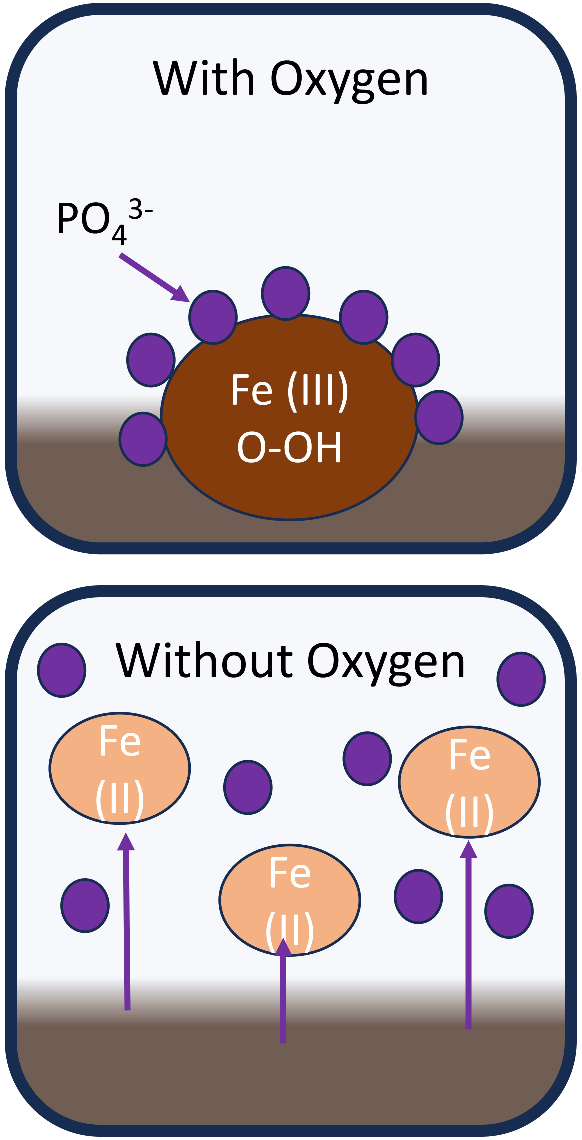
Dr. Peter Isles, VT DEC

Mark Mitchell, VT DEC

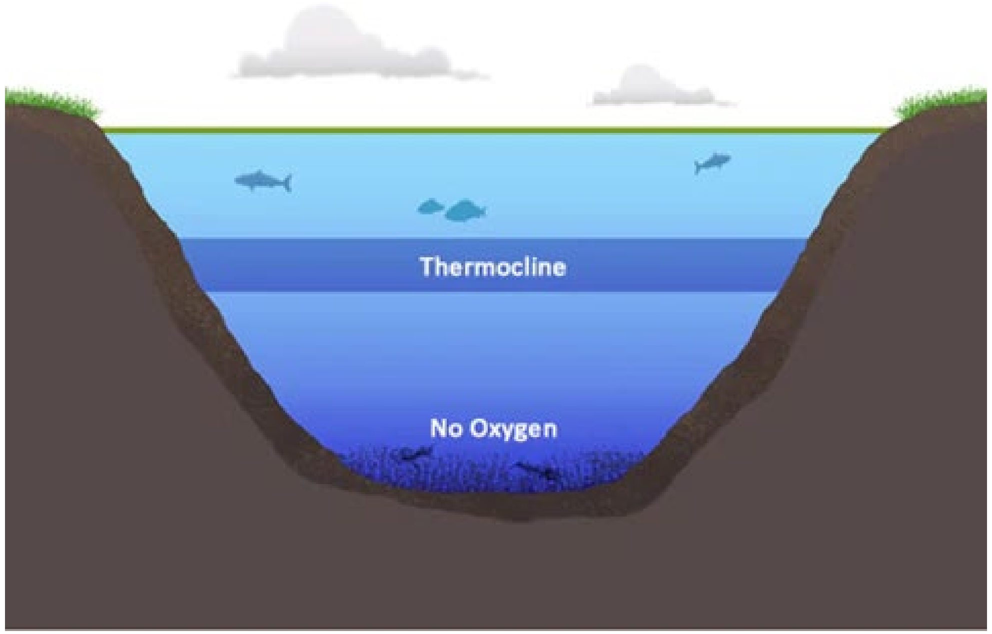
(Prof. Andrew Schroth, UVM)

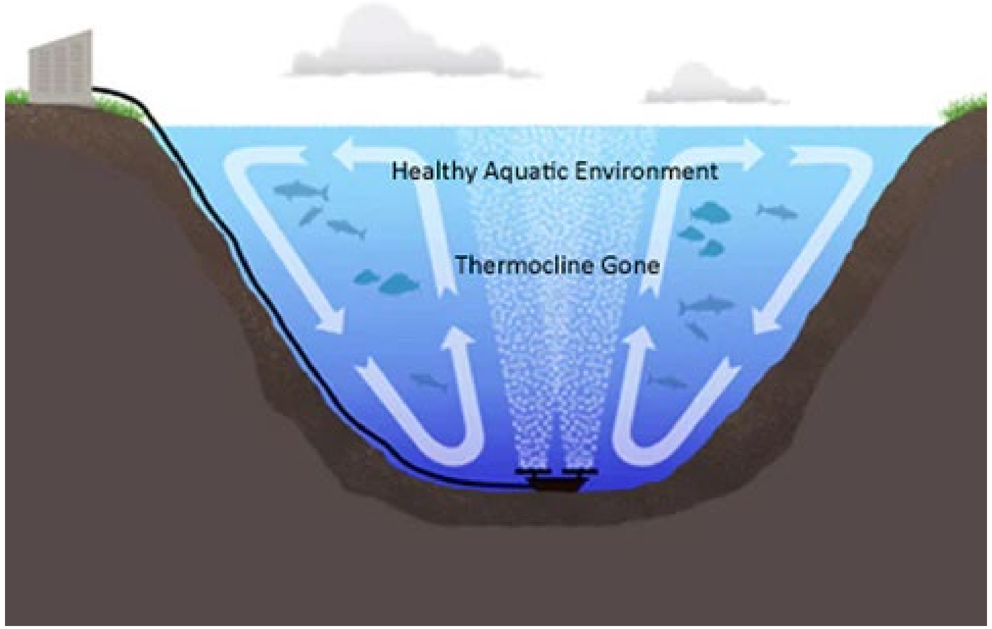
Internal P loading and oxygen





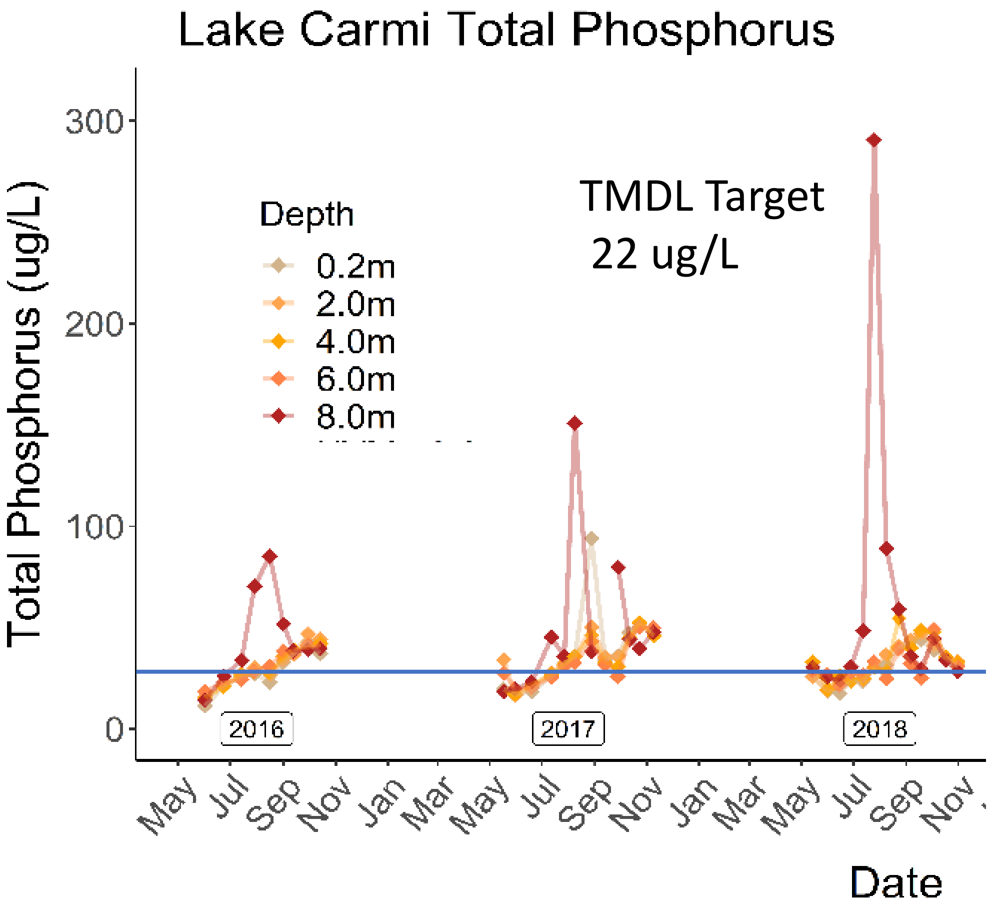
Basic idea of the aeration system



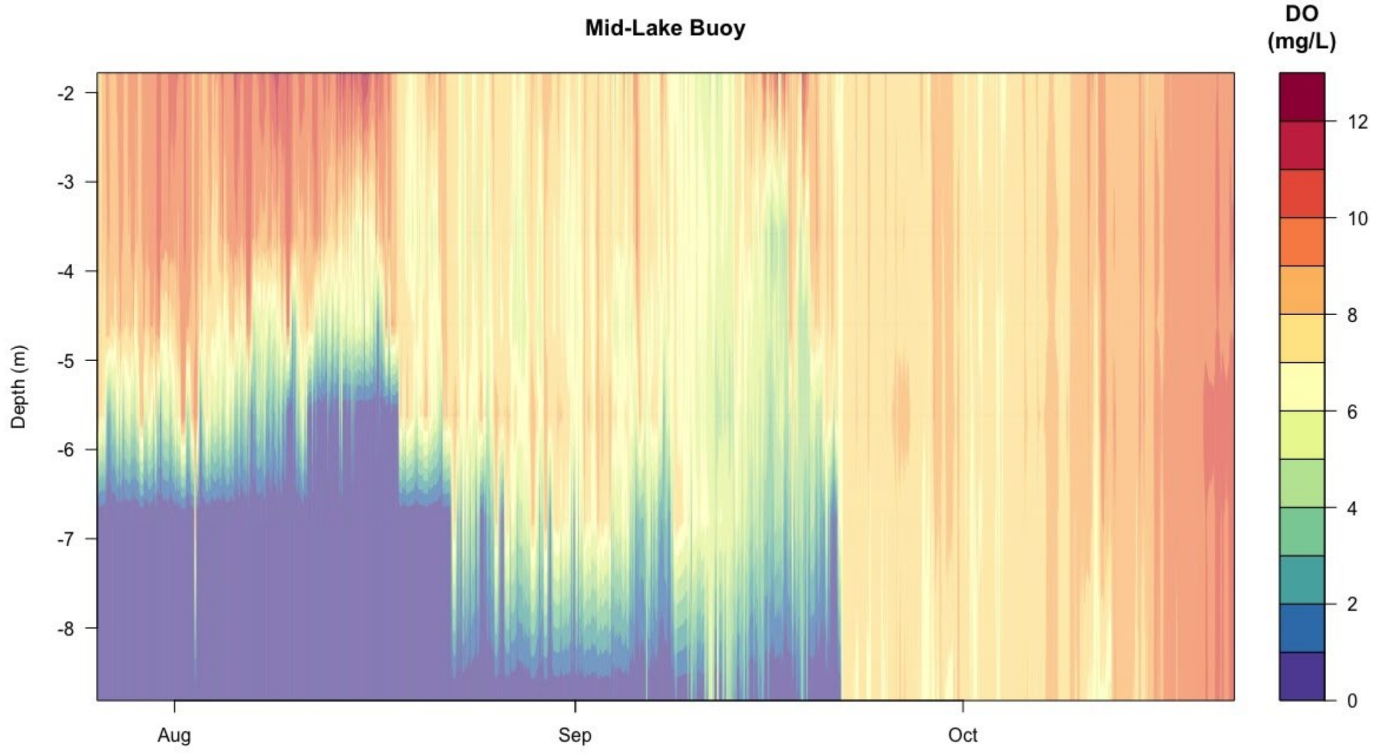


Lake Carmi Pre-Aeration

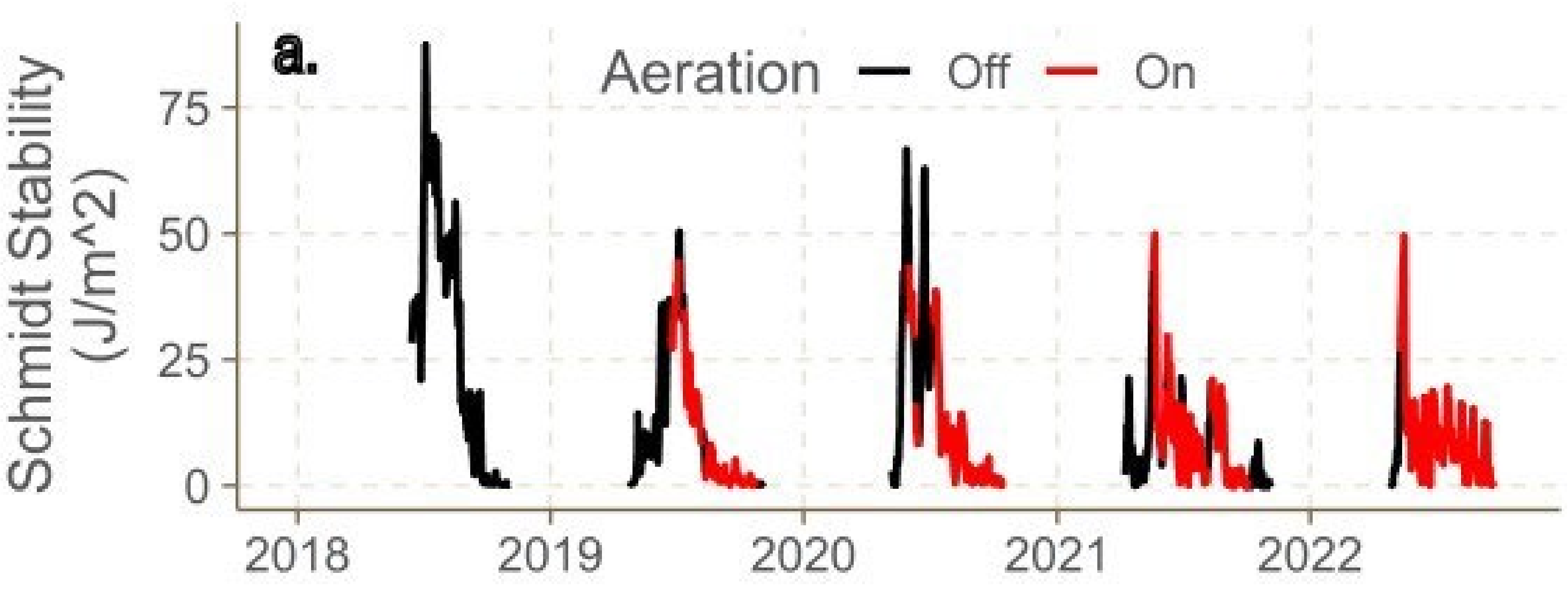
- P stratification (enrichment at depth near the sediment) driven by low O_2
- Naturally dimictic system

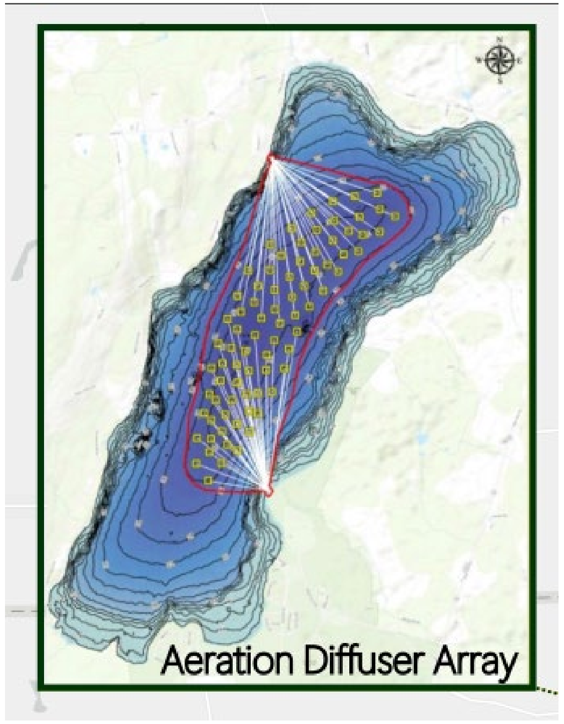


DO Sensor Data 2018



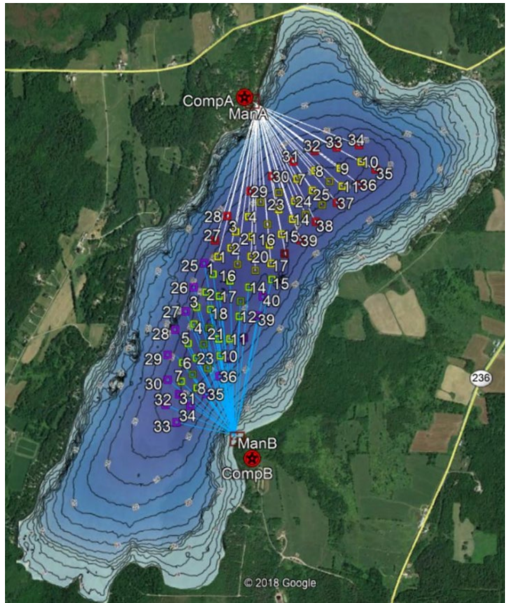
Transitions to a polymictic system with SWI redox dynamics driven by wind and heat waves

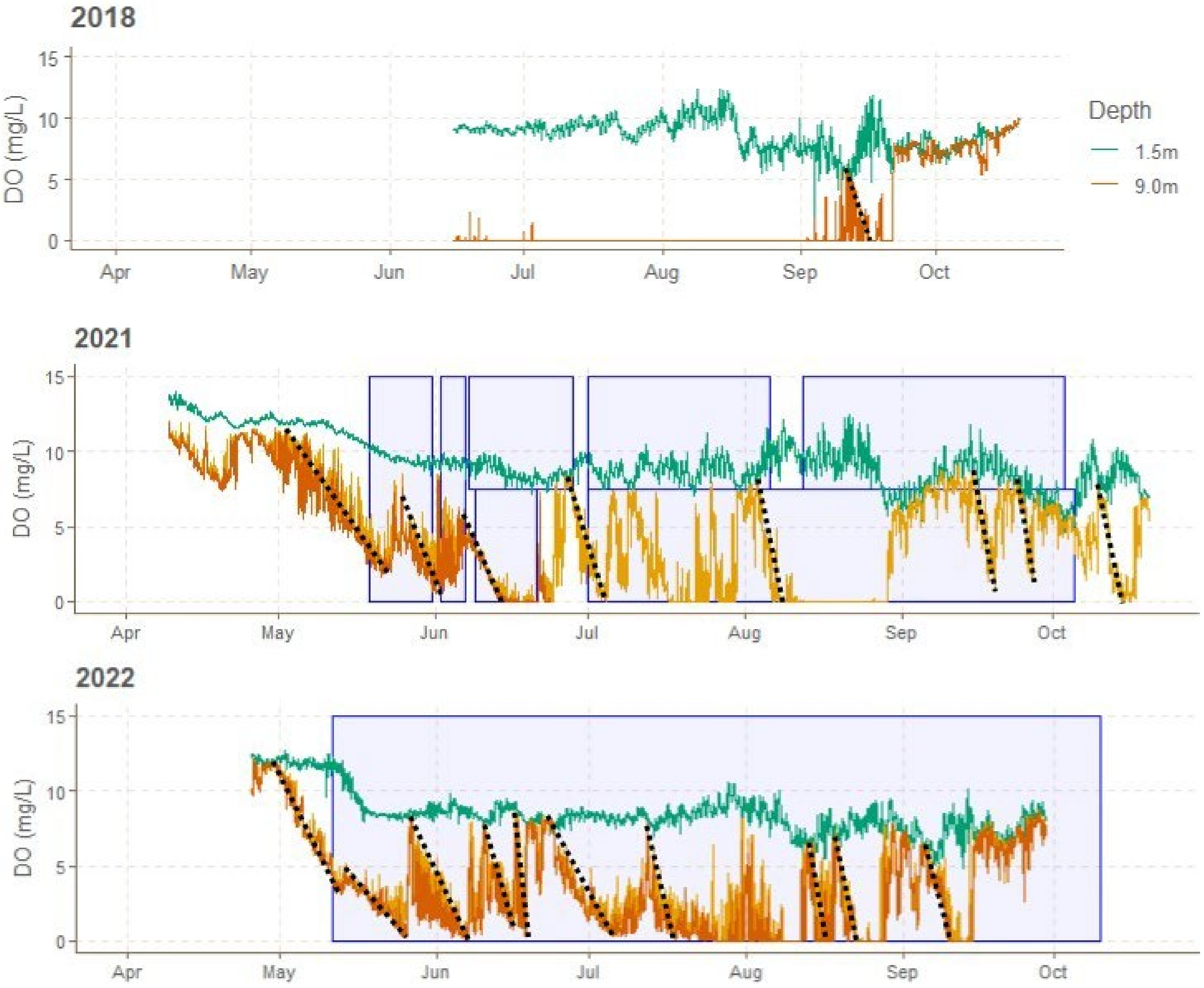




Impact on Dissolved Oxygen

- Wind driven oscillation between anoxia and fully oxidized SWI
- Rapid changes





In the years after the aeration system was in place, TP in surface waters increased

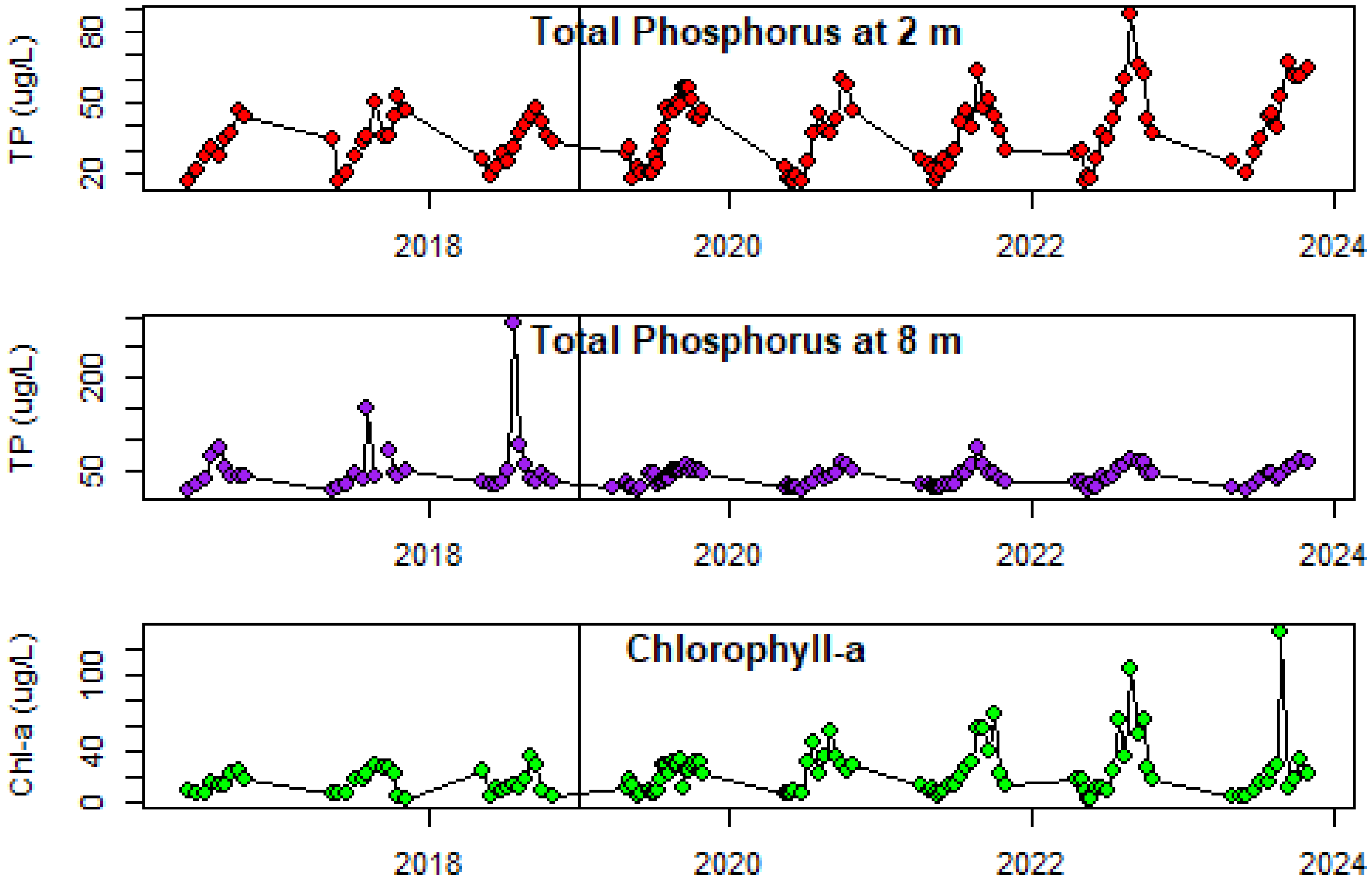
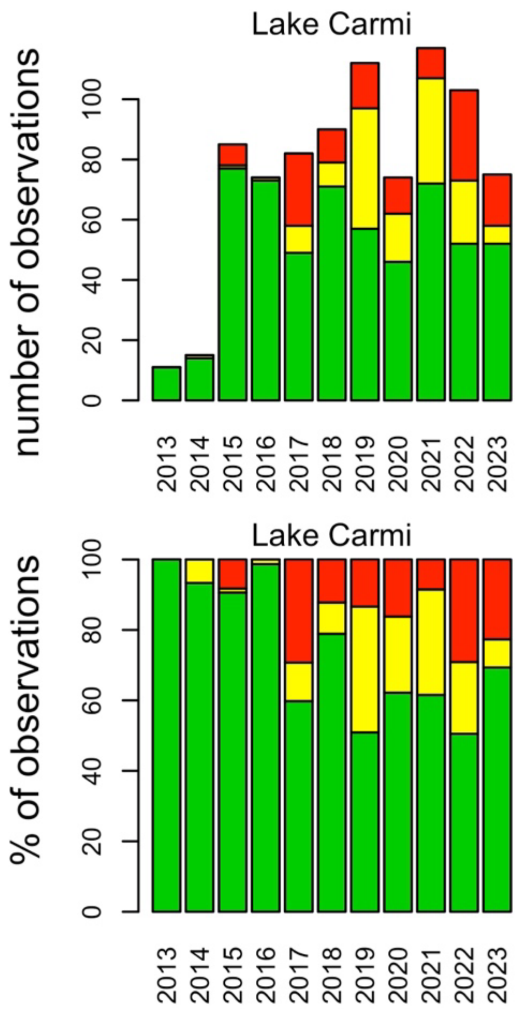


Figure 1: DEC monitoring data from the Carmi central site. Vertical line is Jan 1, 2019



Summary Table of Change Facilitated by Aeration

	Pre-Aeration Summer Mean (2016 – 2018)	Aerated Summer Mean (2019 – 2022)	t-test *p*-value
Bottom DO (mg/L)	0.77	3.96	<0.0001
Bottom Temp (^{o}C)	18.30	21.81	<0.0001
Schmidt Stability (J/m^2)	40.09	9.37	<0.0001
Surface TP (µg/L)	37.09	47.00	0.0204
Bottom TP (µg/L)	71.86	47.12	0.0454
Bottom Fe (µg/L)	569.64	99.34	0.0005
Bottom Mn (µg/L)	787.44	113.34	<0.0001

Conclusions

- The aeration system was partially successful at reducing stratification in Carmi
- However, the system had the unintended consequence of mixing bottom-water TP into surface waters earlier in the season and throughout the season
- This resulted in substantially higher surface water TP and stronger, more protracted cyanobacteria blooms
- Aeration has been effective in other lakes, but it does not seem to be a good solution for lake Carmi

Lake Carmi Feasibility Study

- Assessment of internal phosphorus loading relative to watershed loading
- Evaluation of alternatives to control internal loading
- Evaluation of anticipated benefits, impacts, costs, and longevity of an alum treatment
- Recommendations on alum dosing relative to effectiveness and water quality standards compliance

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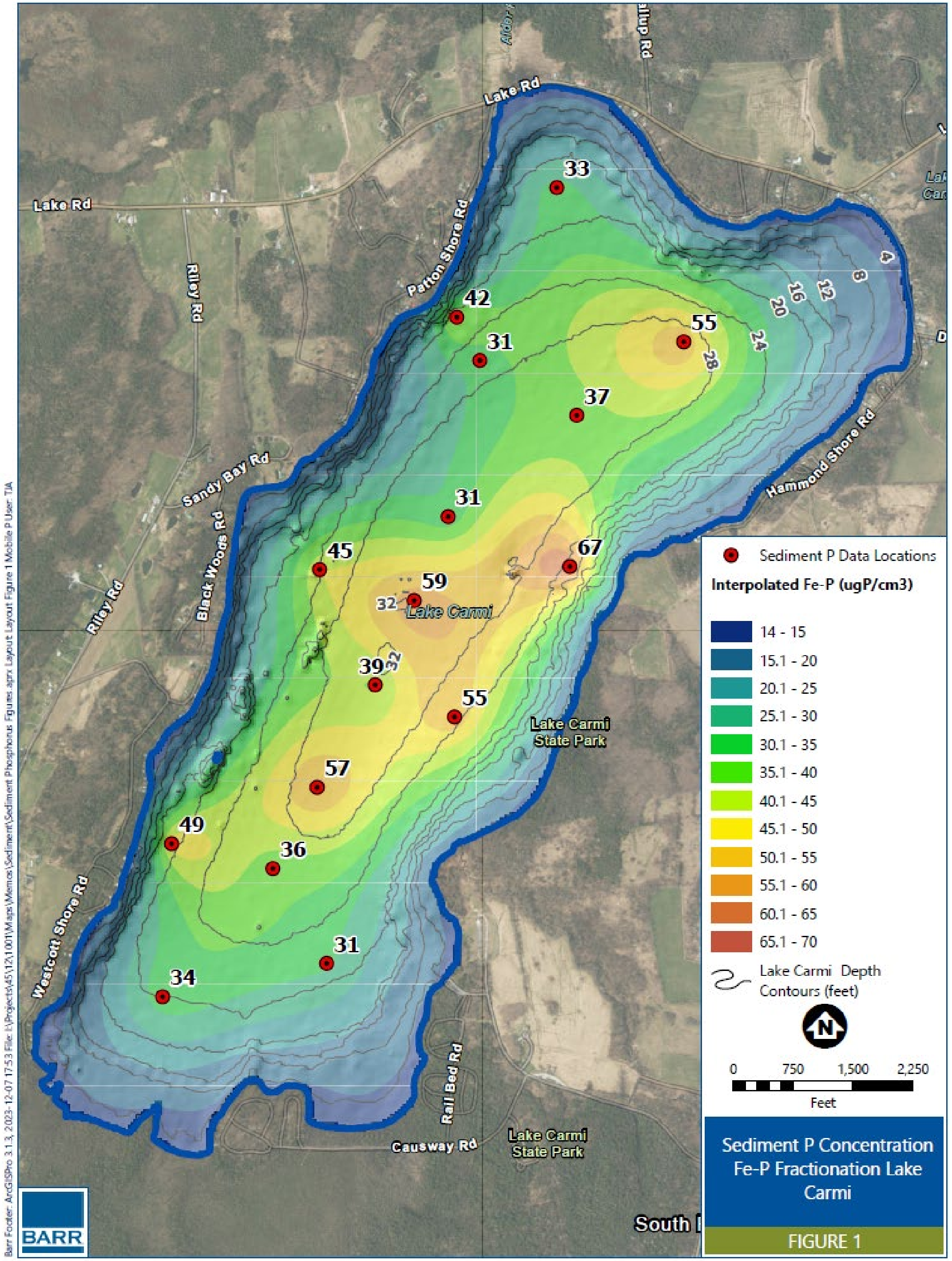
Diagnostic Feasibility Study

for a Phosphorus Inactivation

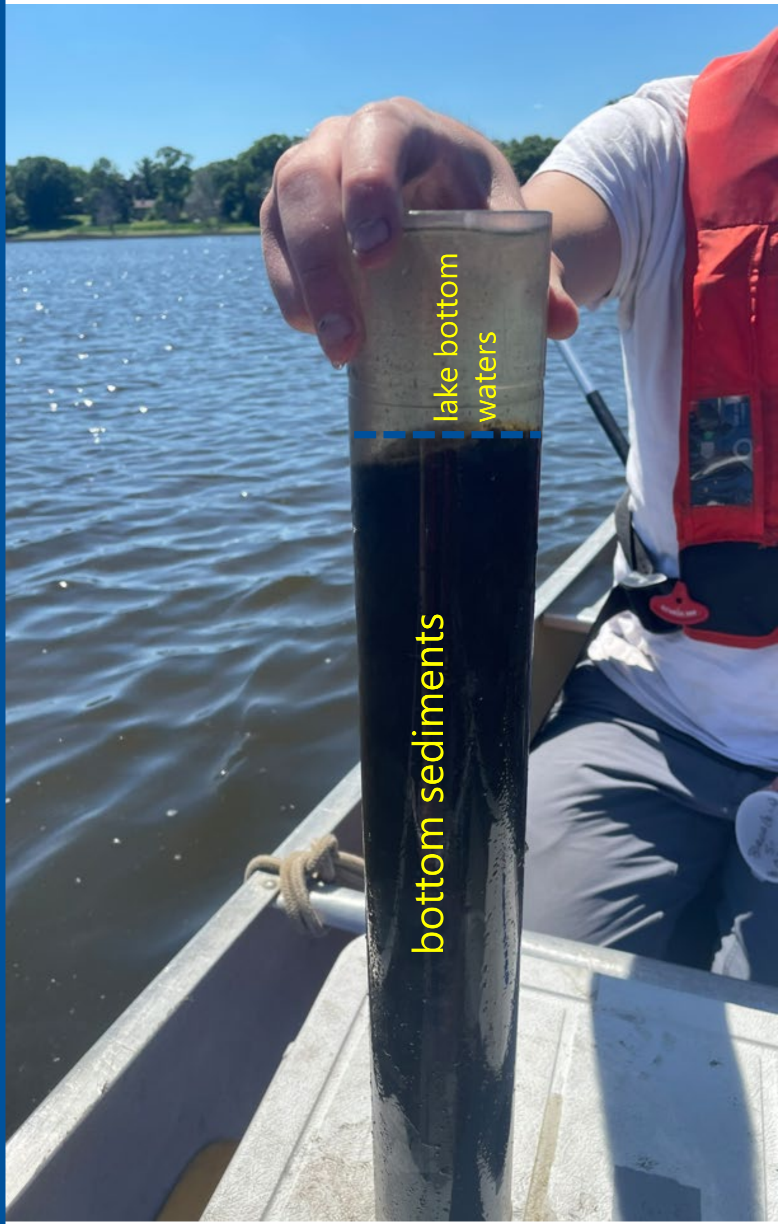
Treatment in Lake Carmi

Lake Carmi Campers Association

April 16, 2024



Study Goals and Components



- Will an aluminum (alum) treatment work?
- If we do an aluminum treatment, will additional watershed controls be needed to stop the algal blooms?
- How much might this cost?
- Will it be one or more treatments (split treatments)? When should treatment occur?
- How long will this treatment last?
- Will this harm fish?
- How will this affect the aquatic plants

Sediment and Treatment

Recommended Treatment Area

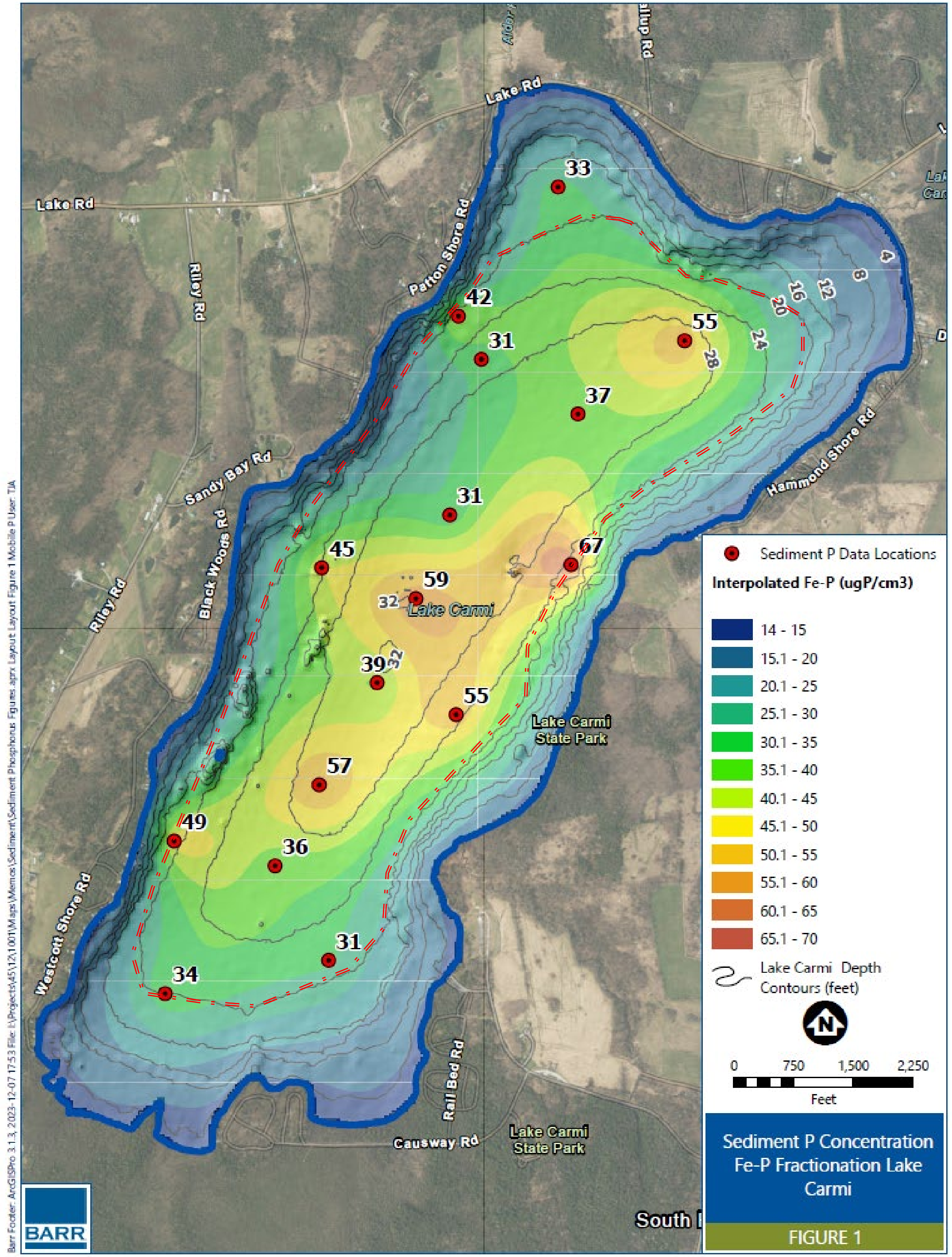
775 acres
20-foot contour

Recommended Dose

67 g/m^2
Liquid Alum: 412,183 gallons
Liquid Sodium Aluminate: 206,092 gallons

Application

147 Tanker Trucks
Application Using a Barge
29 Days Treatment Time



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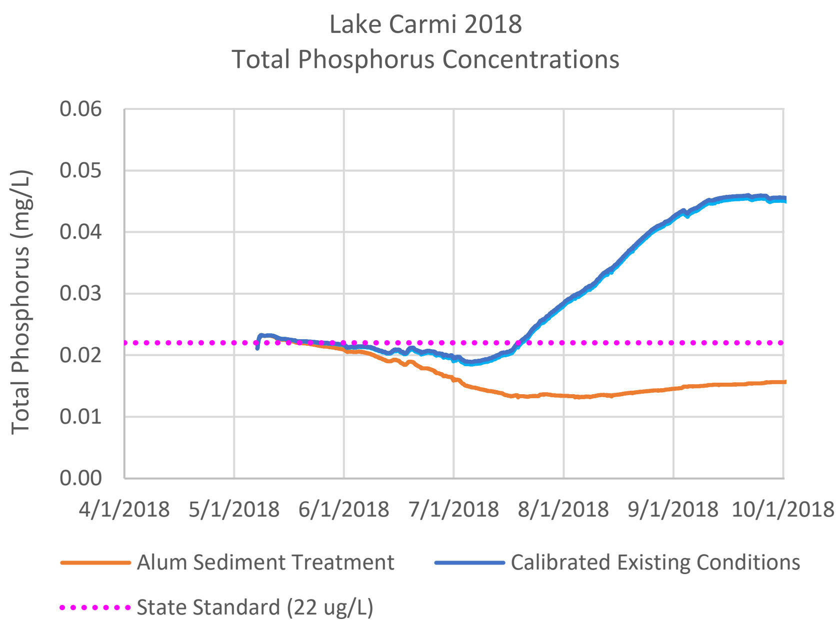
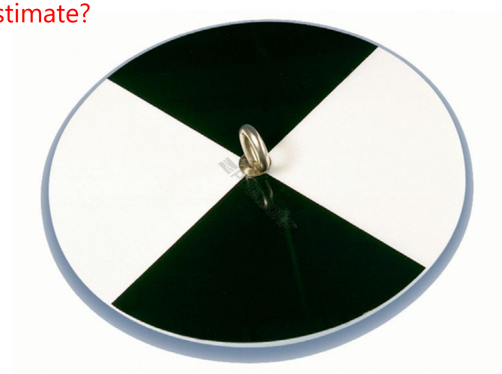
Expected Benefits of the Treatment



Underestimate?



Clarity

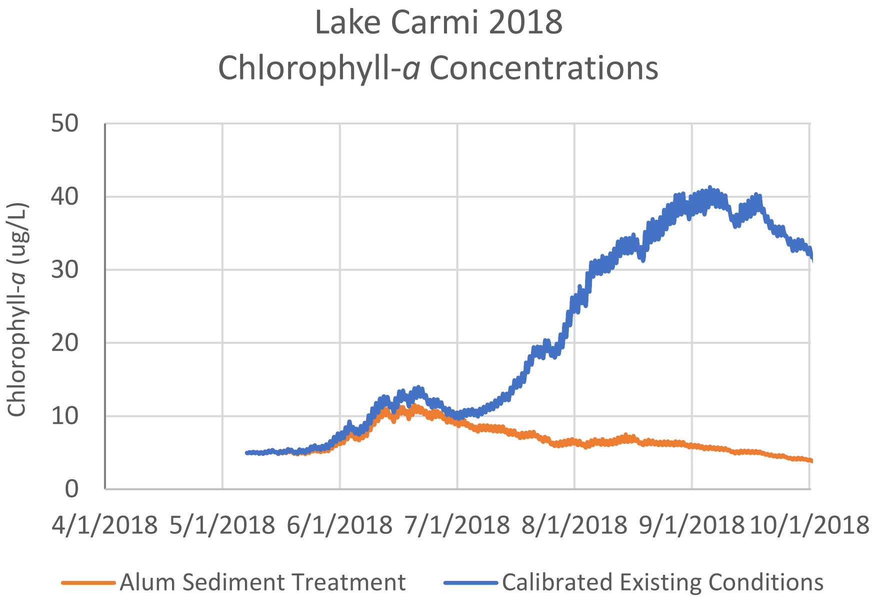
1.5 -> 2.6 meters

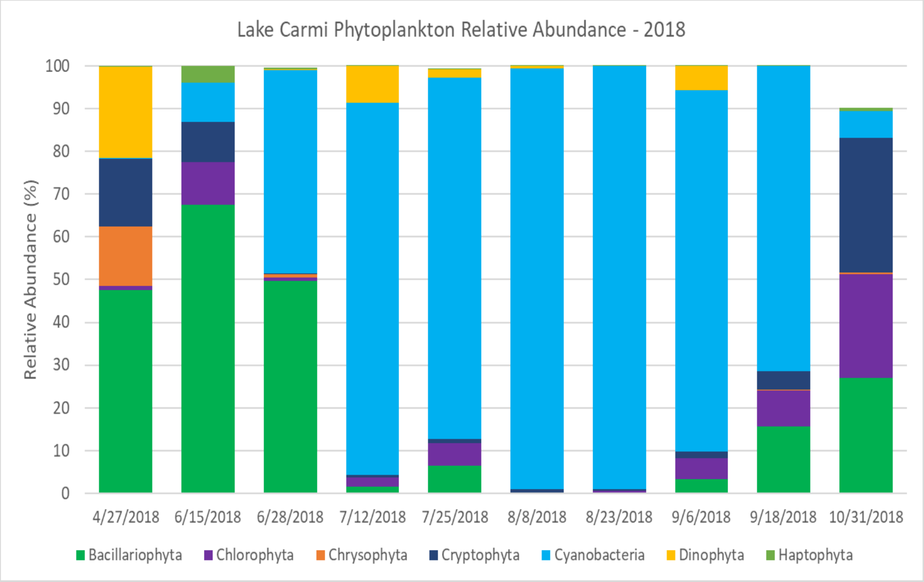
Phosphorus

>50% Reduction

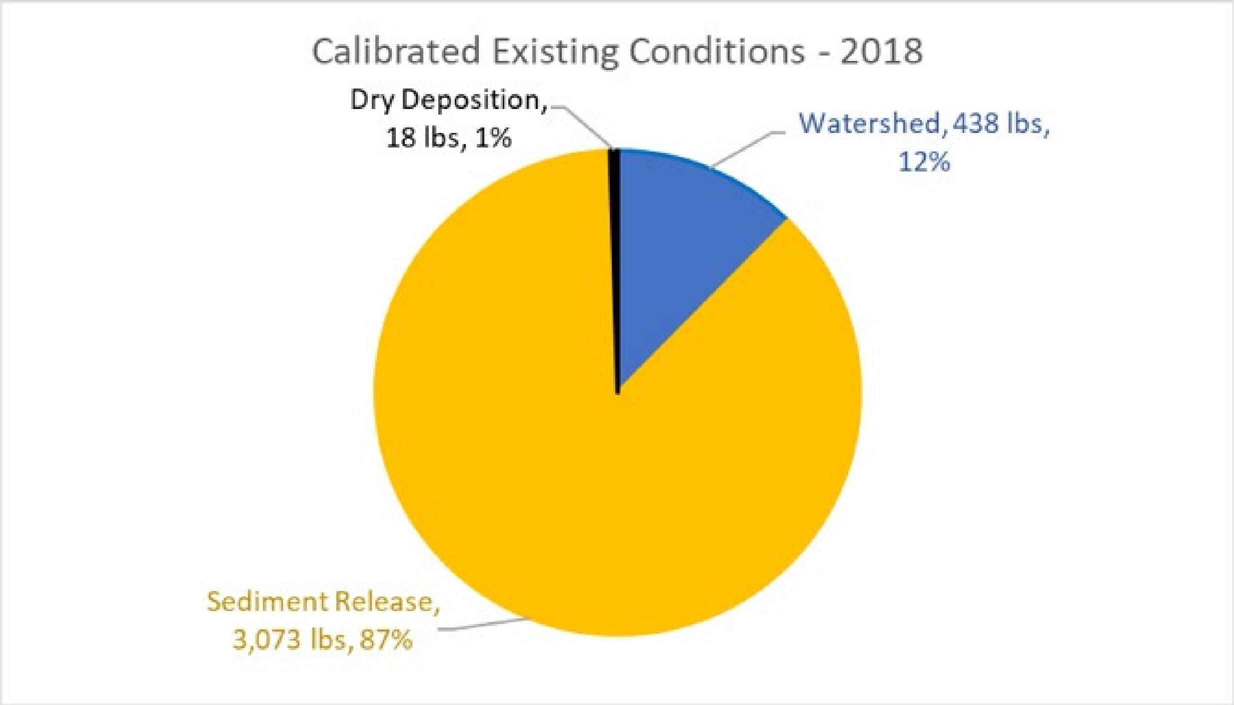
Algae

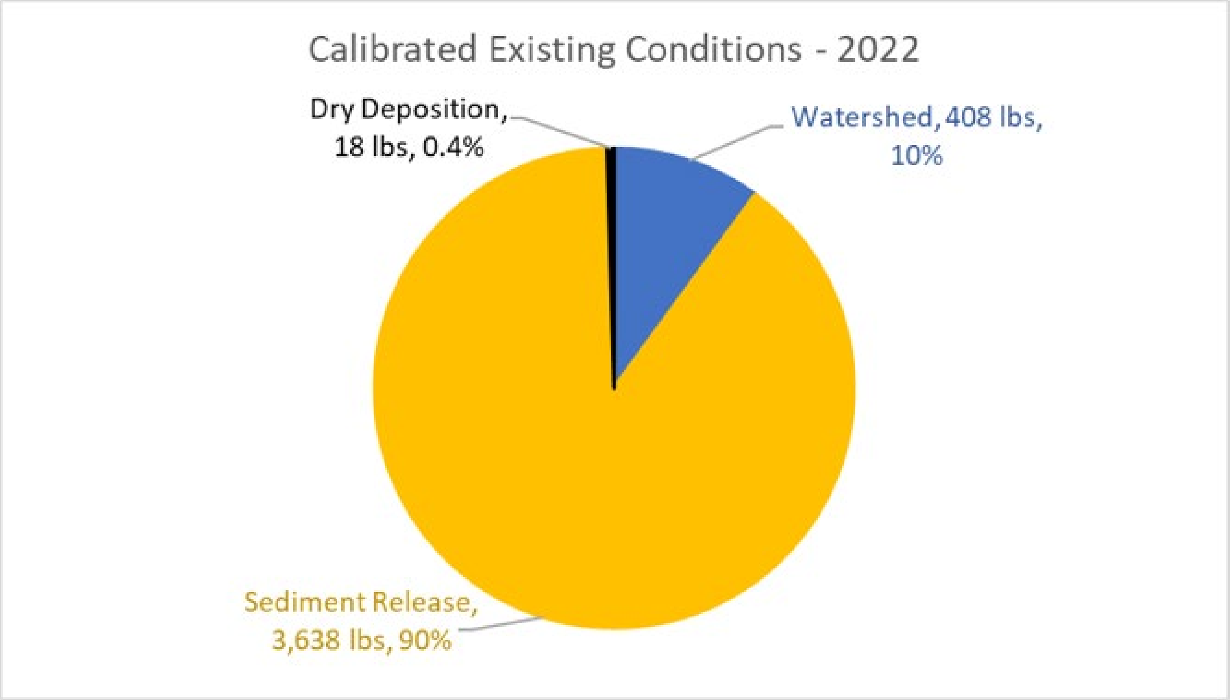
70% reduction





Watershed vs Internal Loads





Watershed vs Internal Loads

Source of Phosphorus Load	Annual Phosphorus Load (kg/year)		
	2018	2022	Average
Watershed Tributaries[1]	605	775	**690**
Septic Loads	15	15	15
Internal Loads	1,451	1,971	**1,711**
Lake Carmi State Park WWTF[2]	0	0	0
Total	2,071	2,761	2,416

29%

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Effects on Fish and Aquatic Plants

Alum Treated Lakes

Lake	Fish Species	Pre-Treatment Mean Weight	Post-Treatment Mean Weight	R^2 Value	Welch Two Sample T-test p-value(1)
Bde Maka Ska	Walleye	1.65 →	2.36	0.1085	No Significant Difference
	LM Bass	0.55	1.82	0.4626	No Significant Difference
Harriet	Walleye	2.6	2.0	0.114	No Significant Difference
	LM Bass	0.64	0.51	0.0036	No Significant Difference
Bald Eagle	Walleye	3.1	2.54	0.0001	No Significant Difference
	LM Bass	0.63	0.48	0.015	No Significant Difference

Lake	Water Quality Parameter	Pre-Treatment Mean	Post-Treatment Mean
Bde Maka Ska	TP	65.5 →	31.5
	Secchi Depth	2.9	4.7
Harriet	TP	88.3	71.6
	Secchi Depth	2.9	4.1
Bald Eagle	TP	72.6	35.1
	Secchi Depth	1.42	2.36

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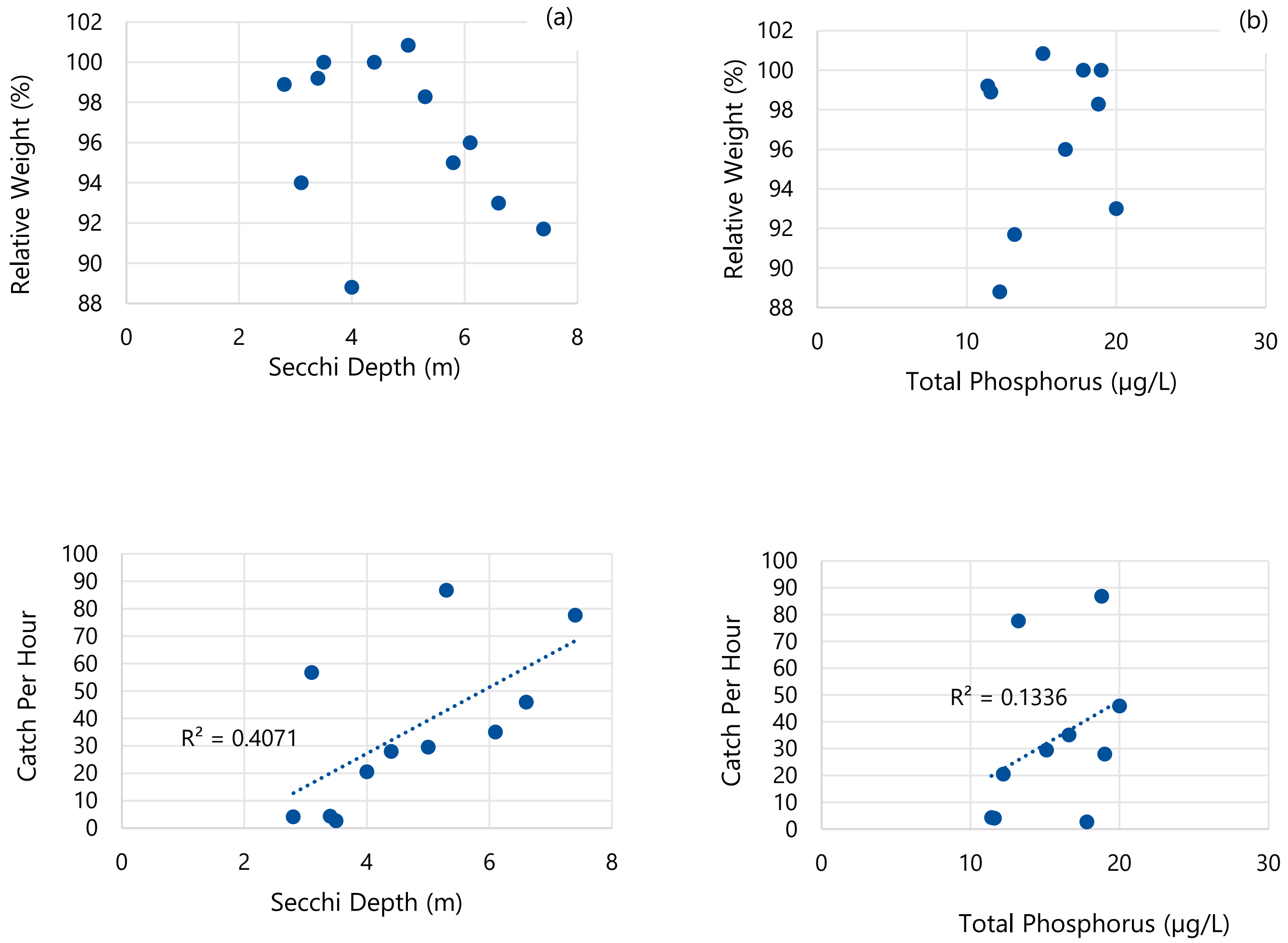
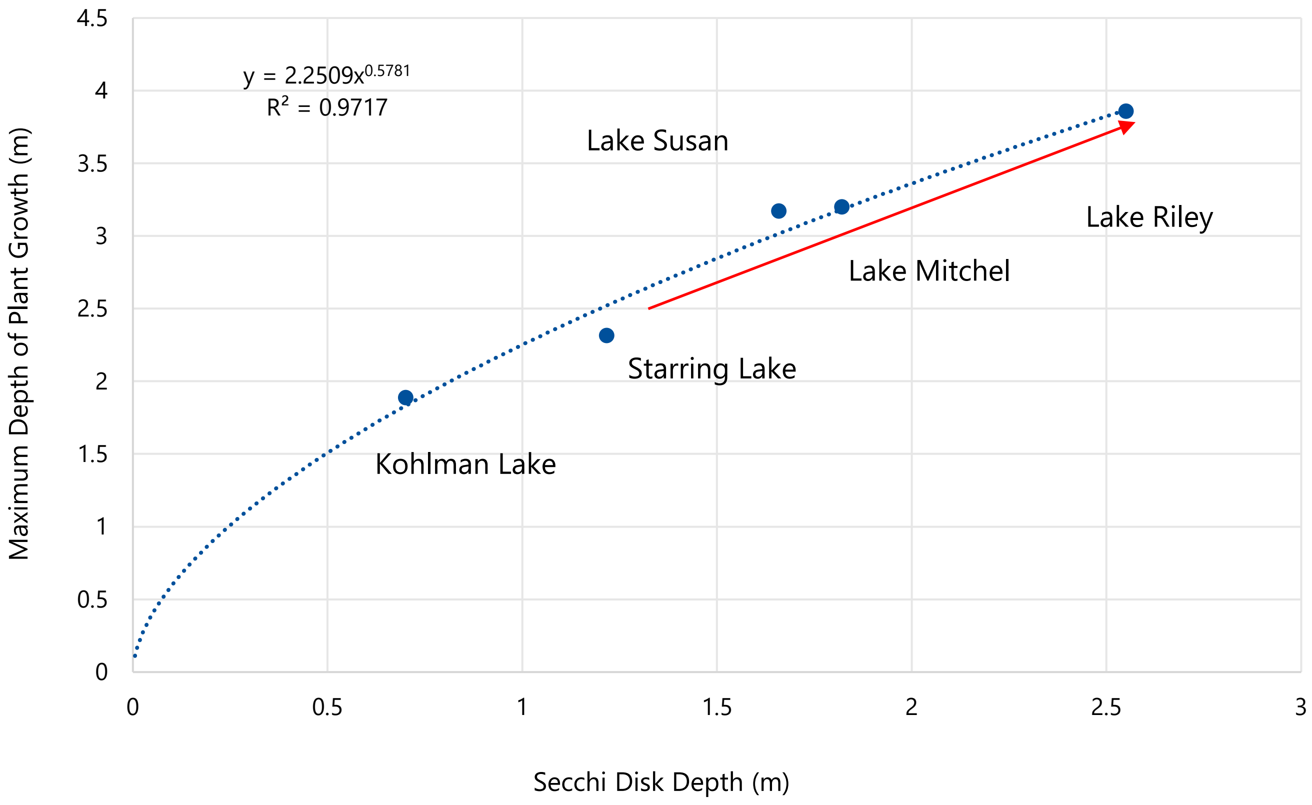
Effects on Fish and Aquatic Plants (Vermont Lakes)

Largemouth Bass



Aquatic Plants



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Conclusions

- Aluminum treatment of lake bottom sediments will be very effective
  - Clarity, cyanobacteria blooms
- Treatment can be conducted as one event or split into two events
  - Timing of funding, permitting
- Do not expect any adverse effects on fish
- Aquatic plants will grow to deeper lake depths

Evaluating the Proposed Use of Alum

- Internal loading is the predominate nutrient source driving eutrophication; i.e., watershed loading has been effectively controlled.
- Proposed dosing concentrations and regime must meet treatment objectives – preventing internal total phosphorus loading for at least ten years;
- Proposed alum treatment can be conducted such that Vermont Water Quality Standards, including the aluminum criteria, are met during and after the treatment;
- Any adjacent wetland functions and values are protected; and
- Fishery and any Rare, Threatened, and Endangered species present are protected.

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NPDES Permitting Requirements

- Alternatives analysis, including different alum dosing concentrations and regimes;
- Proposed dosing regime and ultimate aluminum target concentration;
- Ambient water quality data necessary to conduct a reasonable potential analysis to determine compliance with Vermont Water Quality Standards, including aluminum criteria; and
- Documentation of any Rare, Threatened, or Endangered species in the treatment area.

NPDES Permitting Process and Prospective Timeline

- Project proponent develops and submits application – Summer/Fall 2024
- Wastewater Program reviews application and drafts decision – Fall 2024
- Decision put on 30-day public notice for comment – Winter 2024
- Wastewater Program reviews comments and drafts final decision – Winter 2024/2025
- Wastewater Program issues final decision – Winter 2024/2025

Options for Funding / Financing $2.6M

Clean Water Fund

I. $750,000 Reserved in SFY25 Board-adopted spending plan, pending results of feasibility study.
II. Presently intact in the "Big Bill"
III. CWF will have substantial competing demands in future SFYs
IV. Available 7/1/2024 or thereafter upon Gov. signature

Options for Funding / Financing $2.6M

Clean Water State Revolving Loan Fund

I. Bipartisan Infrastructure Law provides new funding to address emerging contaminants; control of cyanobacterial toxins is an eligible category.
II. 100% subsidy, but a municipality must be applicant.
III. Fund allocated based on prioritized applications
    I. Application period will be early Dec, 2024.
    II. Funds available by late spring, 2025.
IV. This source may have sufficient funding by August, 2025 to cover the full cost after CWF is accounted.

CWSRF is the best option to secure remaining funding

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Options for Funding / Financing $2.6M

Congressionally Directed Spending

I. Direct request to Congressional Delegation
   I. If awarded, funds flow thru Federal budget, to a Fed. Agency, thence to recipient
   II. Application period will open mid winter, 2025
   III. If awarded, funds flow a "few months" after the Federal Budget is signed.

II. Likelihood of success will depend on other applicants and whether a Federal budget is adopted.

CDS is a suitable option to meet needs not met by CWSRF

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Options for Funding / Financing $2.6M

Capital appropriations (this was done for the aeration system)

I. Request to Institutions Committee
II. Would require engagement with DEC, and CW Board to orchestrate request.
III. Feasibility study would need to confirm adequate longevity of treatment.

Capital Appropriation is a fall-back option

Q & A, Other Business

For more information, visit:

https://dec.vermont.gov/watershed/restoring/carmi