

# Restoring Ticklenaked Pond Water Quality: 10+ Years After an Alum Treatment and Agricultural BMPs

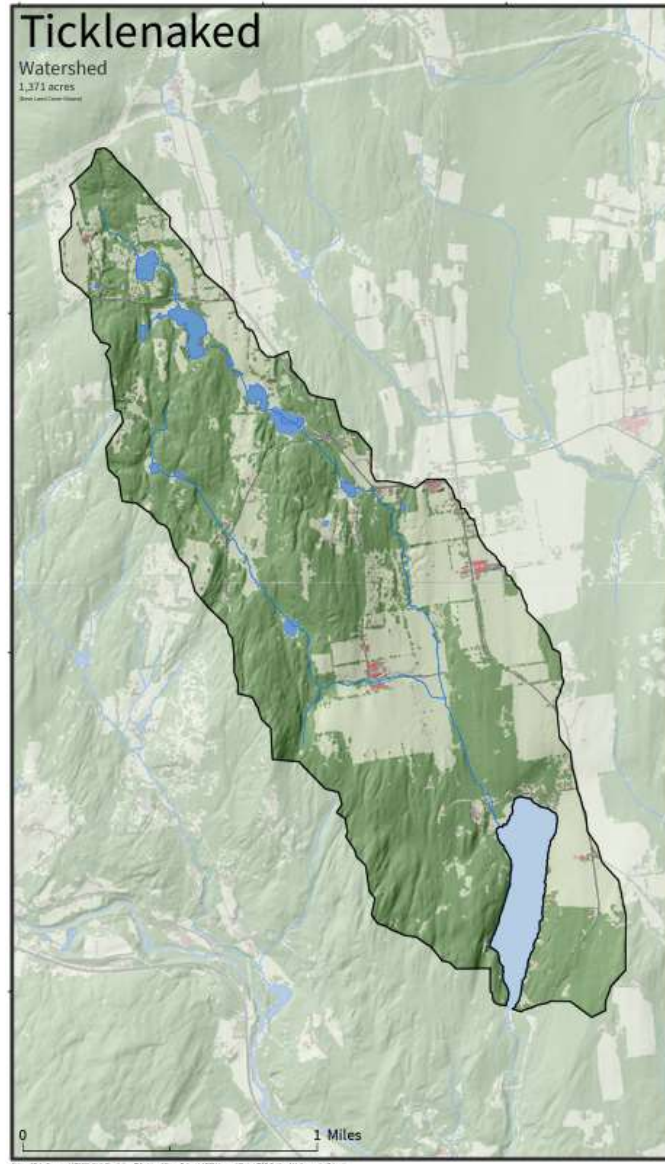
Mark Mitchell, Limnologist

Lake Monitoring and Community Outreach Coordinator

VT DEC Lakes & Ponds Program and UVM Lake Champlain Sea Grant

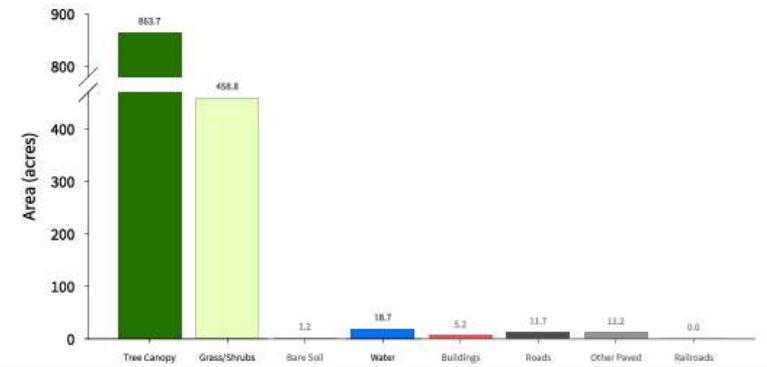
(November 2024)





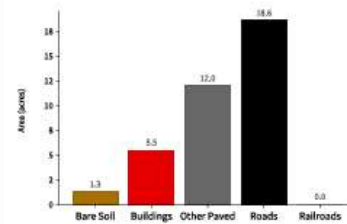
## High-Resolution Land Cover Summary

### Base Land Cover (Top-Down\*)

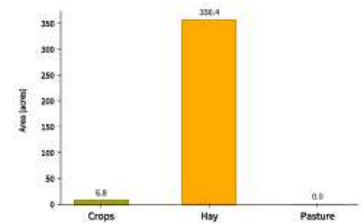


### Supplemental Land Cover

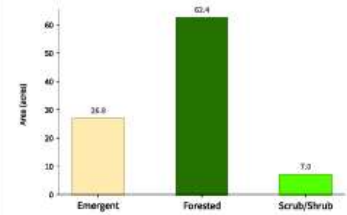
#### Impervious Surfaces (37.25 acres - 2.7% of total) (Bottom-Up\*\*)



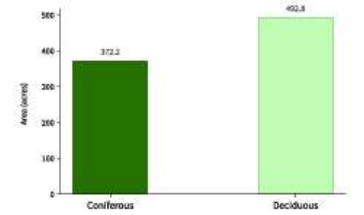
#### Agriculture (363.26 acres - 26.5% of total)



#### Wetlands (96.38 acres - 7% of total)



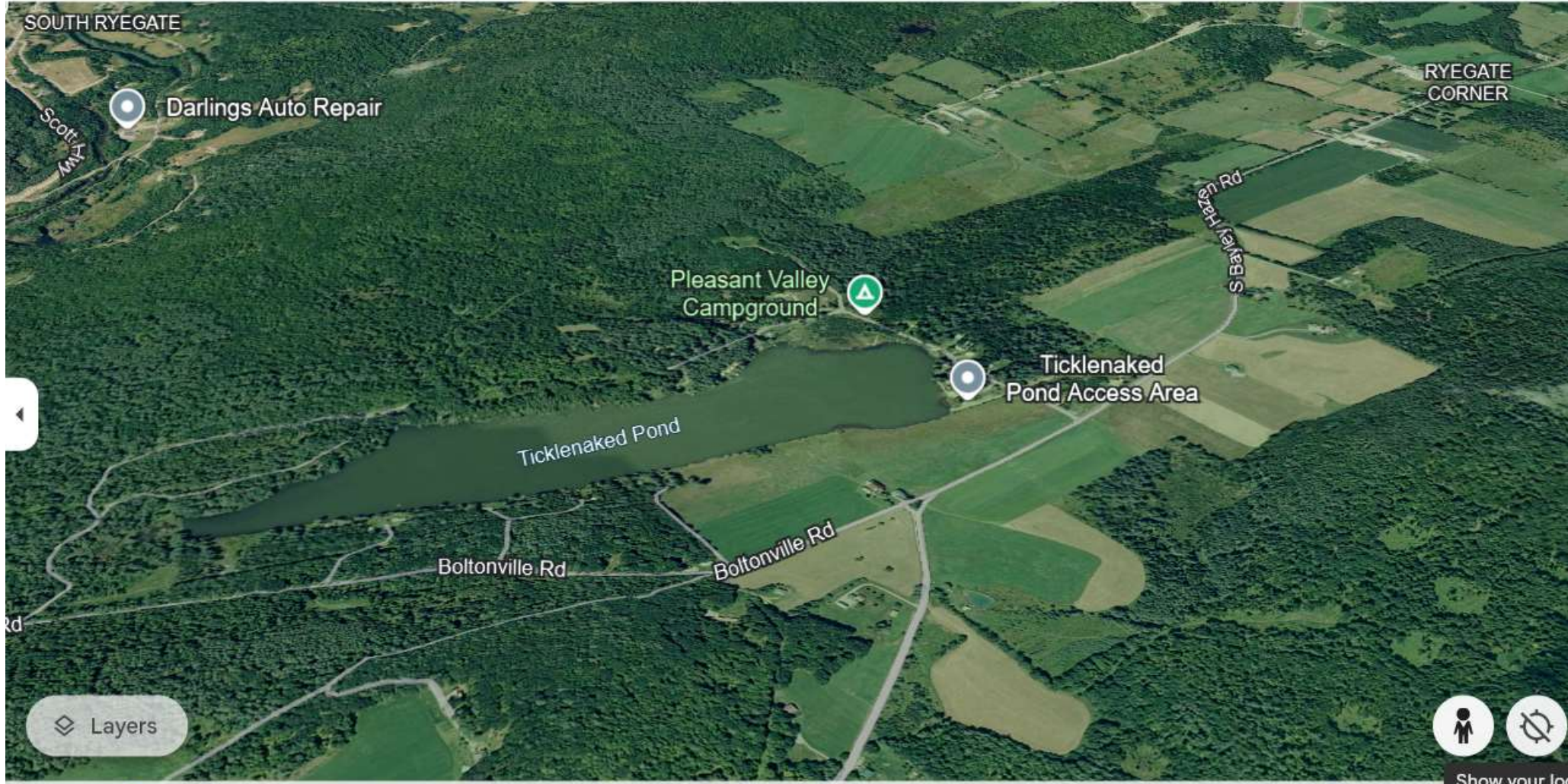
#### Tree Canopy (865.03 acres - 63.1% of total)



\*Top-Down is a bottom-up land cover mapping approach. Land cover is aggregated to the appropriate land cover class.  
 \*\*Bottom-Up is a bottom-up land cover mapping approach. Land cover is aggregated to the base level of land cover data. This approach results in improved mapping of features compared to the top-down approach.



Historical Imagery < 2009-09-20 >



Layers



Show your location

Google 100% Data attribution older-9/20/2009

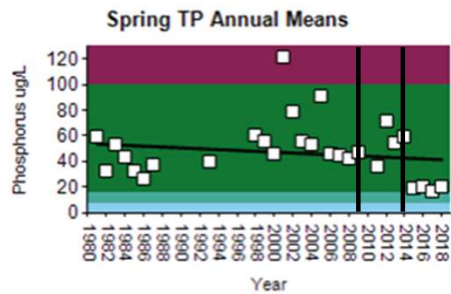
300 m Camera: 1,517 m

# TICKLENAKED - data through 2018

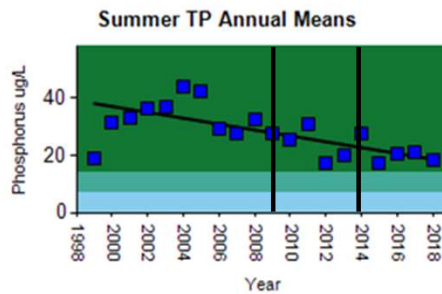
[Learn How Lakes Are Scored](#)



Spring TP Trend:  $p = 0.3428$  | CV = 47  
Stable



Summer TP Trend:  $p = 0.007$  | CV = 30  
Highly significantly decreasing

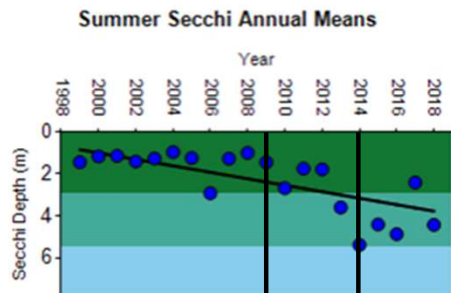


Trend Score: **Good**

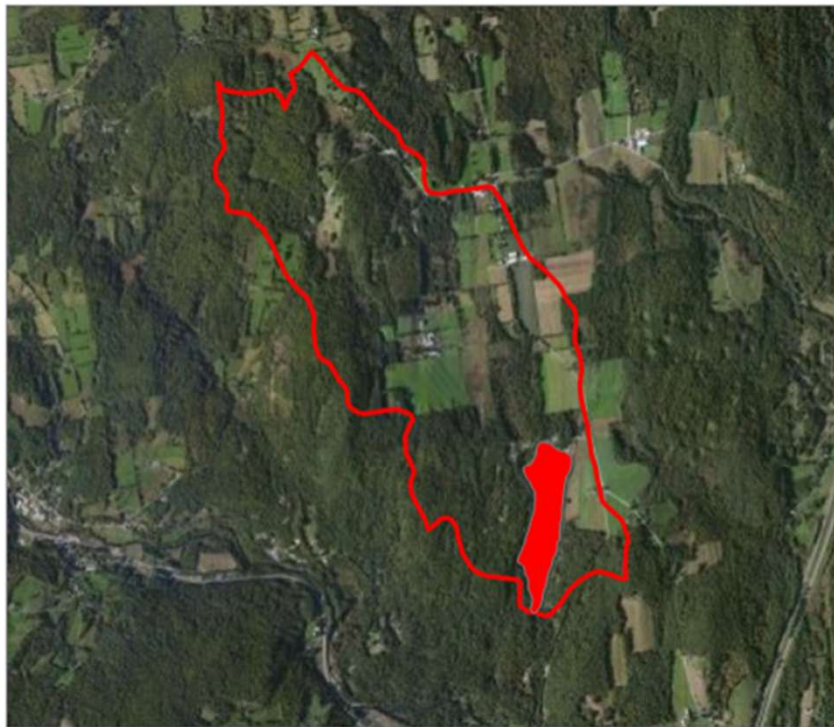
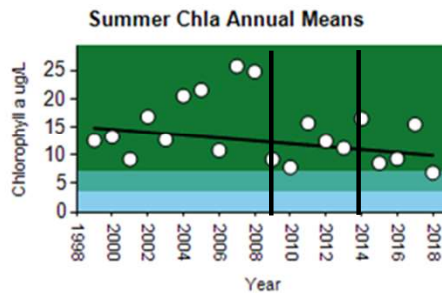
WQ Standards Status: **Impaired**

Watershed Score: **Highly Disturbed**

Summer Secchi Trend:  $p = 0.0011$  | CV = 59  
Highly significantly increasing



Summer Chla Trend:  $p = 0.1955$  | CV = 40  
Stable



Lake Area:  
55 acres  
Basin Lake Area Ratio:  
26  
Max Depth:  
15.5 meters  
Mean Spring TP:  
48.8 ug/L  
Mean Summer TP:  
28.1 ug/L  
Mean Summer Chla:  
14.1 ug/L  
Mean Summer Secchi:  
2.4 meters

Hypereutrophic  
Eutrophic  
Mesotrophic  
Oligotrophic

## Stresses / Impairments

Stressed -- Organic Enrichment - DO

Impaired -- Phosphorus

2008-2009: Phosphorus TMDL and Action Plan  
2014: Aluminum Sulfate (Alum) Treatment (2<sup>nd</sup> in VT)  
2020: Delisted for Phosphorus Impairment (1<sup>st</sup> in VT)

# VT DEC Lakes Lay Monitoring Report

## TICKLENAKED POND

Annual Data (1979- 2018 Station 1 water column)

Year	Days Sampled	Secchi (m)	Secchi View Tube (m)	Chloro-a (µg/l)	Summer TP (µg/l)	Spring TP (µg/l)
1979						31.0
1981						59.0
1982						32.0
1983						53.0
1984						43.0
1985						32.0
1986						26.0
1987						37.0
1993						40.3
1998						60.0
1999	8	1.5		12.5	18.6	55.7
2000	7	1.2		13.2	31.6	46.3
2001	9	1.2		9.1	33.0	122.0

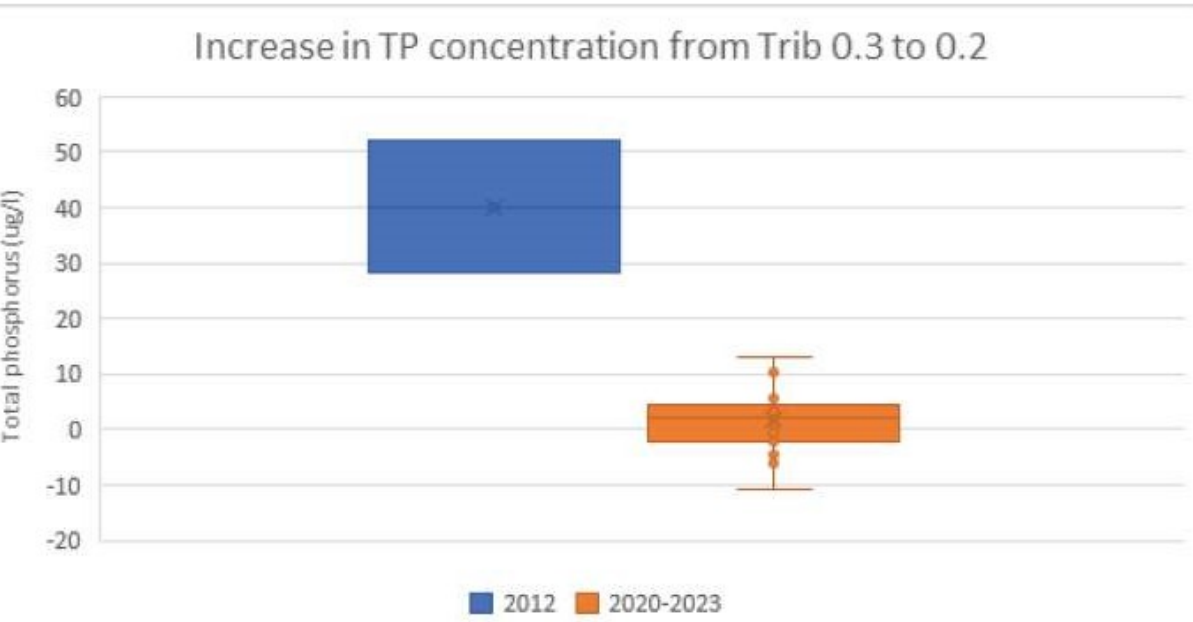
Annual Data (1979- 2018 Station 1 water column)

Year	Days Sampled	Secchi (m)	Secchi View Tube (m)	Chloro-a (µg/l)	Summer TP (µg/l)	Spring TP (µg/l)
2002	9	1.5		16.4	36.2	78.7
2003	9	1.3		12.7	37.1	55.3
2004	9	1.0		20.5	44.0	53.0
2005	9	1.3		21.6	42.1	91.3
2006	10	2.9		10.8	29.4	45.8
2007	9	1.3		25.7	27.7	45.0
2008	10	1.0		24.8	32.2	42.8
2009 (TMDL)	10	1.5		9.7	27.8	46.8
2010	9	2.7		7.8	25.4	
2011	10	1.8		15.7	31.1	36.5
2012	8	1.8		12.4	17.0	72.4
2013	9	3.6		11.2	19.9	54.2
2014 (Alum)	9	5.4		16.5	27.8	59.3
2015	9	4.4		8.5	17.3	19.0
2016	9	4.9		9.3	20.7	22.0
2017	9	2.4		15.5	20.8	16.1
2018	9	4.4		6.8	18.6	19.2

\*Ticklenaked Pond TMDL Target TP Criterion = 24 ug/l

# West Tributary WQ improvements since 2012

Farmstead practices completed after 2012 have significantly reduced phosphorus loading from the tributary.



Samples on this stream were taken just above and below the farmstead.

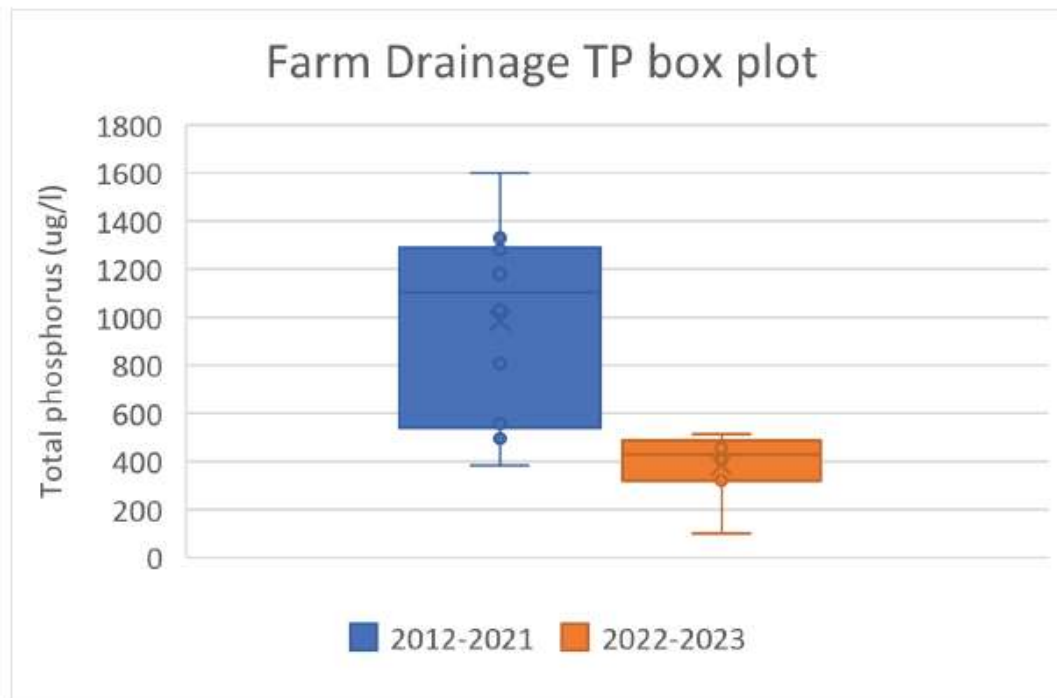
The improvement was evaluated by looking at the reduction in the increase from site 0.3 to 0.2, where this was REDUCED from an average 38ug/l increase in 2012 (126%) to an average 3ug/l increase (16%) in 2023.

# Eastern Farm Drainage WQ Improvements since 2022?

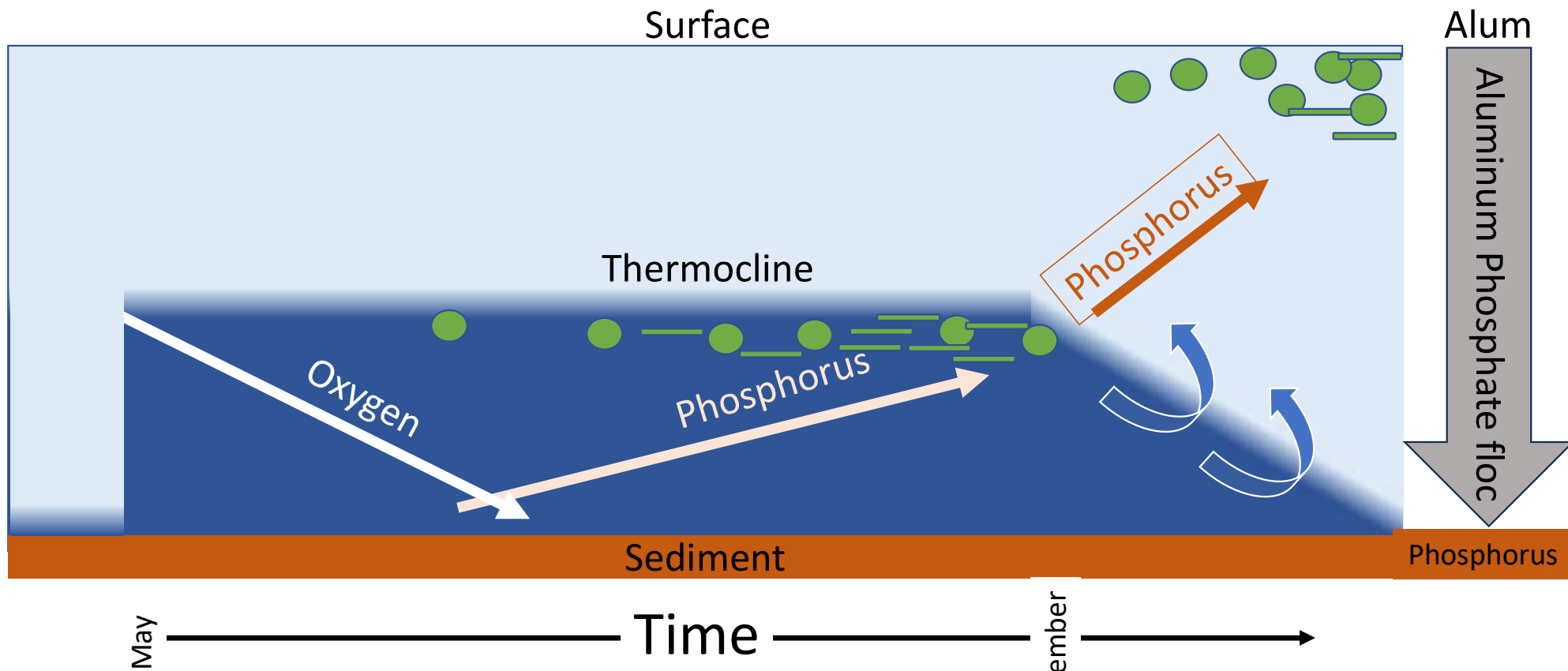


Some indications that farmstead work / management decisions in the Eastern Farm drainage watershed may have reduced phosphorus loading

The average concentration dropped from 1360 in 2012 to 826 in 2020/2021 and 381 in 2022/2023.



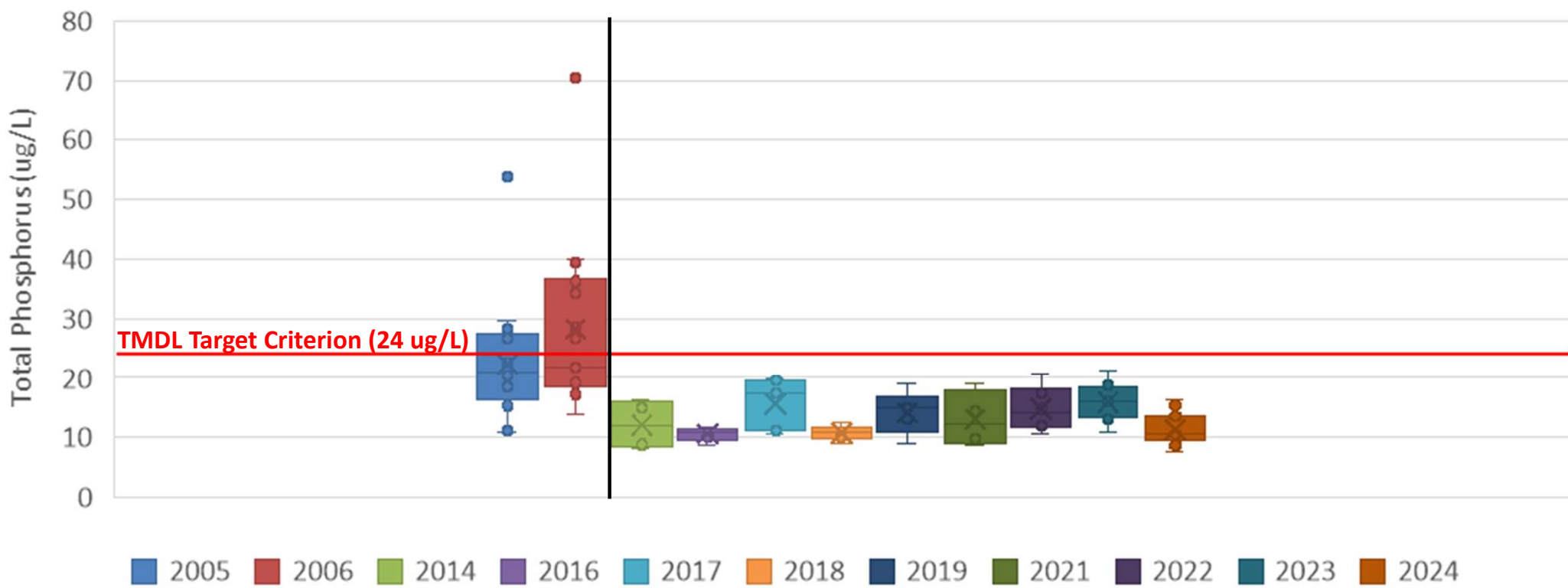
# Internal Phosphorus Loading From Anoxic Sediment + Alum



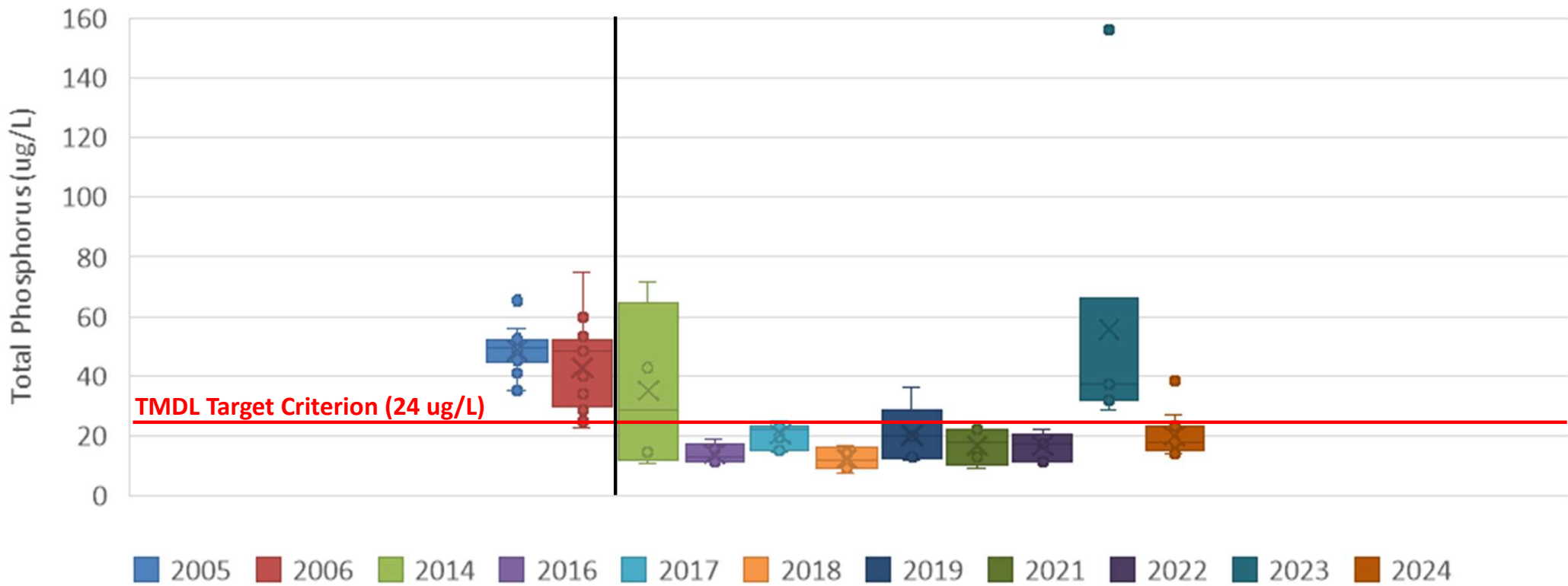
(Image modified from Peter Isles, VT DEC)



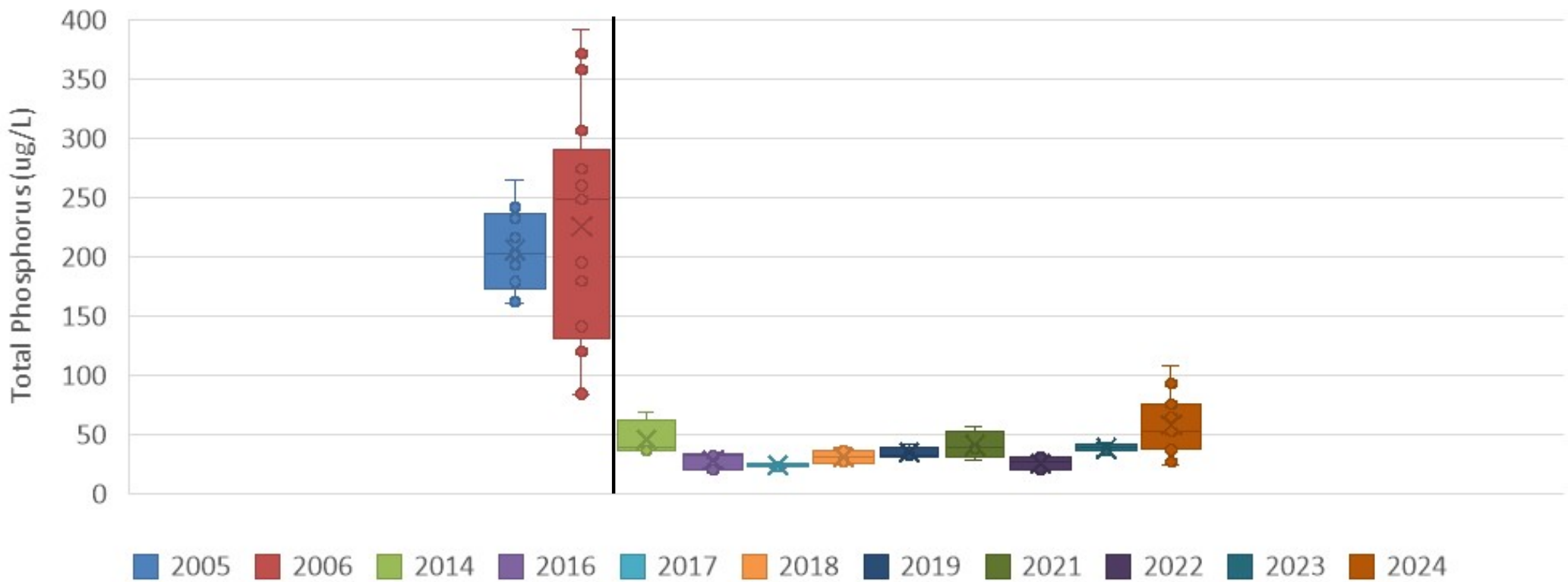
## Ticklenaked Pond Epilimnetic (0.2-1 m) Total Phosphorus: Before (2005-2006) and After (2014-2024) Alum Treatment



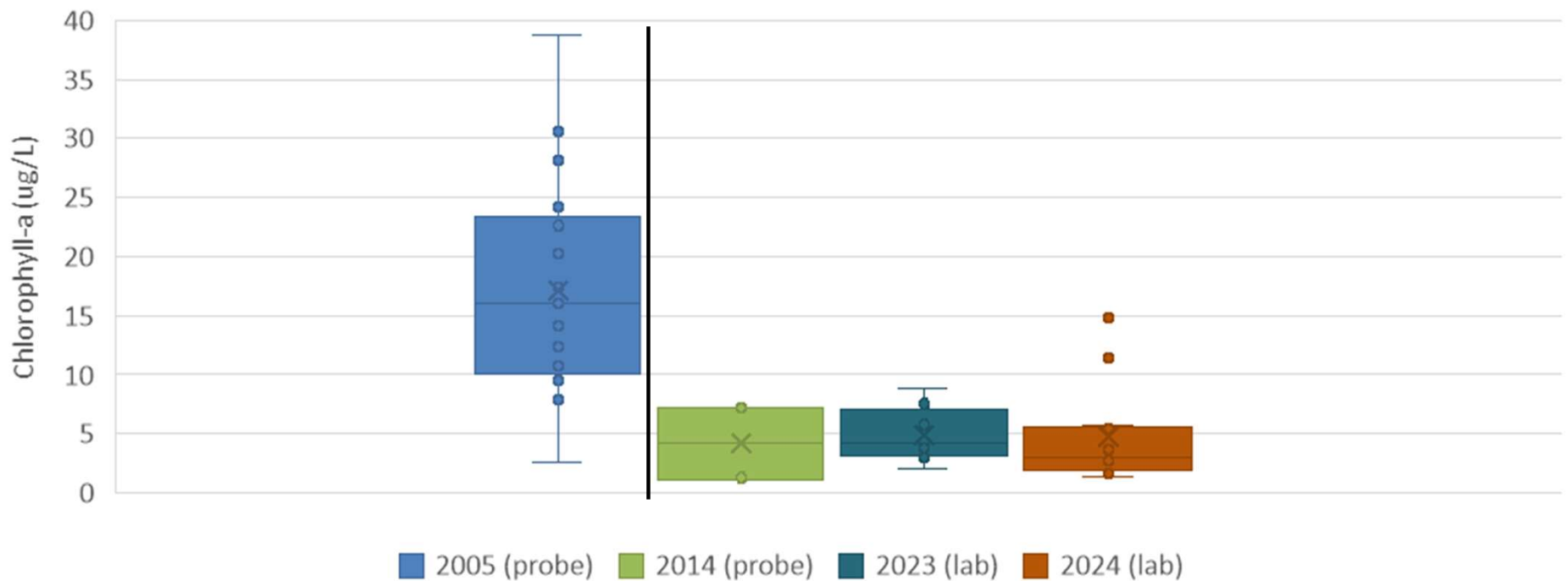
# Ticklenaked Pond Metalimnetic (5-6 m) Total Phosphorus: Before (2005-2006) and After (2014-2024) Alum Treatment



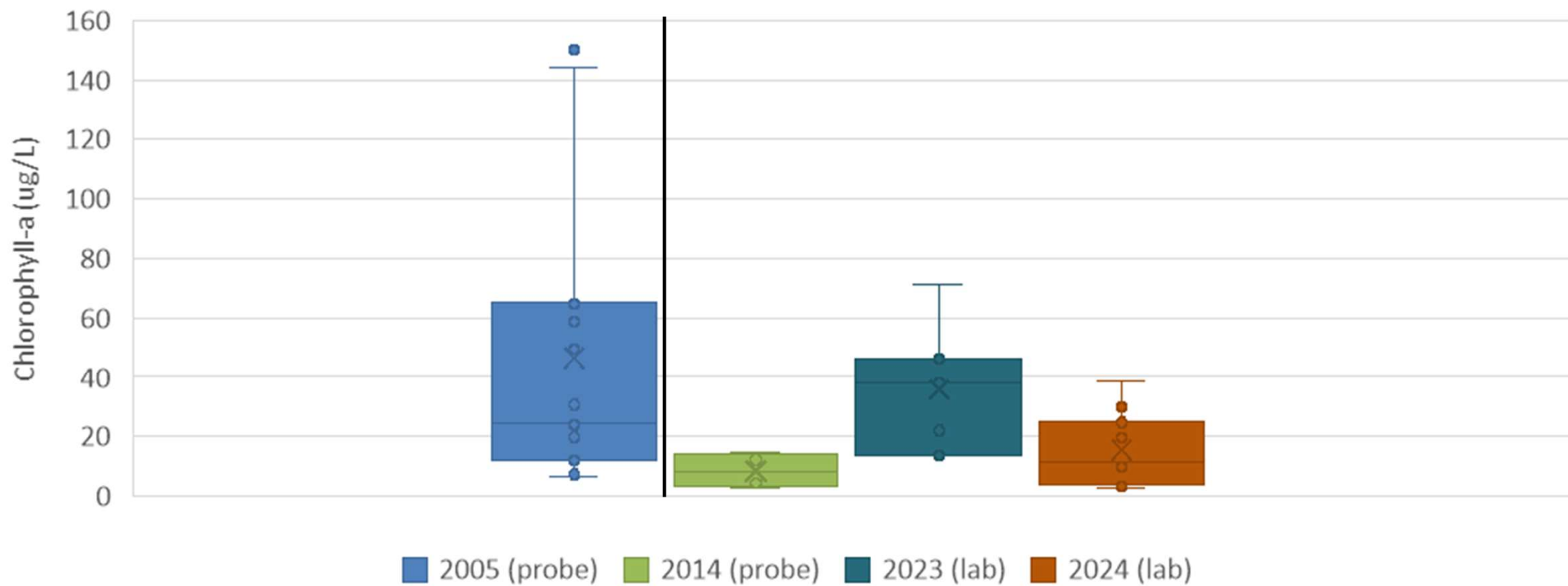
# Ticklenaked Pond Hypolimnetic (12-13 m) Total Phosphorus: Before (2005-2006) and After (2014-2024) Alum Treatment



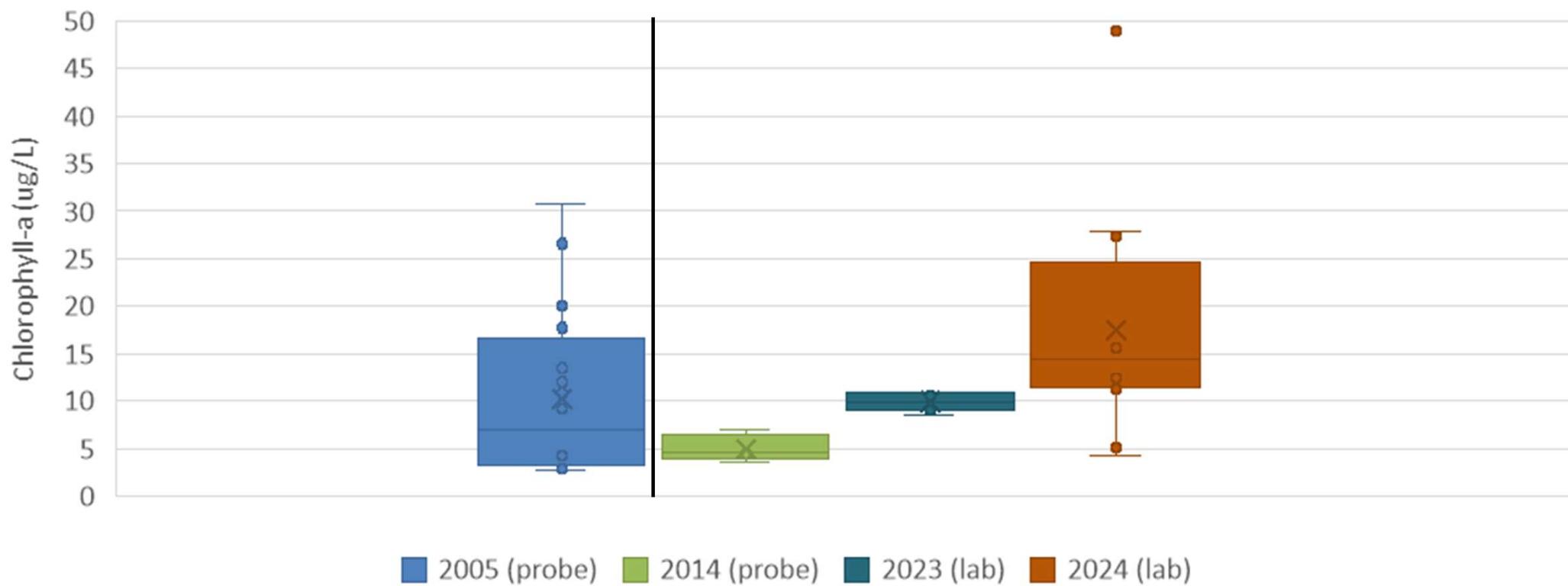
### Ticklenaked Pond Epilimnetic (0.2-1 m) Chlorophyll-a: Before (2005) and After (2014, 2023-2024) Alum Treatment



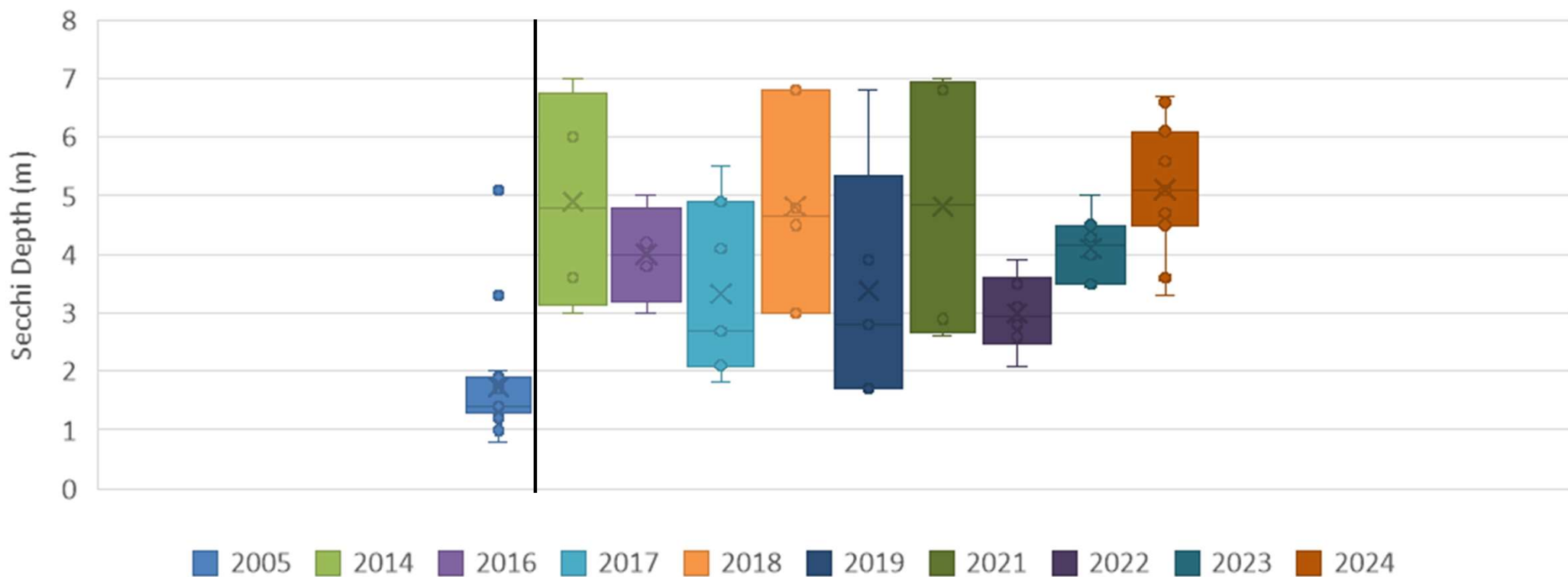
## Ticklenaked Pond Metalimnetic (6 m) Chlorophyll-a: Before (2005) and After (2014, 2023-2024) Alum Treatment



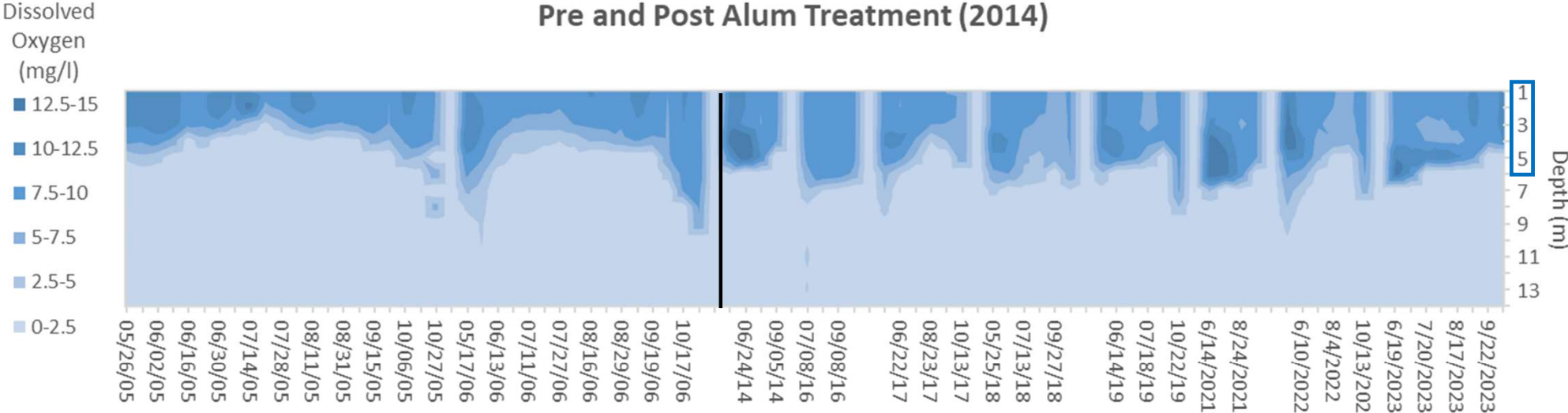
# Ticklenaked Pond Hypolimnetic (12 m) Chlorophyll-a: Before (2005) and After (2014, 2023-2024) Alum Treatment



## Ticklenaked Pond Secchi Transparency: Before (2005) and After (2014-2024) Alum Treatment

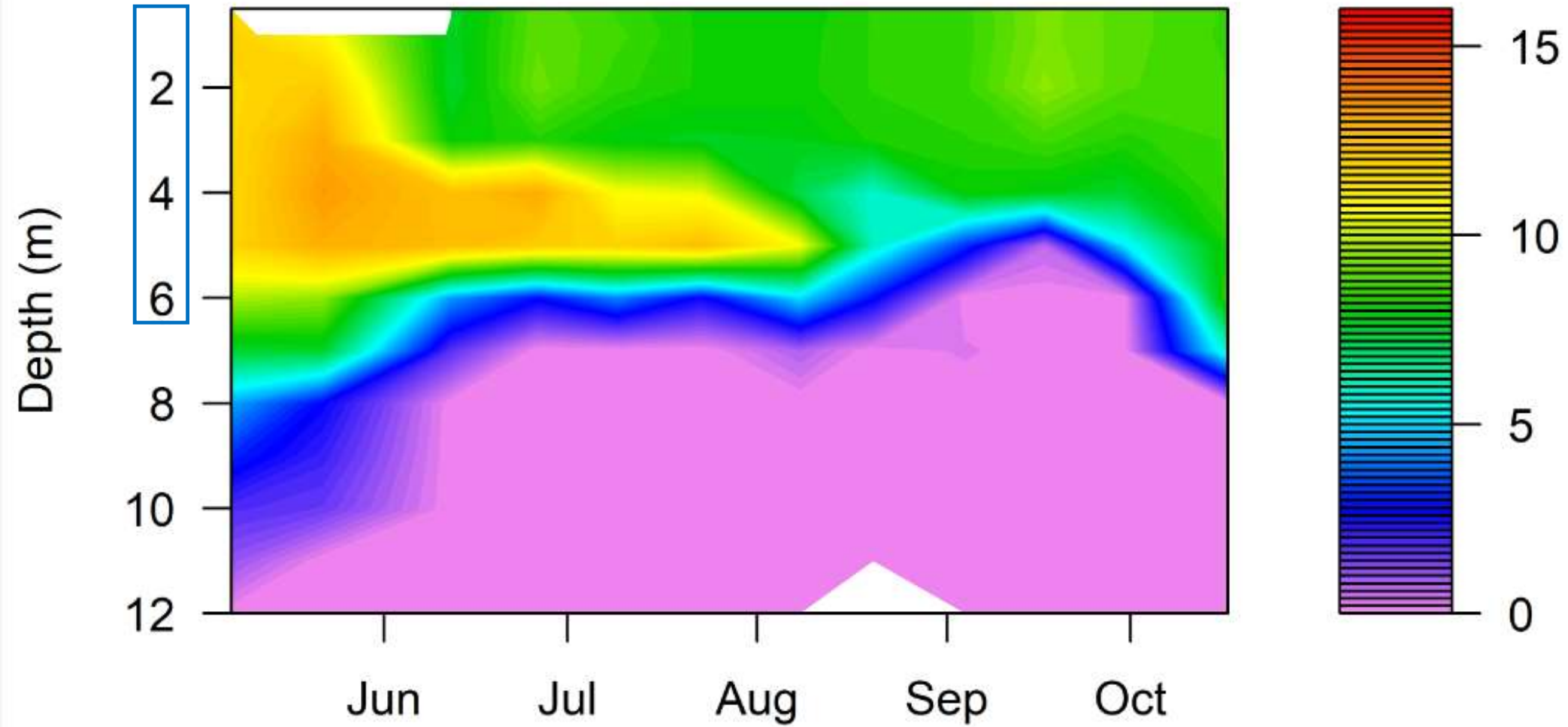


### Ticklenaked Pond Station # 1 Dissolved Oxygen Profiles May-Oct 2005-2006 and 2014-2023: Pre and Post Alum Treatment (2014)





# Ticklenaked 2024 - Dissolved Oxygen (mg/L) LDO (mg/L)



# 2024 Monitoring Summary and Next Steps

- Mean epilimnetic and metalimnetic TP not exceeding TMDL target 24 ug/l
- Mean hypolimnetic TP higher but still well below pre-alum concentrations
- Mean epilimnetic chlorophyll-a continues to be lower (mesotrophic range)
- Mean metalimnetic and hypolimnetic chlorophyll-a are in eutrophic range
- Mean Secchi transparency continues to be higher (mesotrophic range)
- Dissolved oxygen continues to be higher at deeper depths (less hypoxia)
- ID/count phytoplankton samples and compare to 2019 study by UVM
- Continue monitoring and start planning for another alum treatment



Thanks!

Questions?

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