

# Test Results

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In 2023, our water quality testing volunteers focused on four metrics: cyanobacteria, microcystins, phosphorus, and nitrates. The original four tests were recommended to FOLQ by the Massachusetts Department of Public Health. They are the tests MassDPH uses to evaluate whether a cyanobacteria advisory can be lifted. The fifth metric, Secchi Disk Depth, measures lake turbidity, a.k.a. cloudiness, which is an important component of water quality assessments and can correlate to cyanobacteria levels.

Starting in 2024, many more materials were added. A list of these as well as substances tested in prior years is listed to the right. An asterisk (\*) after the material indicates historical data prior to 2021 is also graphed.

Graphs of all test data are presented below. Green areas on the graphs indicate preferable levels for each substance.

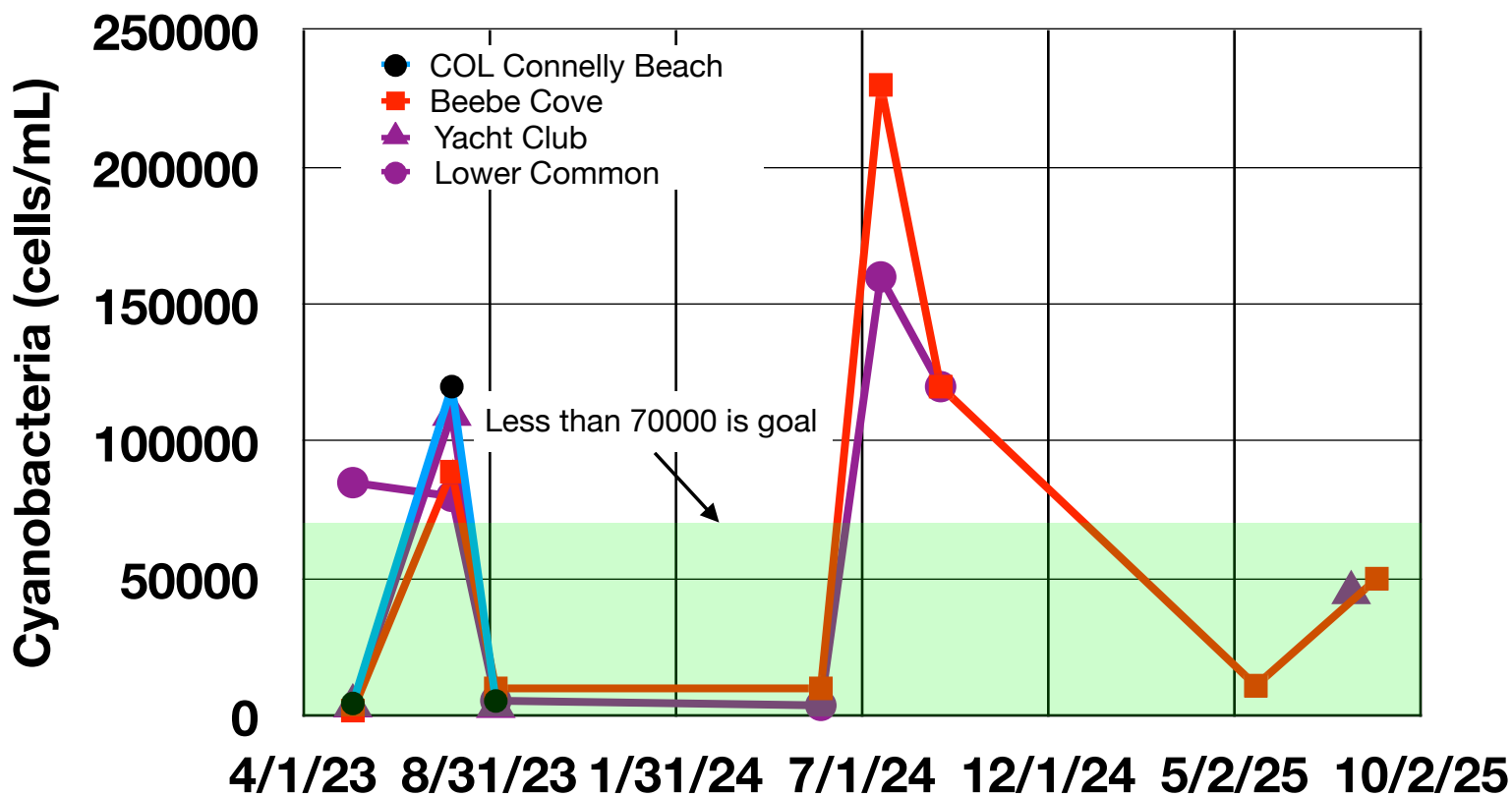
## Substances Tested

1. Cyanobacteria
2. Microcystins
3. Total Phosphorus\*
4. Reactive Soluble Phosphorus and Orthophosphate
5. Nitrates and Nitrites\*
6. Total Kjerdahl Nitrogen
7. Secchi Disk Depths\*
8. Trophic State Index (TSI)\*
9. Alkalinity\*
10. Dissolved Oxygen\*
11. pH\*
12. Chloride\*
13. Chlorophyll a\*
14. Sample (Water) Temperature\*
15. Arsenic
16. Sodium
17. Sulfate, (SO<sub>4</sub>,2-)
18. Calcium
19. Conductivity
20. Fluoride
21. Hardness
22. Iron
23. Magnesium
24. Manganese
25. Total Coliforms
26. E. coli
27. Lead
28. Total Dissolved Solids

# 1. Cyanobacteria

Cyanobacteria cell counts are a measurement of the combined level of all species of cyanobacteria (also known as blue-green algae). Cyanobacteria are a water quality and public health concern for many lakes and ponds in Massachusetts. They can produce toxins, including Microcystins (a liver toxin). The goal is to reduce the counts to below 70,000 cells/mL. The cell counts in August 2023 and July and September 2024 are higher than that goal.

### Cyanobacteria, 2023 - 2025



## 2. Microcystins

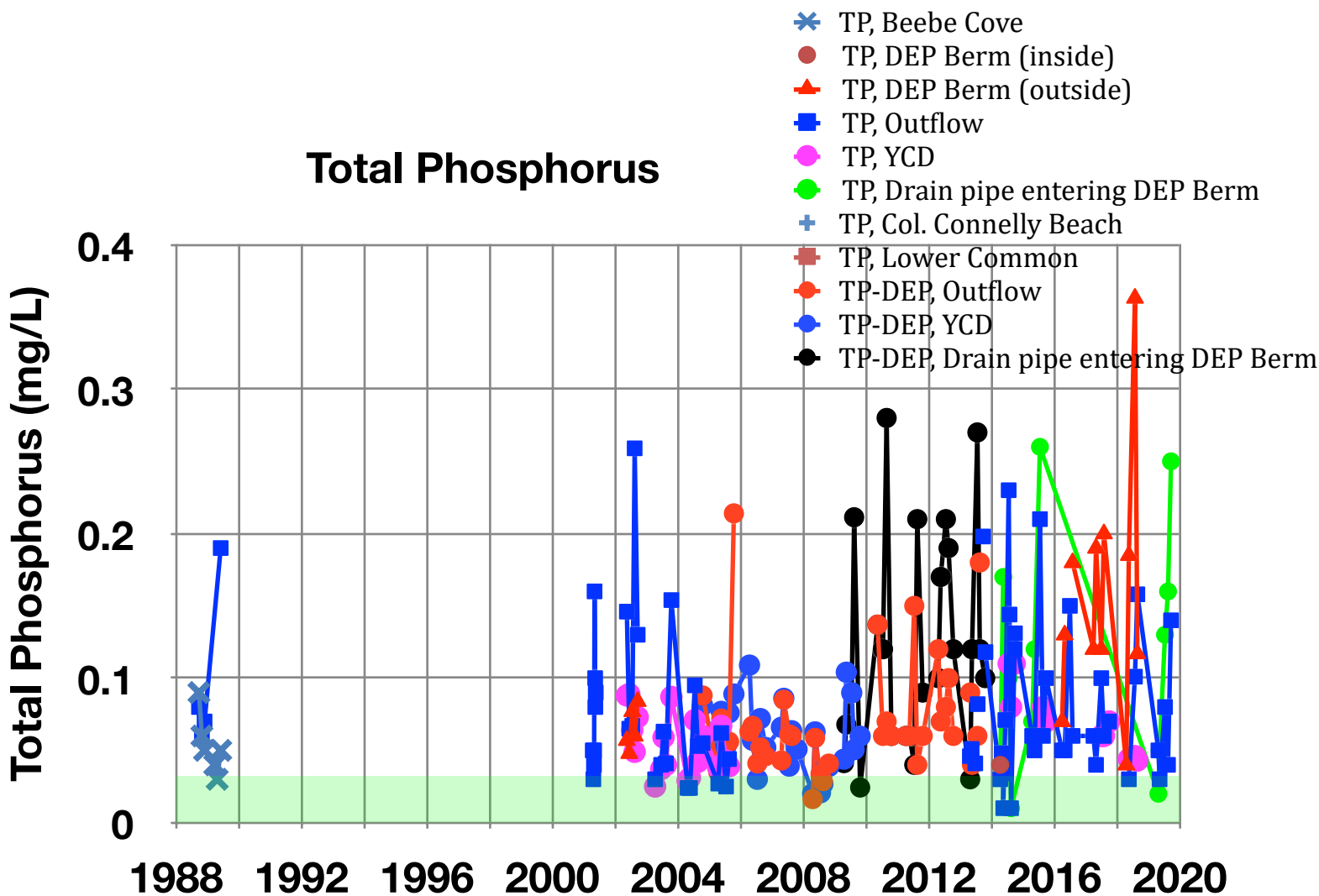
Microcystins are the most common class of toxins formed by cyanobacteria. Massachusetts DPH recommendations for microcystins are a public health advisory if the level is >8ug/L, and no contact with water if the level is >14ug/L. The boxes in the table below marked in red have levels >5ug/L, and are thus of some concern.

### Microcystins, 2023 - 2025

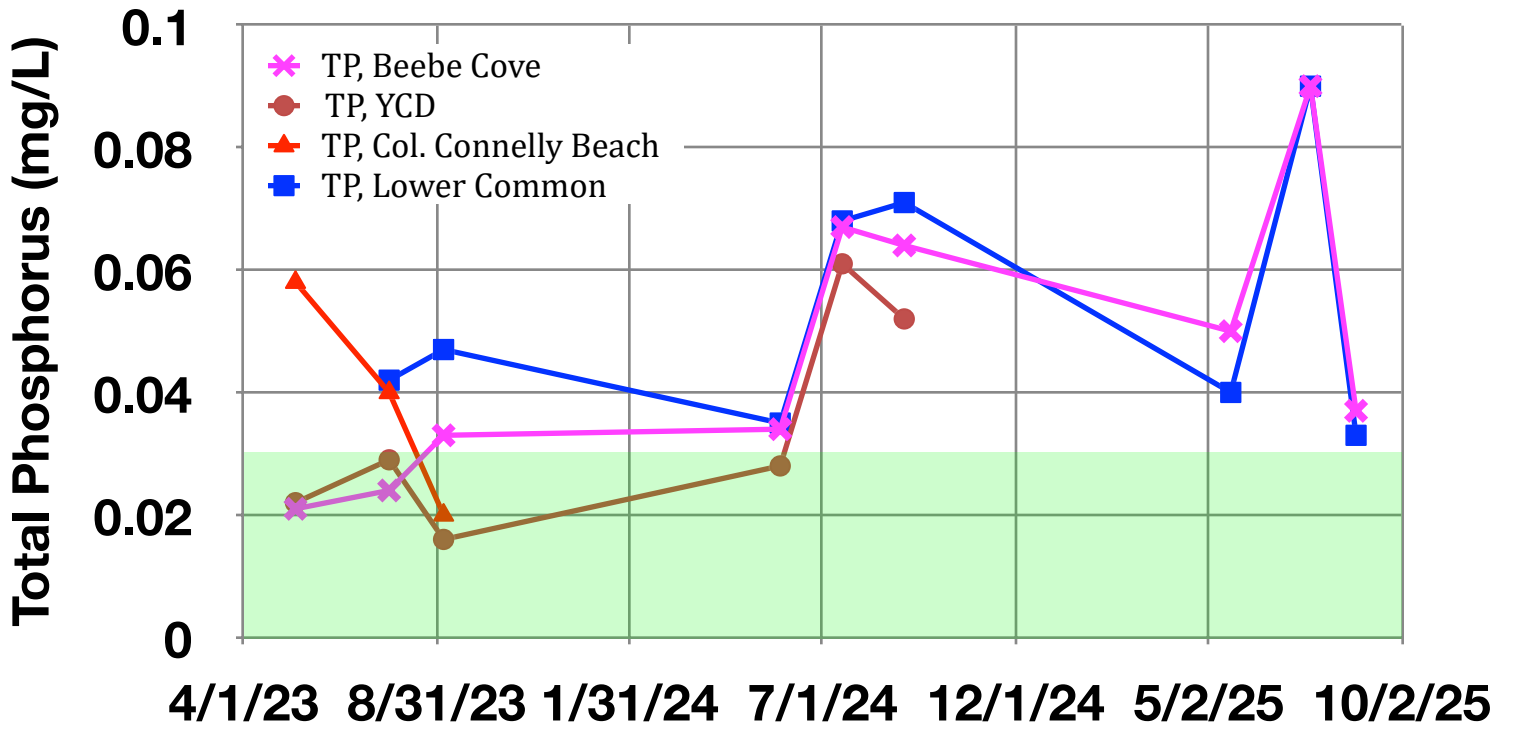
	CC (ug/L)	BC (ug/L)	YC (ug/L)	LC (ug/L)
<b>5/12/23</b>	<1	<1	<1	>5
<b>8/1/23</b>	>5	2.5 to 5	>5	2.5 to 5
<b>9/6/23</b>	1	<1	<1	2.5 to 5
<b>5/29/24</b>		2.5		2.5
<b>7/17/24</b>		>5		>5
<b>9/4/24</b>		4		3
<b>5/20/25</b>		2.5		
<b>8/6/2025</b>			1	
<b>8/27/25</b>		2		

### 3. Total Phosphorus

Phosphorus is an important nutrient for algae and cyanobacteria. We measure Total Phosphorus, which includes both organic and inorganic forms of phosphorus. Historically, phosphorus levels have been very high, and this contributes to algae blooms, since phosphorus is believed to be the limiting nutrient for cyanobacteria. A goal is to reduce the phosphorus levels to below 0.03mg/L, since this should eliminate the algae blooms.



# Total Phosphorus, 2023 - 2025

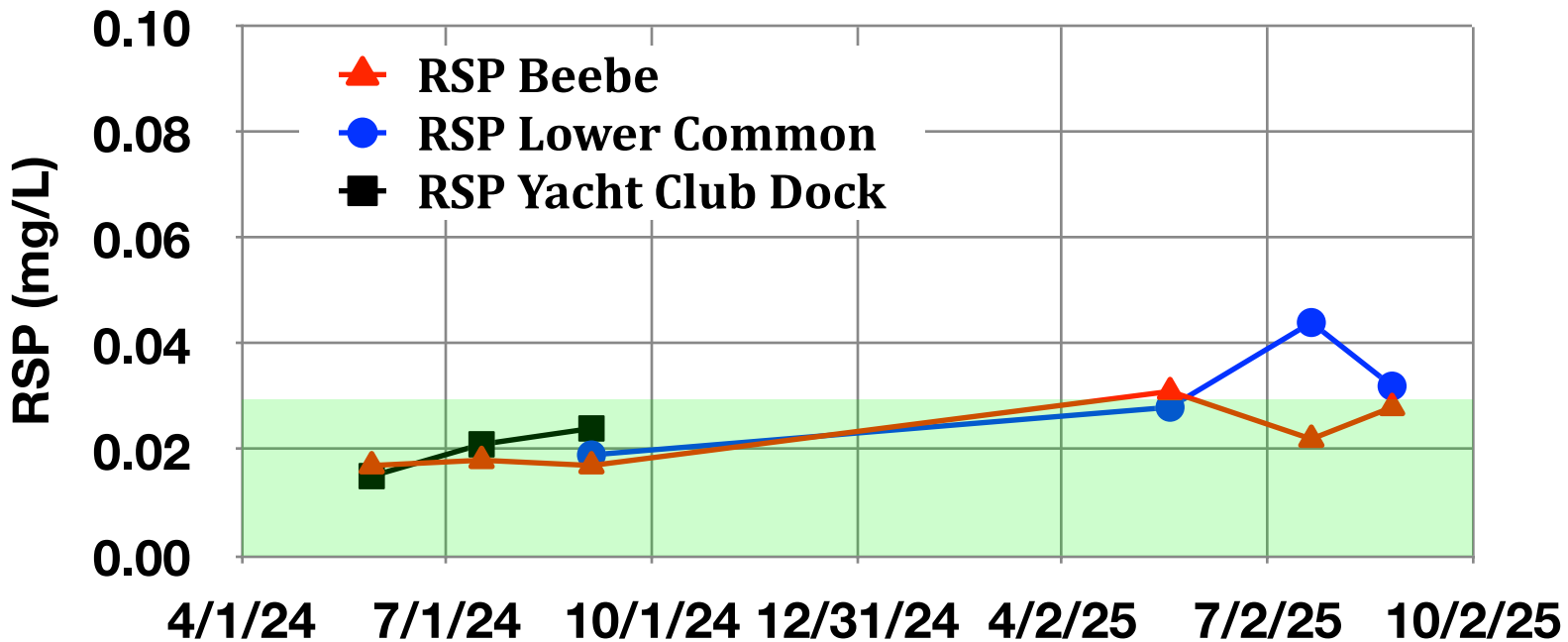


# 4. Reactive Soluble Phosphorus (RSP) and Orthophosphate

Reactive Soluble Phosphorus, or RSP, is the fraction of the total phosphorus that can pass through a filter and react with chemical reagents in the test. It is considered “immediately bioavailable”, that is, it can easily be taken up by plants and algae.

Orthophosphate (as P) levels were below detection limits in 2024 and 2025.

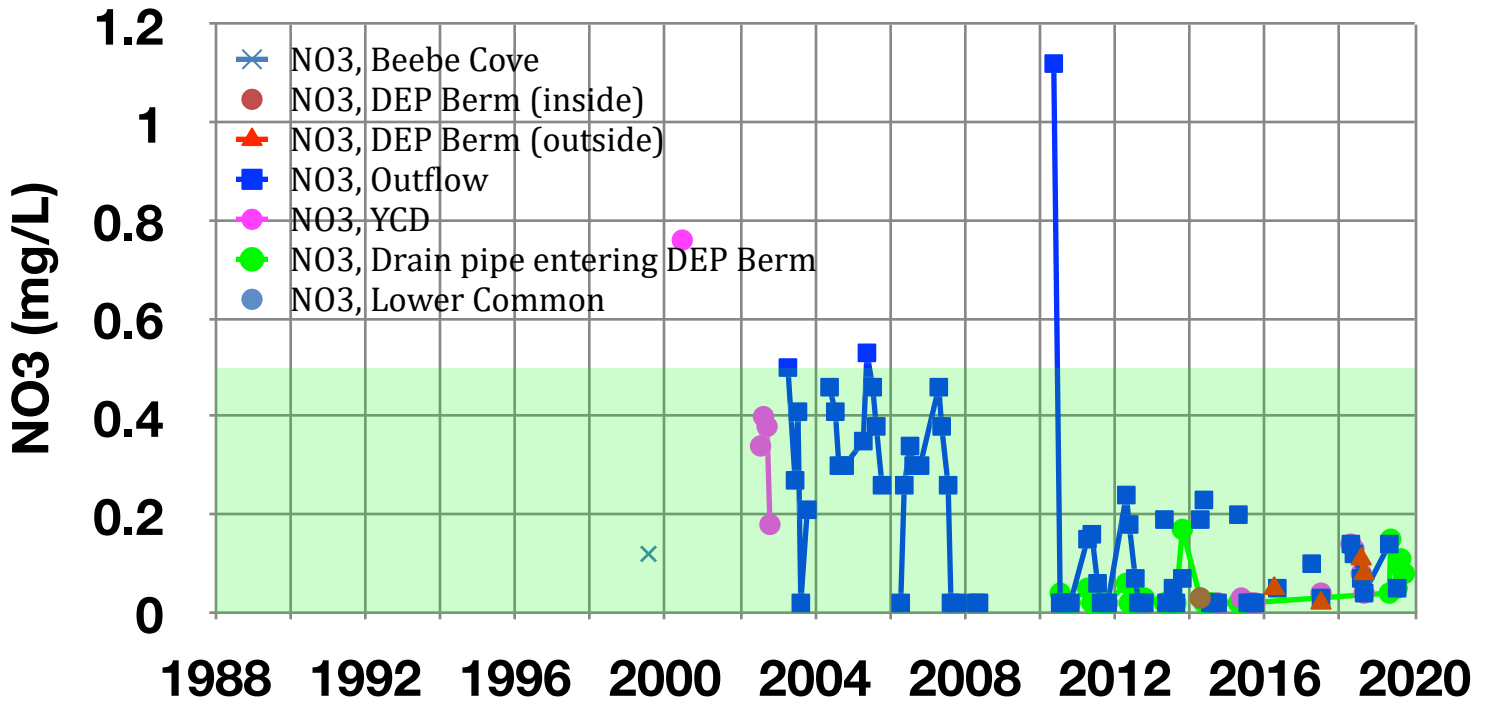
### Reactive Soluble Phosphorus (RSP), 2024 - 2025



# 5. Nitrates and Nitrites

Nitrogen is a nutrient needed by cyanobacteria. Some cyanobacterial species can fix atmospheric nitrogen, while others obtain it from organic nitrogen, ammonium, nitrate, or nitrite ions. The levels of nitrates recorded have been acceptable (<0.5mg/L). The nitrite levels were below detection limits in 2024 and 2025.

## Nitrate (NO3)



## Nitrate (NO3), 2023 - 2025

Date	CC (mg/L)	BC (mg/L)	YC (mg/L)	LC (mg/L)
5/12/23	ND	ND	ND	0.05
7/25/23	ND	ND	ND	ND
9/6/23	ND	ND	ND	ND
5/29/24		0.09		
7/17/24		ND, <0.04		
9/4/24		ND, <0.04		
5/20/25		0.15		0.16
7/22/25		ND, <0.5		ND, <0.5
8/27/25		ND, <0.5		ND, <0.5

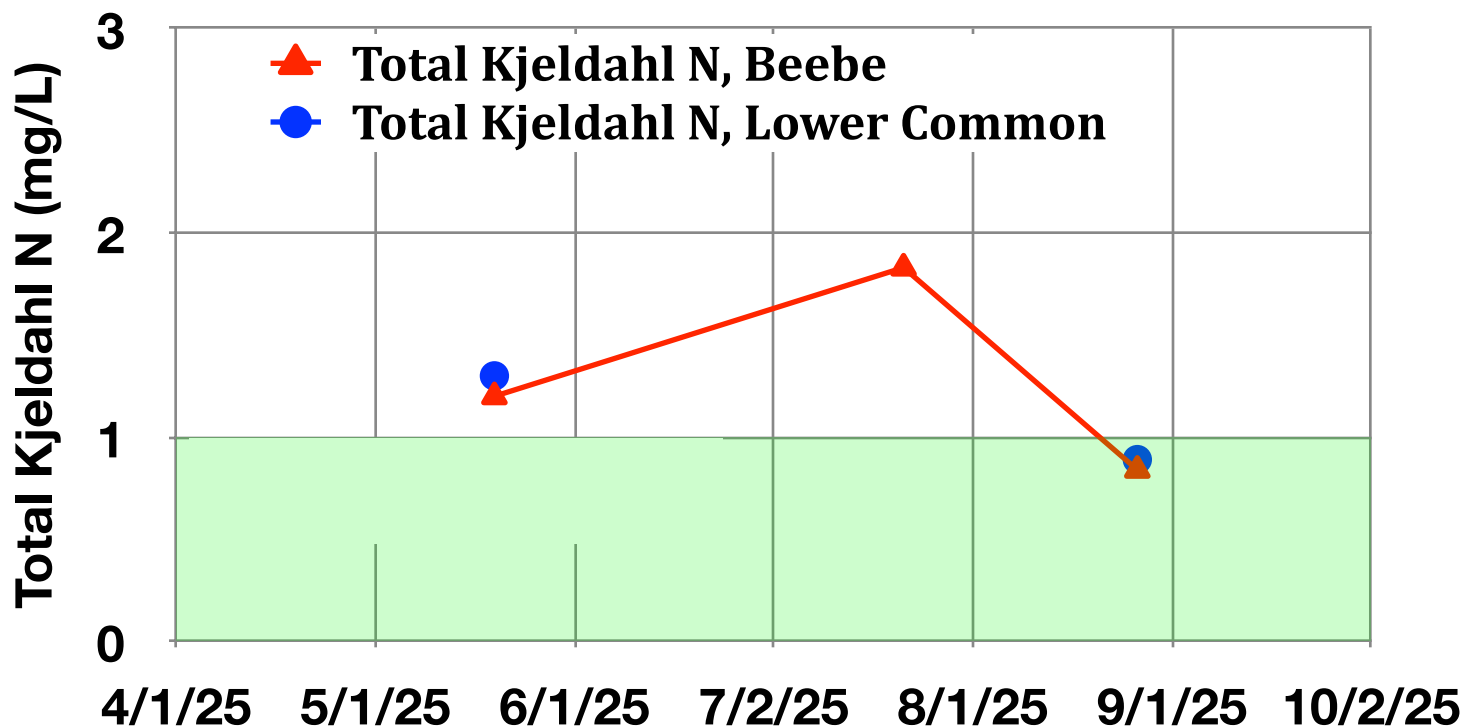
## 6. Total Kjeldahl Nitrogen

Total Kjeldahl nitrogen consists of organic nitrogen (nitrogen contained within organic molecules of living or dead organisms) plus ammonia (NH<sub>3</sub>) and ammonium (NH<sub>4</sub><sup>+</sup>). The total nitrogen consists of the total Kjeldahl nitrogen plus nitrates and nitrites.

Interpreting TKN values (from AI)

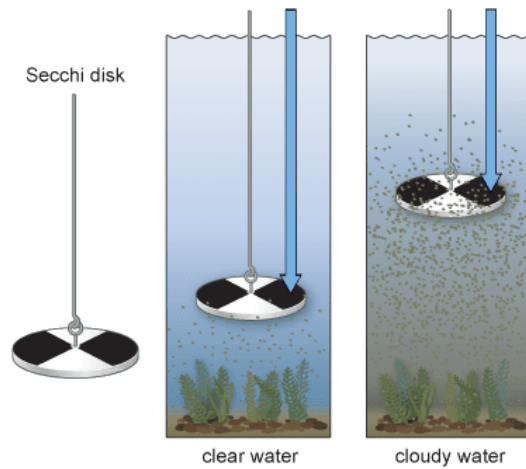
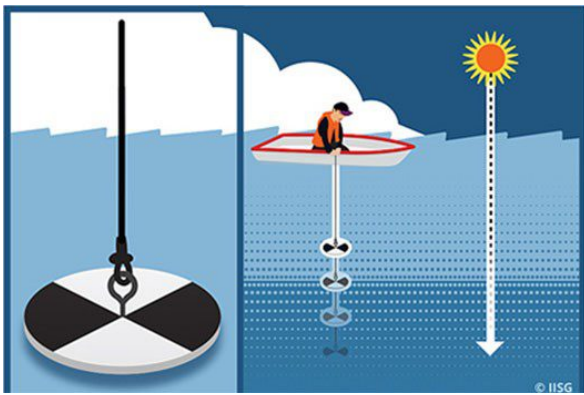
- Less than 1 mg/L: Generally considered a good value, indicating low organic nitrogen and ammonia.
- 1–2 mg/L: May indicate some level of nutrient input, and you should look for other indicators of water quality.
- 2–10 mg/L: Suggests a potential problem with nutrient pollution, which can lead to algal blooms and lower oxygen levels.
- Above 10 mg/L: This is considered high and indicates significant pollution from sources like sewage, agriculture, or urban runoff.

### Total Kjeldahl Nitrogen (TKN), 2025

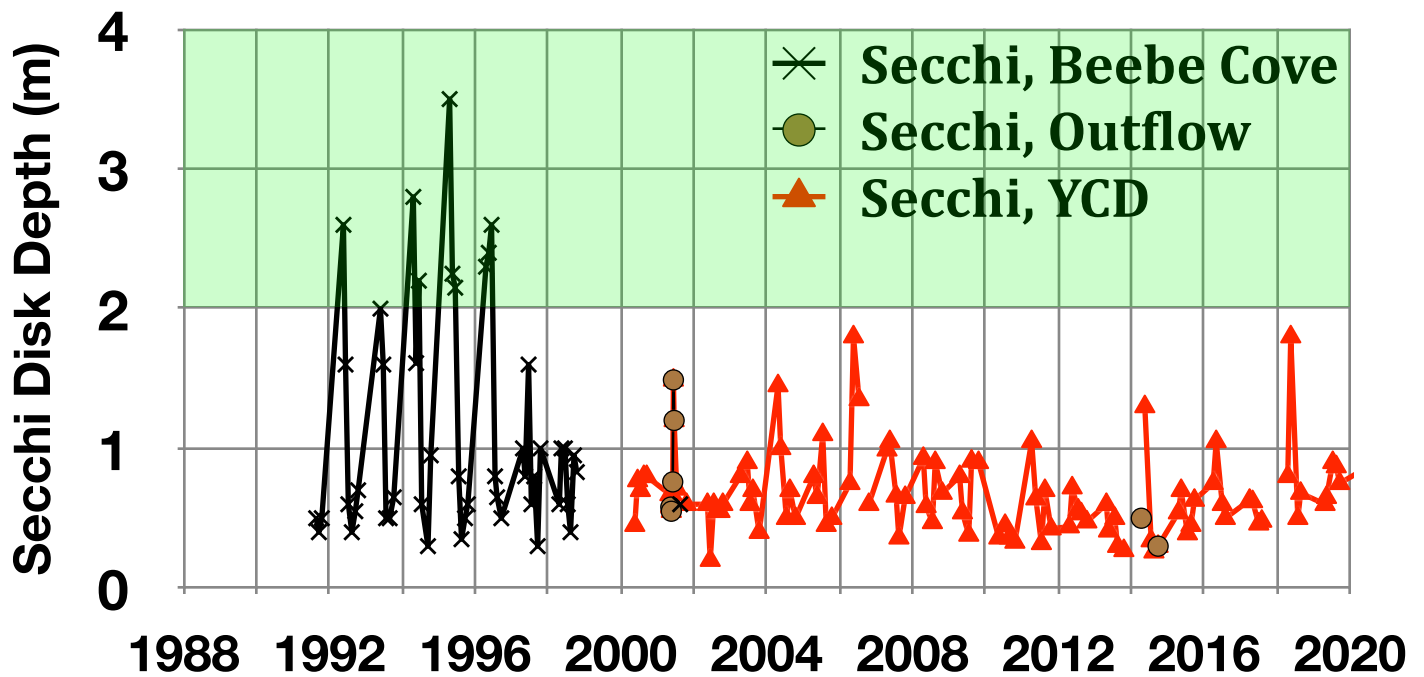


# 7. Secchi Disk Depths

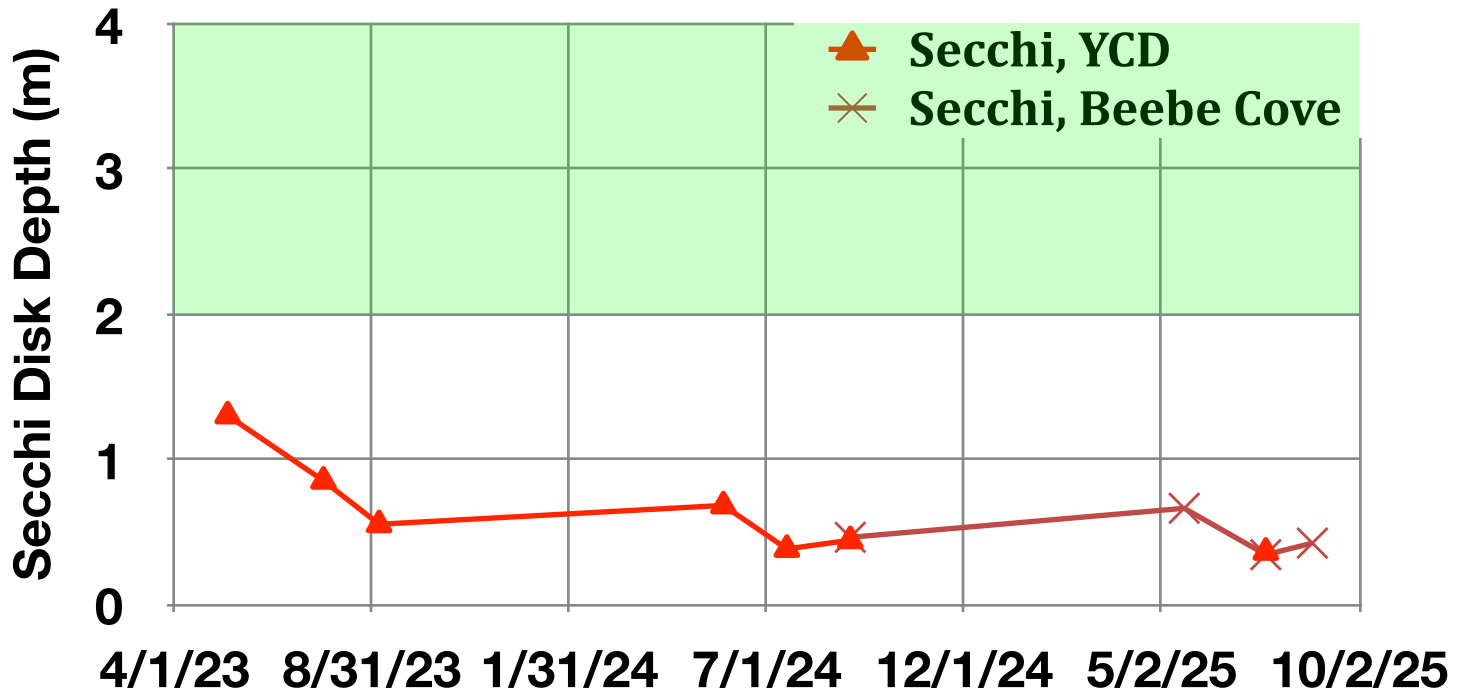
Secchi disk depth is a measure of lake cloudiness or turbidity (an important component of water quality assessments). In this measurement, a disk with alternating white and black sections is lowered into the lake. The depth at which it is no longer visible is reported. Greater depths mean higher water clarity. The Secchi disk depths for Lake Quannapowitt are low, often below 1 meter, indicating low water clarity. A goal is a minimum of 2 meters.



## Secchi Disk



# Secchi Disk, 2023 - 2025



## 8. Trophic State Index (TSI)

Lake Quannapowitt is a Eutrophic Lake (rich in nutrients and having a high level of biologic productivity). A TSI level of 40-50 is a reasonable goal.

Oligotrophic, mesotrophic, and eutrophic are the most common trophic classifications. Oligotrophic lakes are nutrient-poor, with few plants and very clear water. Eutrophic lakes are highly productive, with lots of plants and/or algae and less clear water. Mesotrophic lakes are in-between.

Trophic State Classification, Water Quality

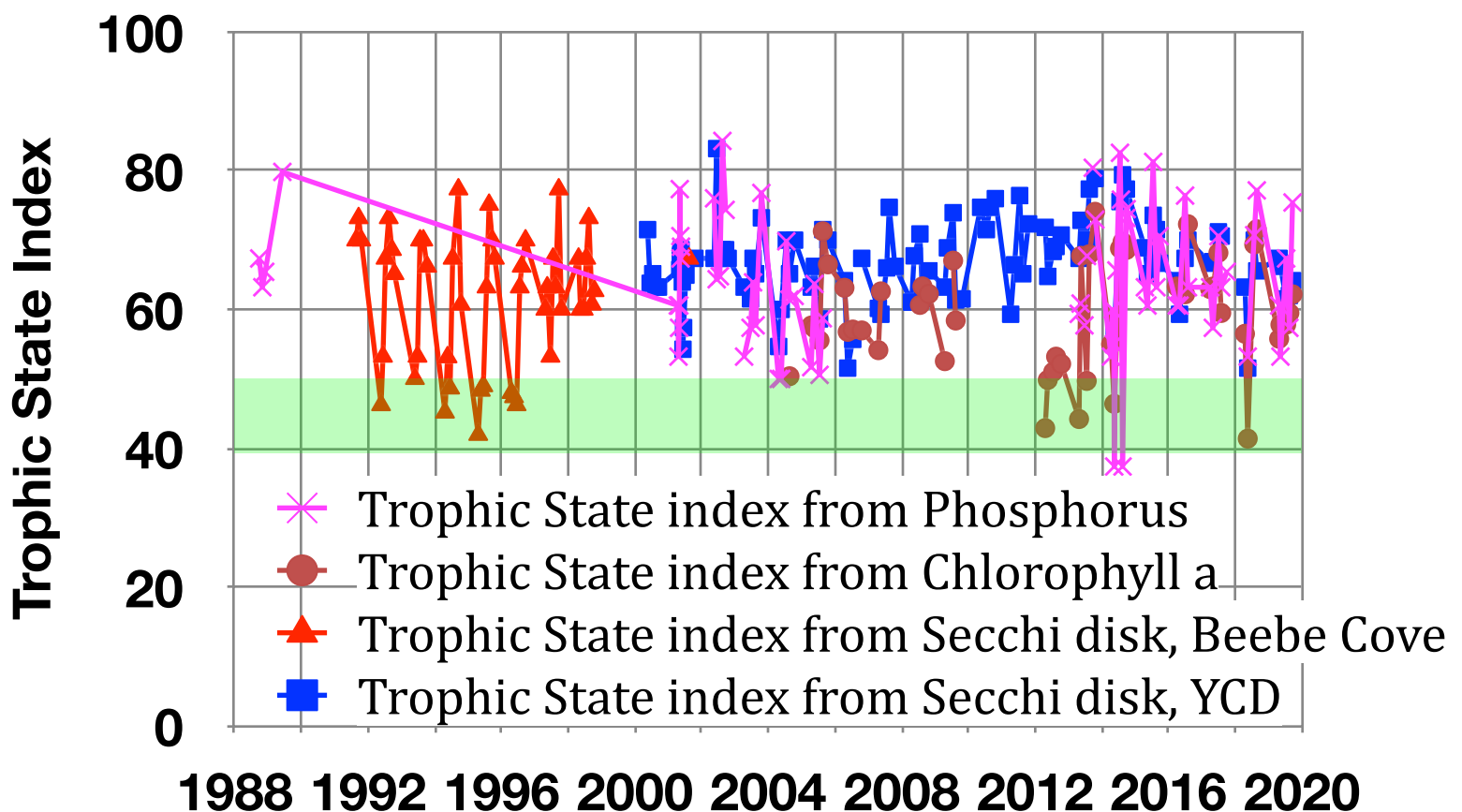
0-59 Oligotrophic through Mid-Eutrophic, Good

60-69 Mid-Eutrophic through Eutrophic, Fair

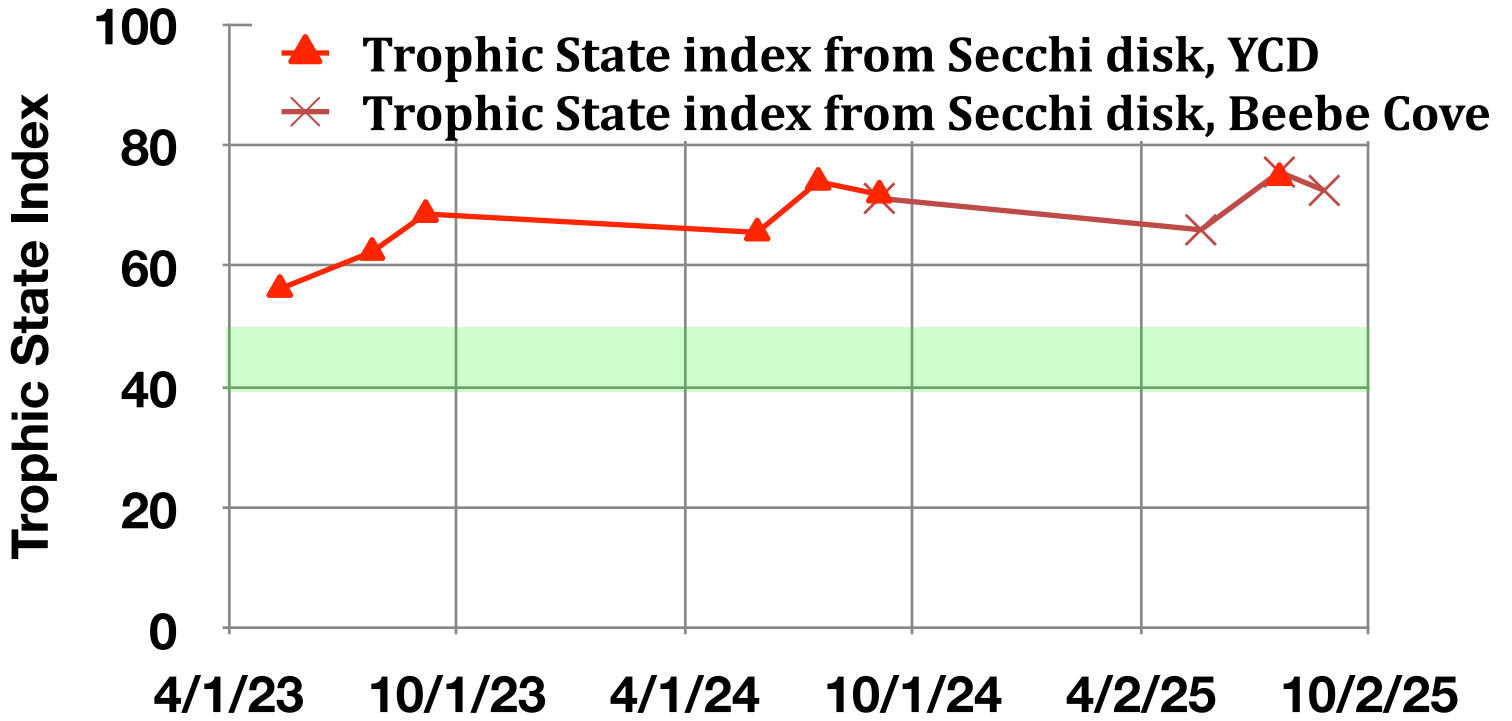
70-100 Hypereutrophic, Poor

FOLQ Phosphorus measurements were taken at Outflow

### Trophic State Index



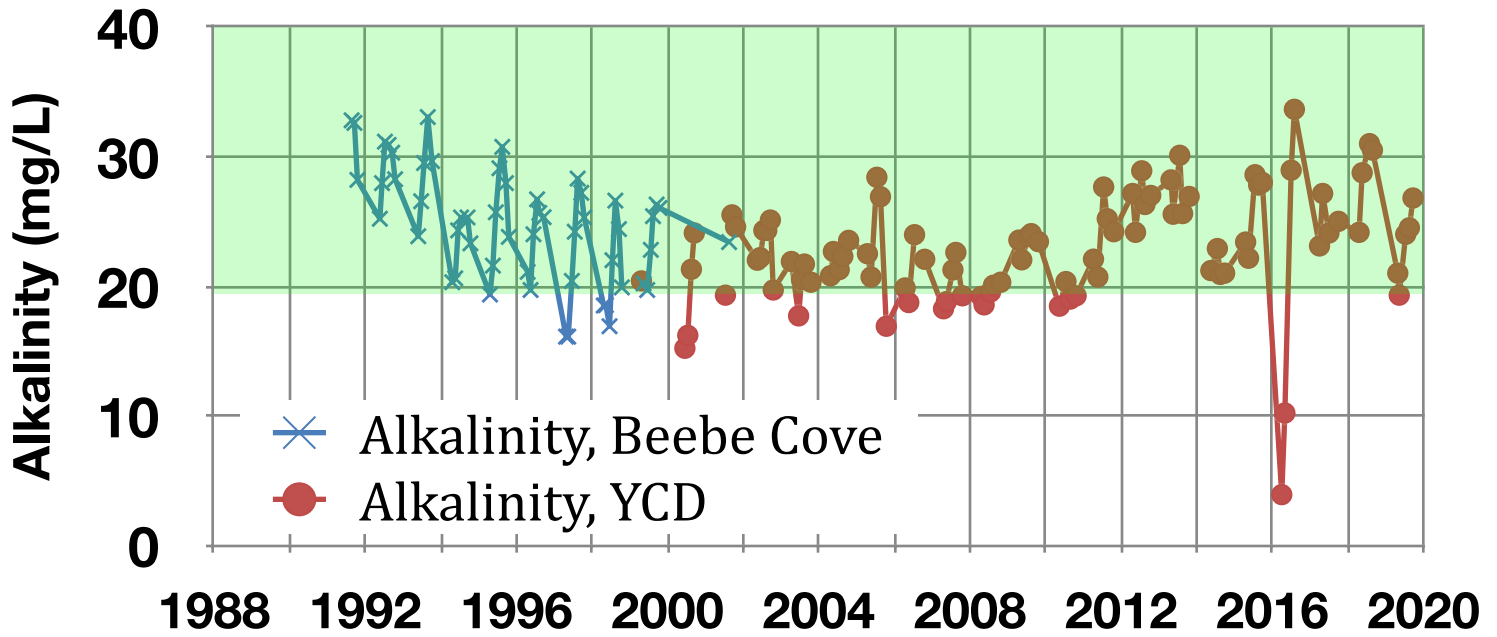
## Trophic State Index (TSI), 2023 - 2025



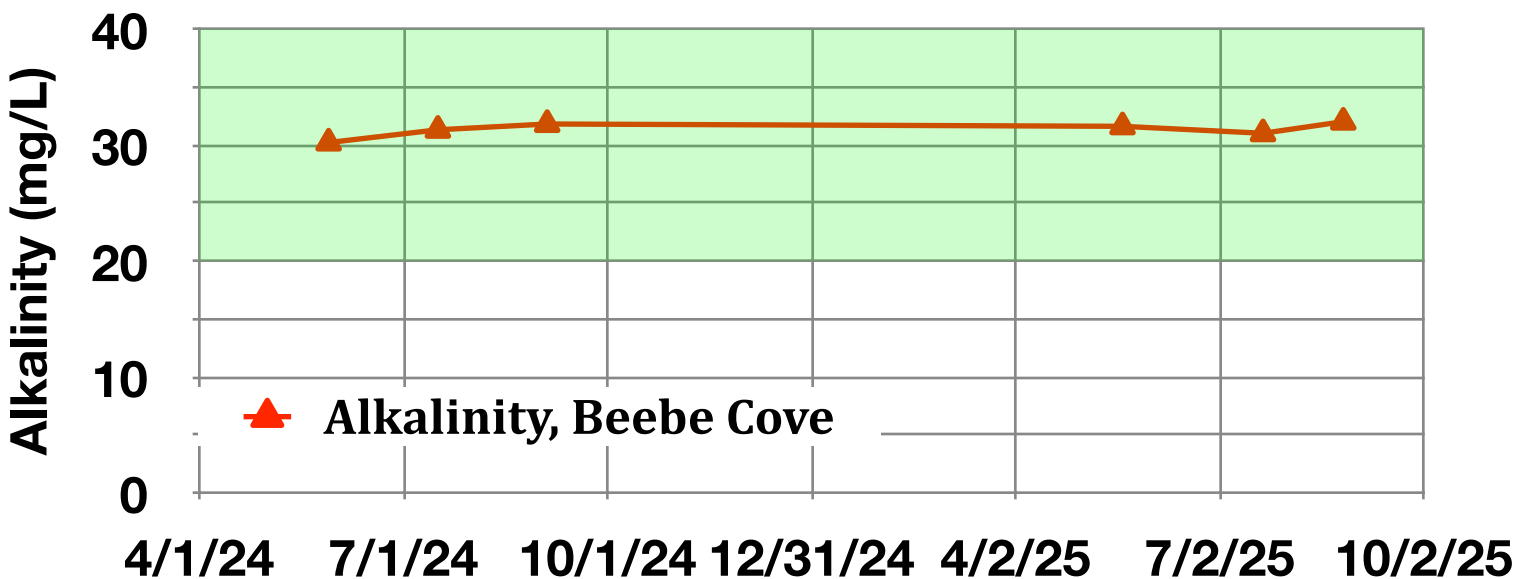
# 9. Alkalinity

Alkalinity is a measure of water's ability to neutralize or "buffer" acidity. Minerals in the soil and watershed affect a lake's alkalinity. Lakes with alkalinity between 2 and 10 mg/L are considered moderately sensitive to acid rain. Levels of 20-200 mg/L are typical of natural waters, like lakes. The green shaded area below indicates water that is not sensitive to acid rain. The alkalinity of Lake Quannapowitt is very good.

### Alkalinity



### Alkalinity, 2024 - 2025

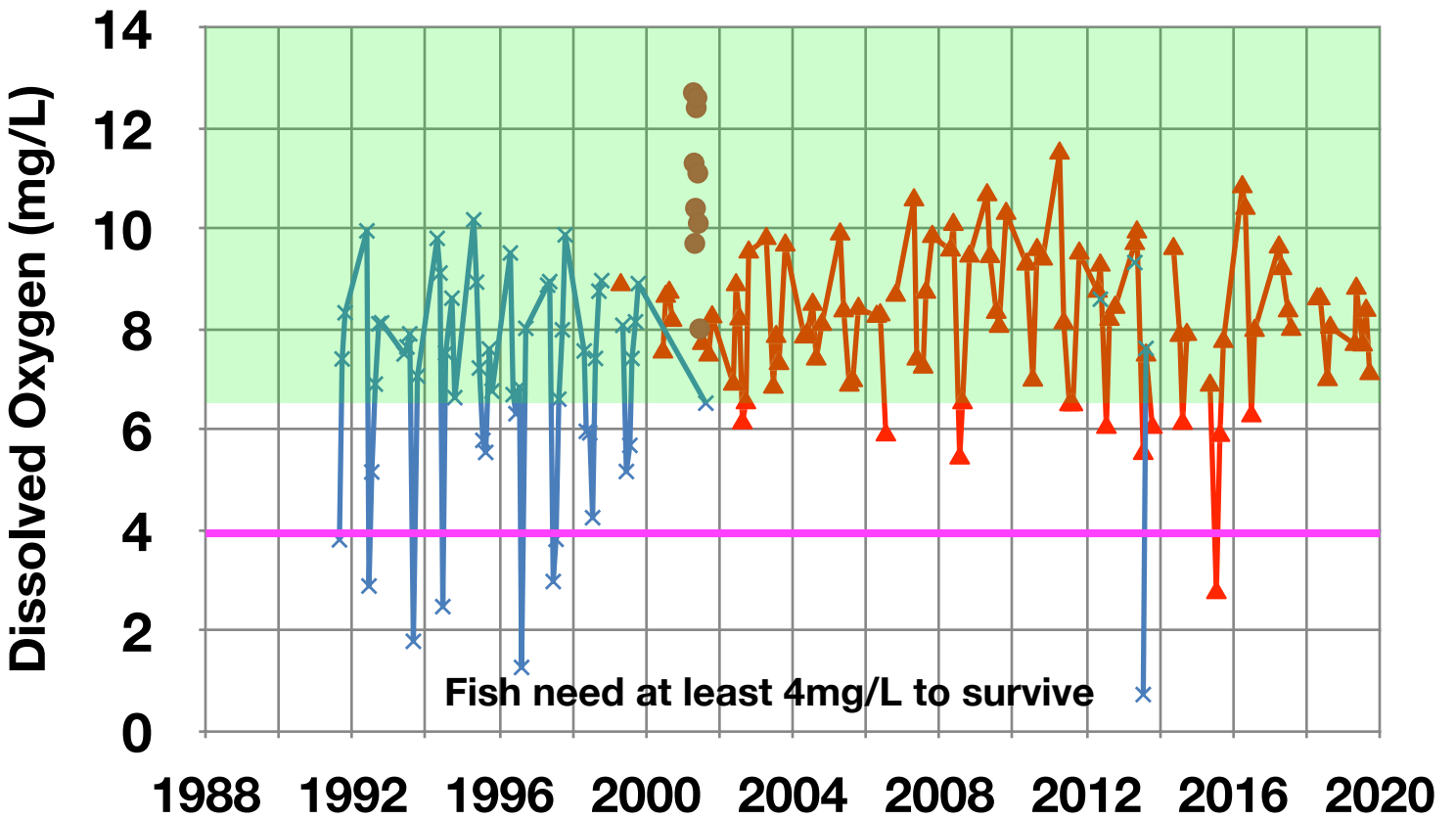


# 10. Dissolved Oxygen

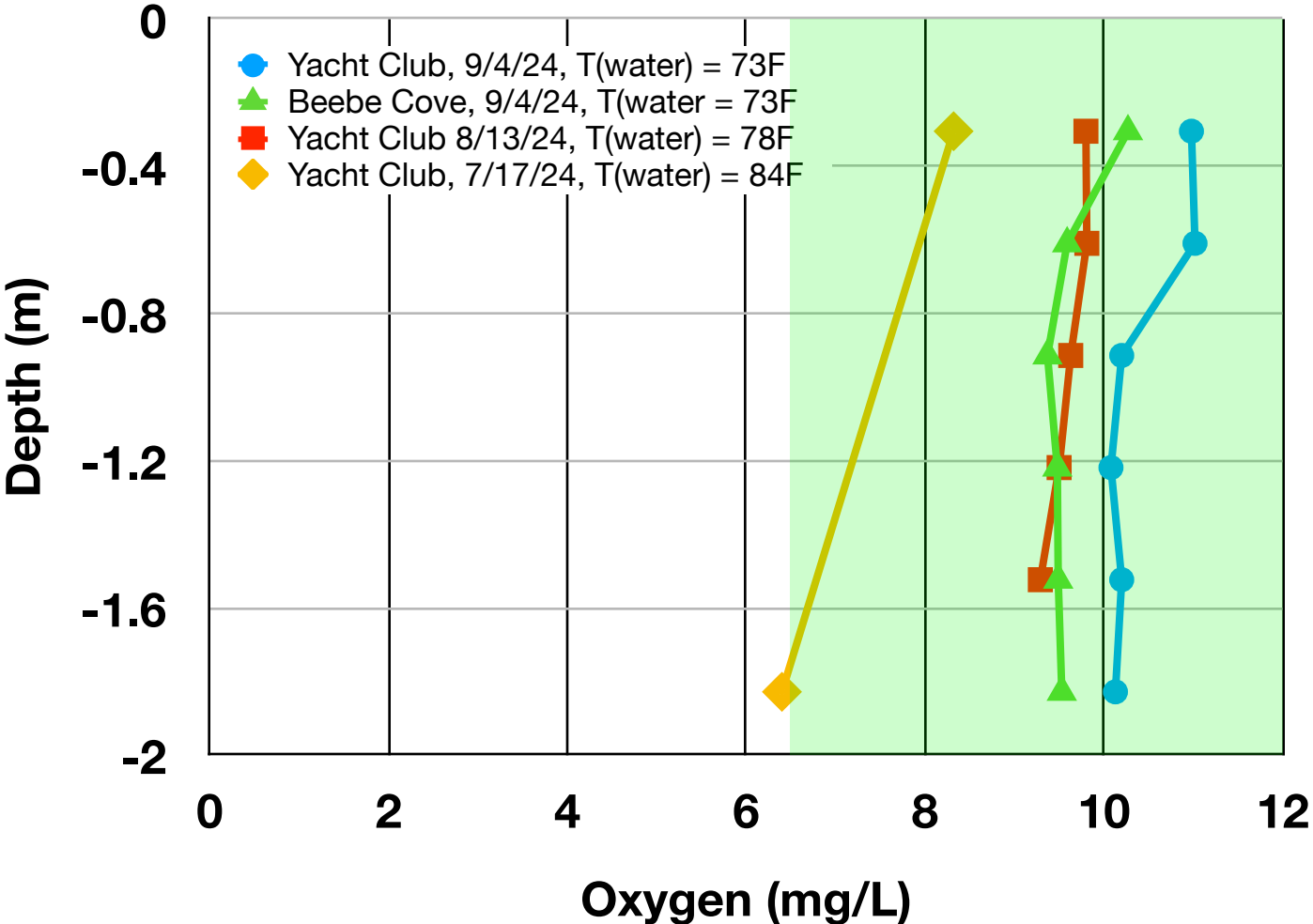
Healthy water should generally have dissolved oxygen concentrations above 6.5-8 mg/L. Lake Quannapowitt dissolved oxygen levels are very good. The second graph shows the dissolved oxygen levels stay nearly constant with depth, with the exception of the data taken in July at a higher water temperature.

- ✕ DO, Beebe Cove
- DO, Outflow
- ▲ DO, YCD

### Dissolved Oxygen

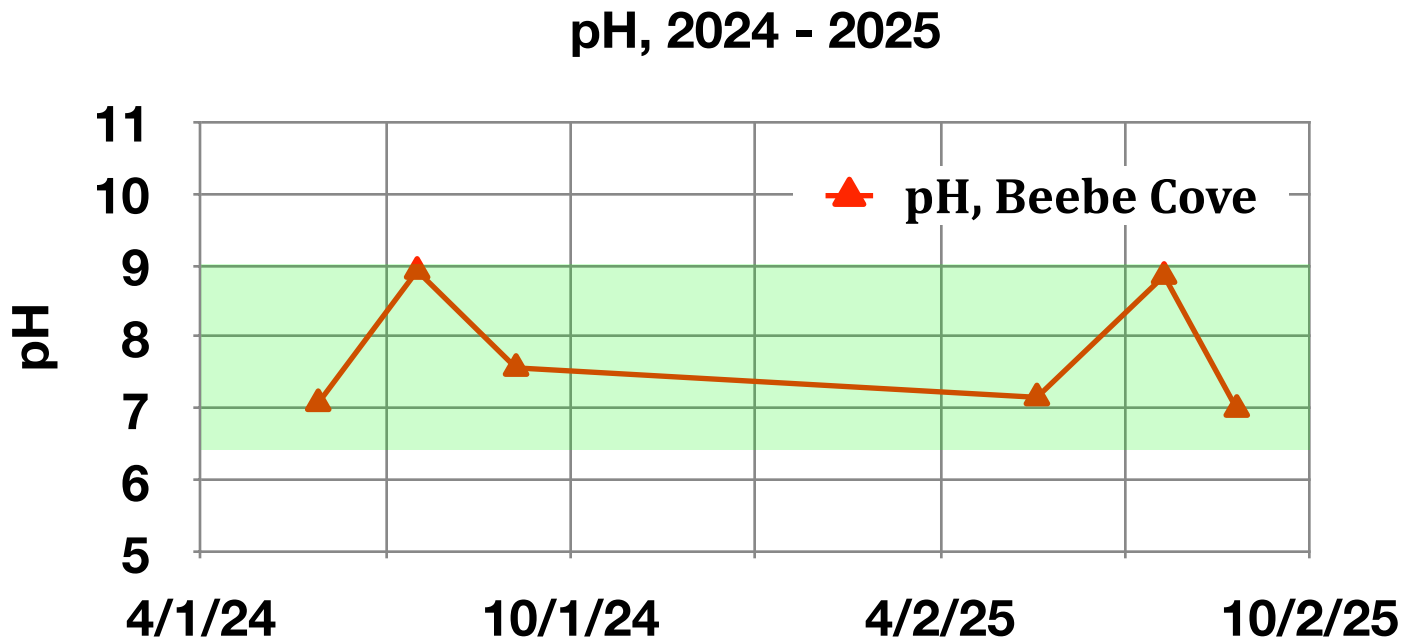
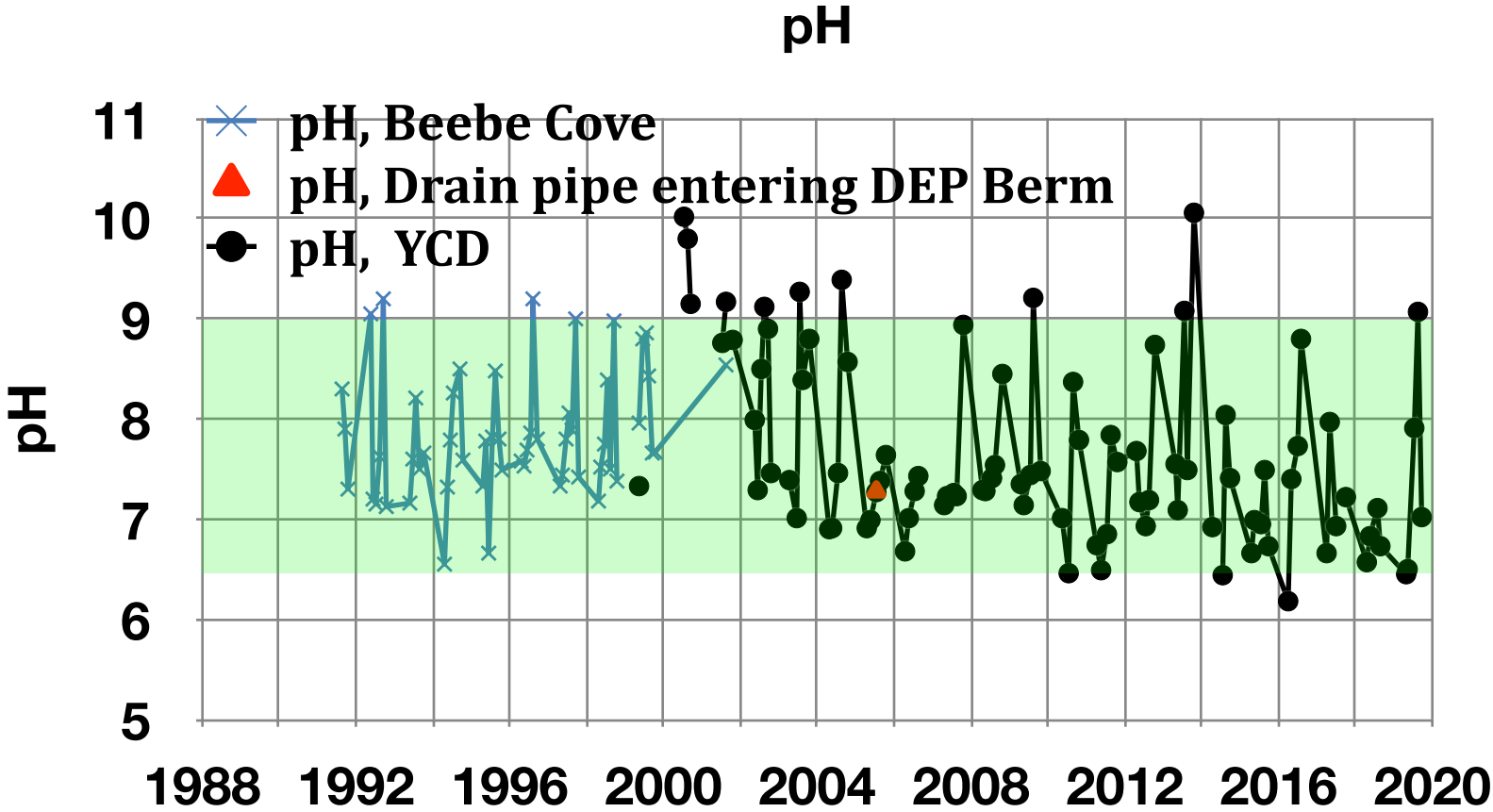


# Dissolved Oxygen vs. Depth



# 11. pH

The pH of a pond or lake should generally fall between 6.0 and 9.0. The largest variety of aquatic animals prefer a pH range of 6.5 – 8.0. Lake Quannapowitt pH rises significantly in the middle of summer, but the pH is generally in a good range.

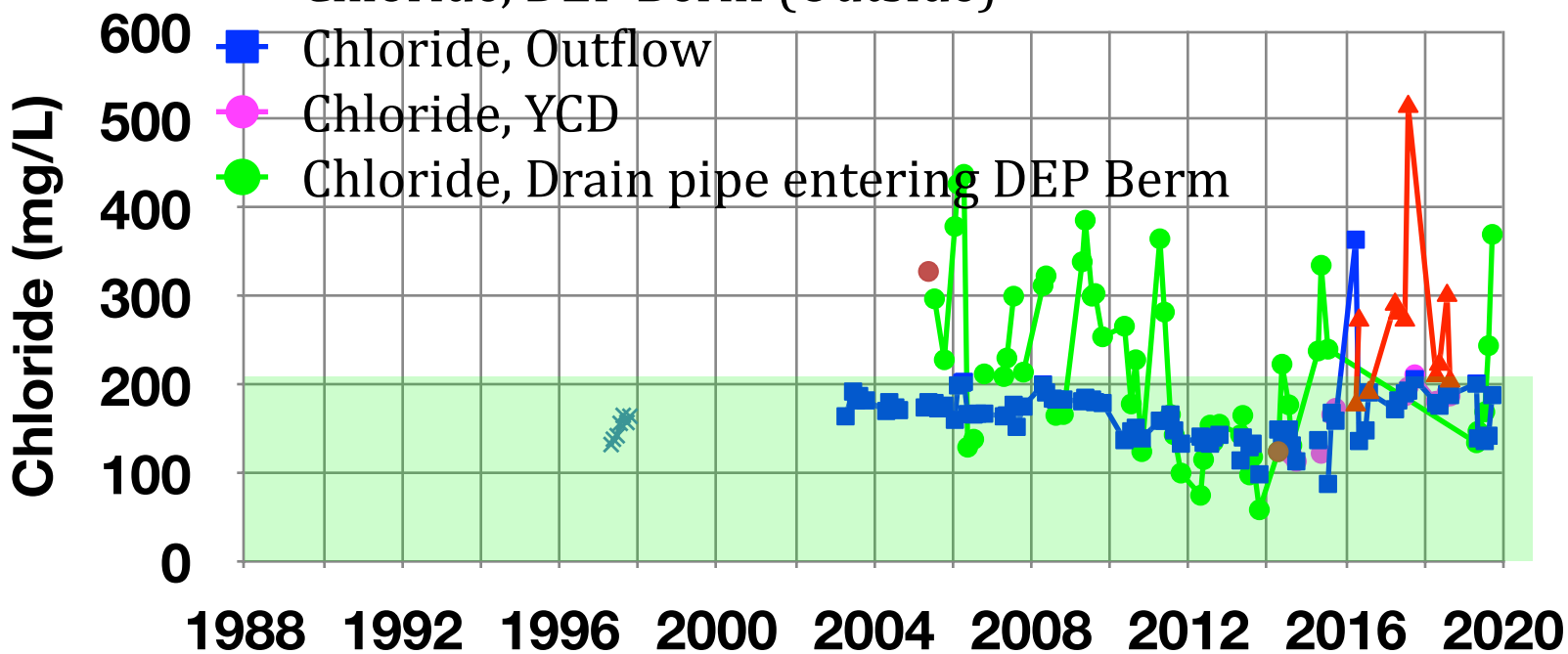


# 12. Chloride

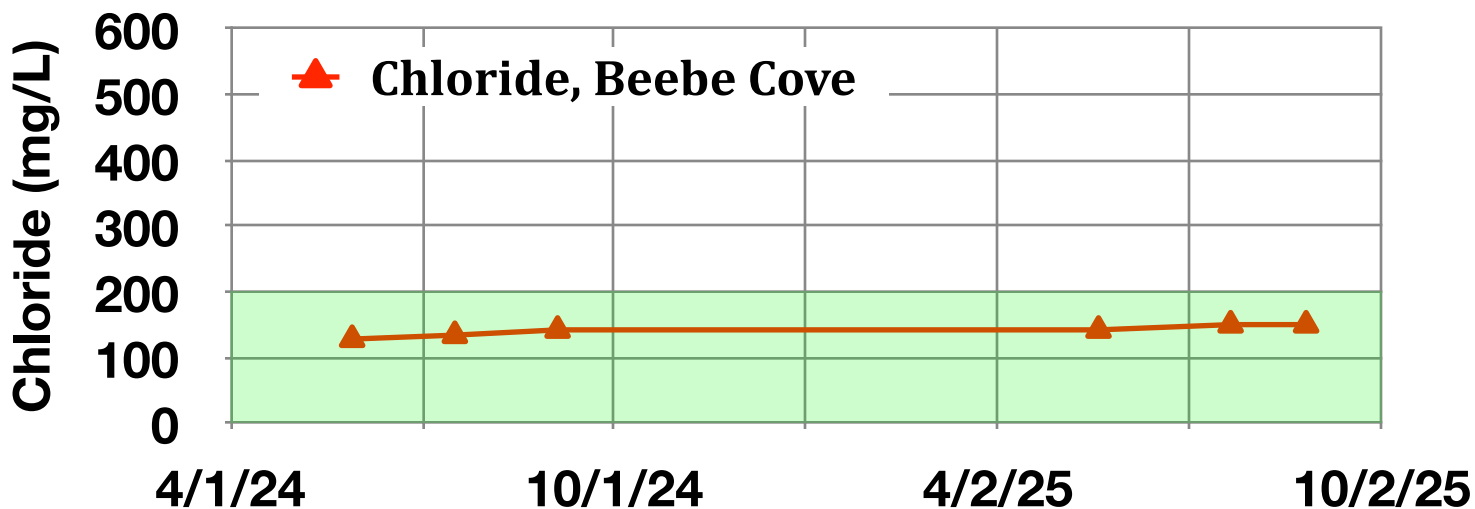
Road salt is a common source of chloride in lakes. Historically, chloride is not excessive at the Lake Quannapowitt outflow, but is higher at other locations. Less than 200mg/L is considered acceptable for lakes. Above 500mg/L is semi-saline. Chloride level is generally acceptable.

- ✕ Chloride, Beebe Cove
- Chloride, DEP Berm (inside)
- ▲ Chloride, DEP Berm (Outside)
- Chloride, Outflow
- Chloride, YCD
- Chloride, Drain pipe entering DEP Berm

## Chloride



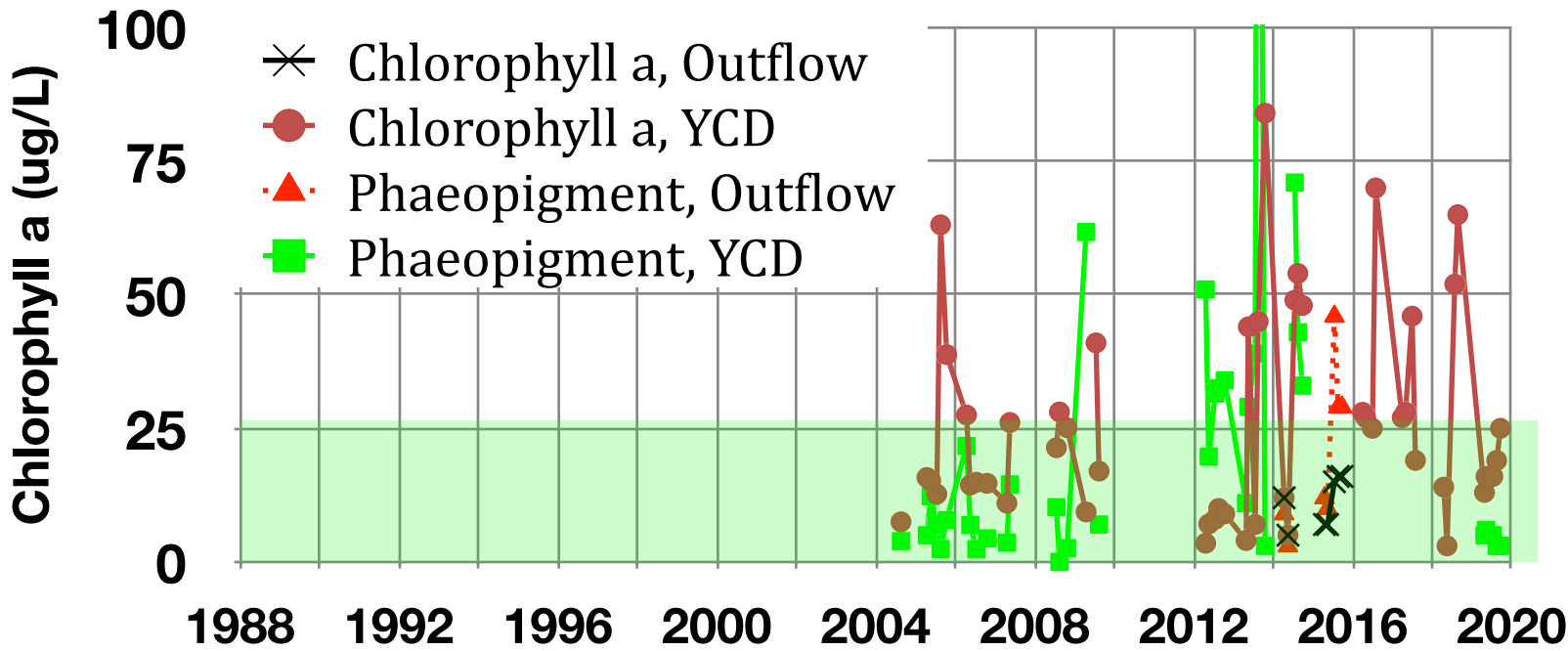
## Chloride, 2024 - 2025



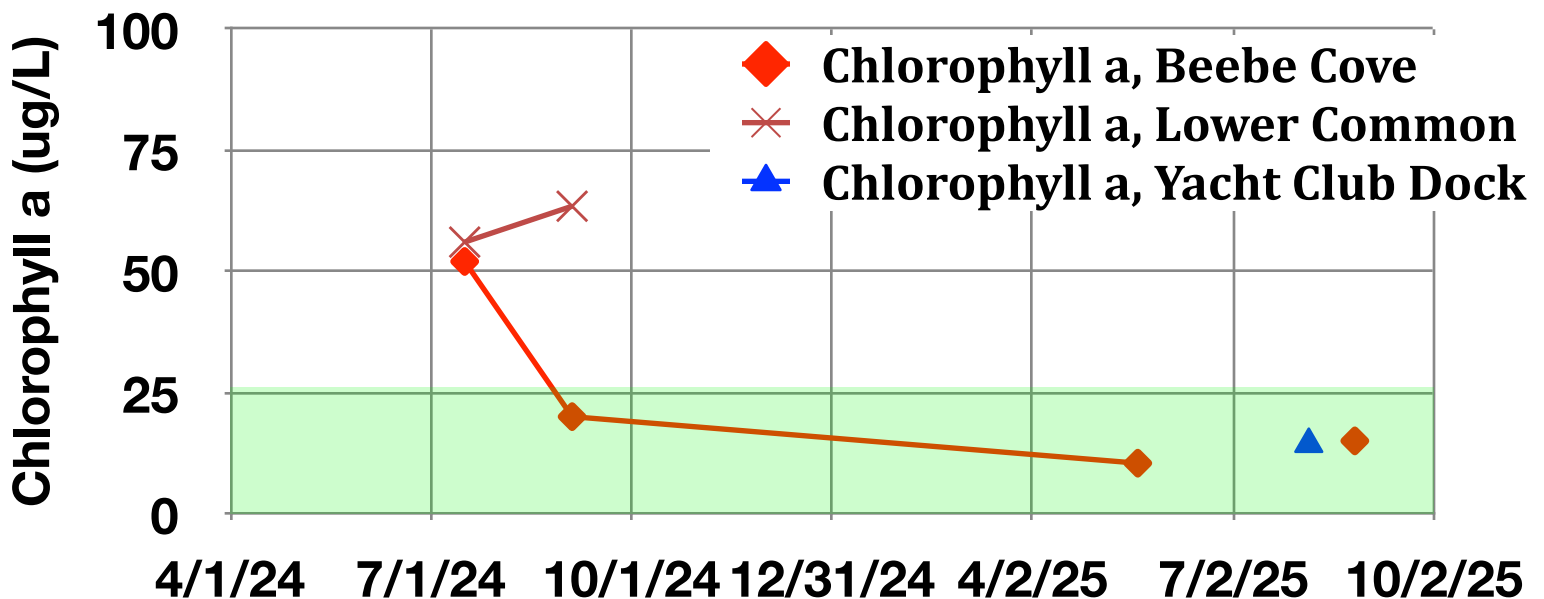
# 13. Chlorophyll a

A recommended Chlorophyll level is < 25ug/L for recreational lakes. Higher levels can lead to algae scums and water discoloration. Levels in Lake Quannapowitt are often higher than the recommended level. Phaeopigments are a group of non-photosynthetic pigments formed from the degradation of chlorophyll in algae, especially after phytoplankton blooms.

## Chlorophyll a

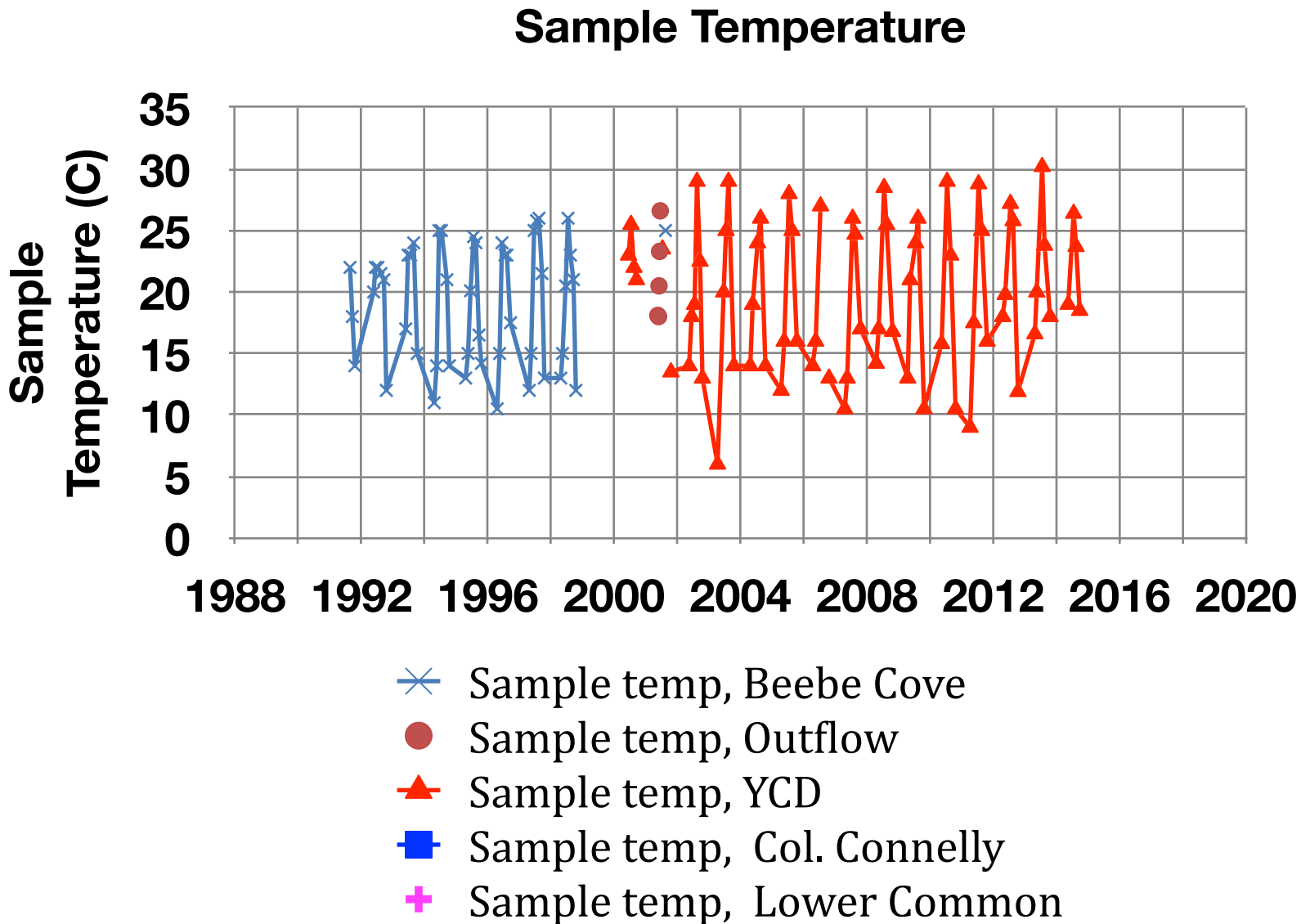


## Chlorophyll a, 2024 -2025

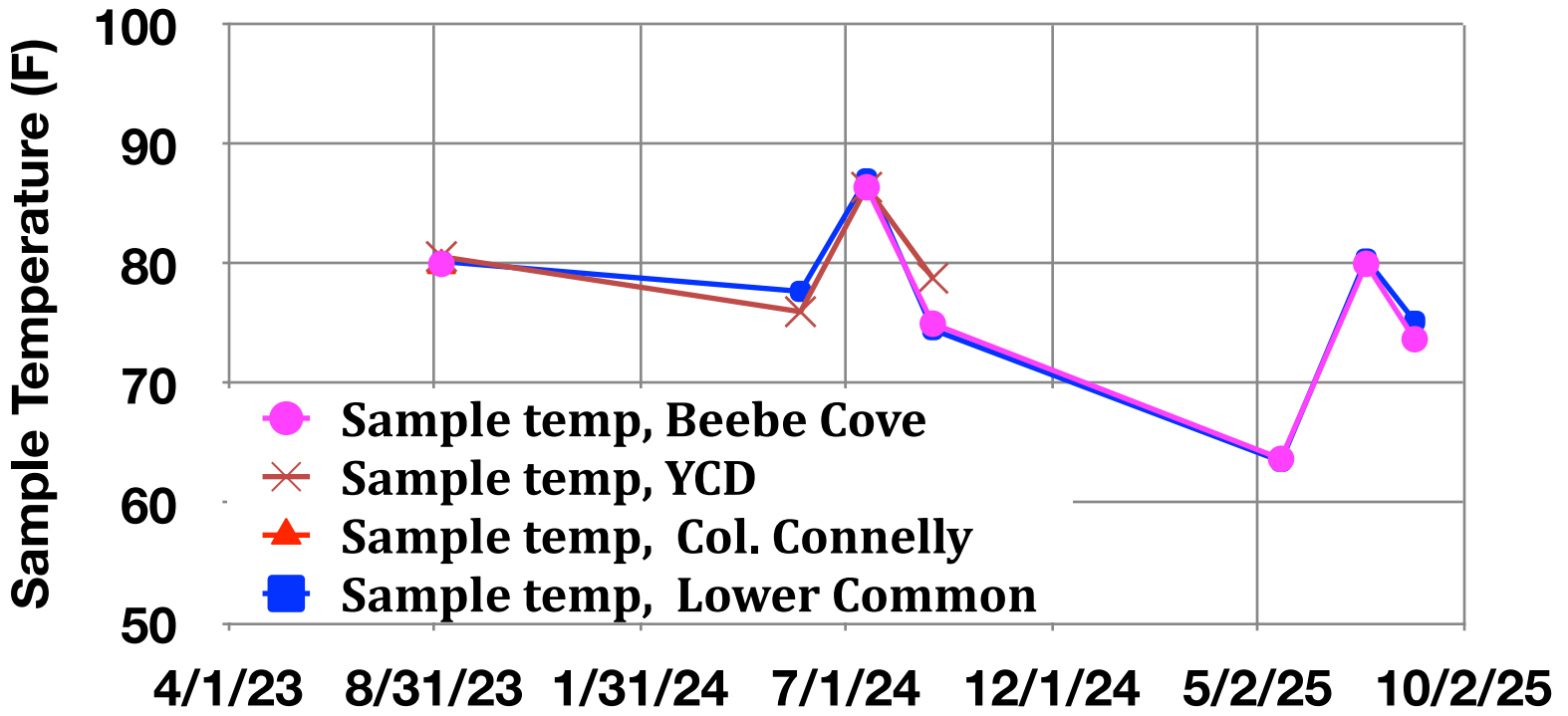


# 14. Sample (Water) Temperature

Higher water temperatures can promote the growth of cyanobacteria, as well as decreasing the dissolved oxygen. Historically, water temperature has varied from about 15C (59F) to about 28C (82F), depending on the month.



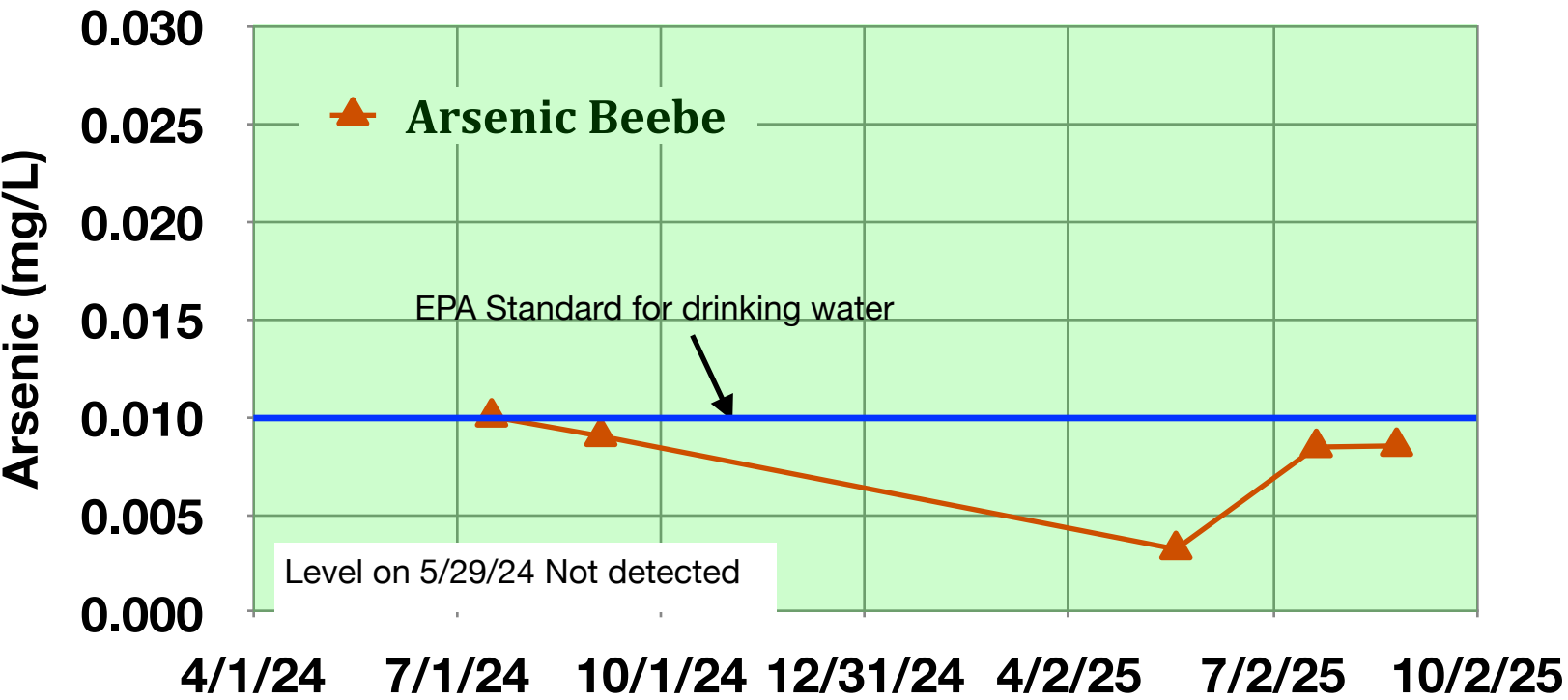
# Sample Temperature, 2023 - 2025



# 15. Arsenic

Arsenic levels are very low, and close to the EPA standard for drinking water.

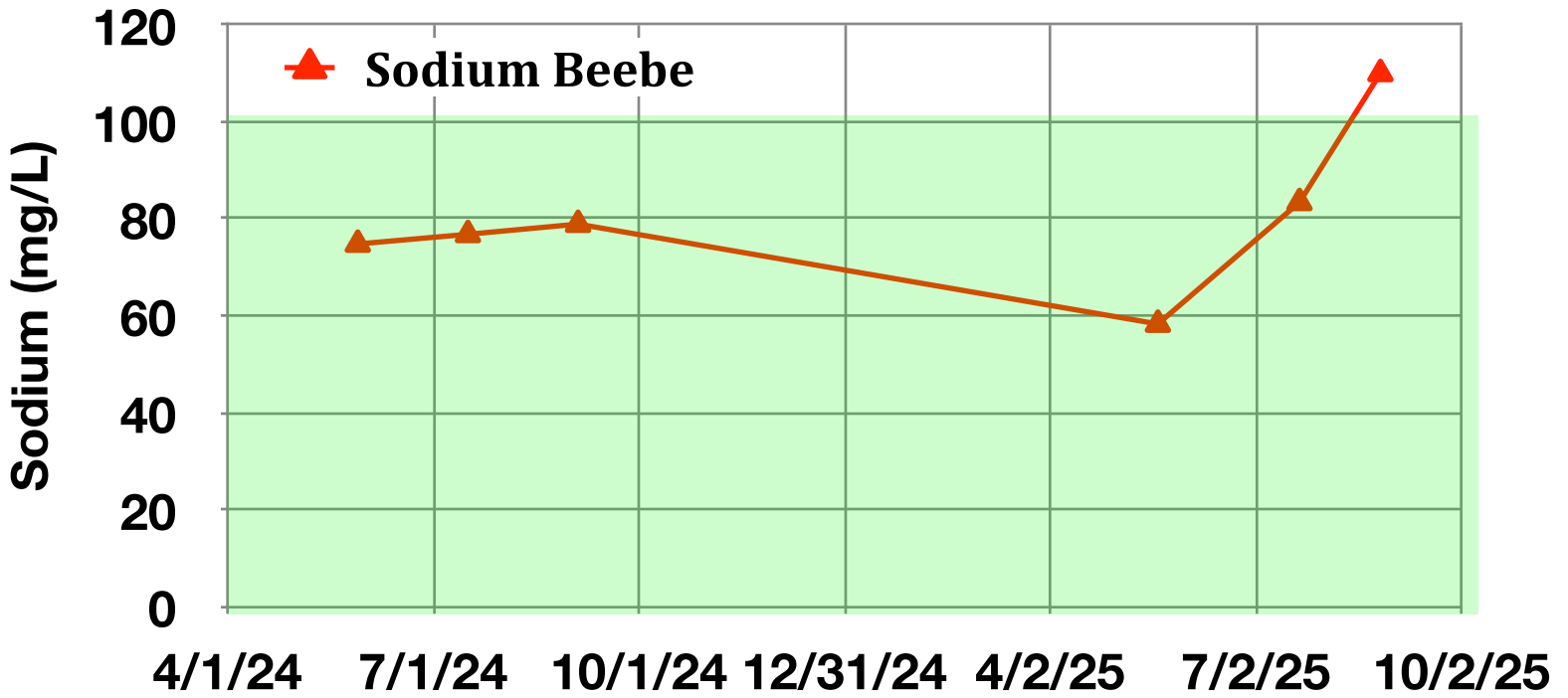
### Arsenic, 2024 - 2025



# 16. Sodium

Sodium levels in lake water should be <100mg/L. The drinking water guideline in MA is <20mg/L.

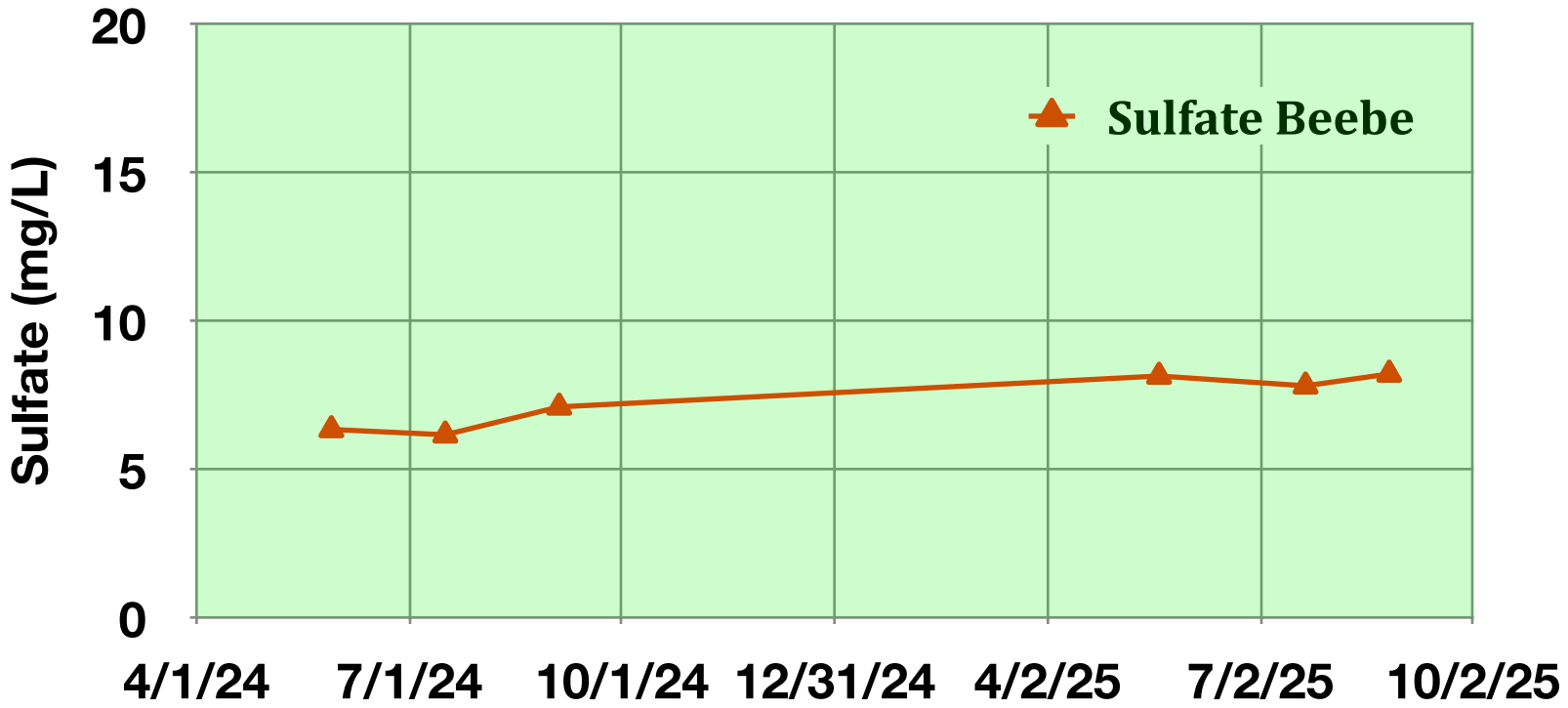
### Sodium, 2024 - 2025



# 17. Sulfate (SO<sub>4</sub>,2-)

Sulfate levels are low. Recommended level in drinking water is <250mg/L.

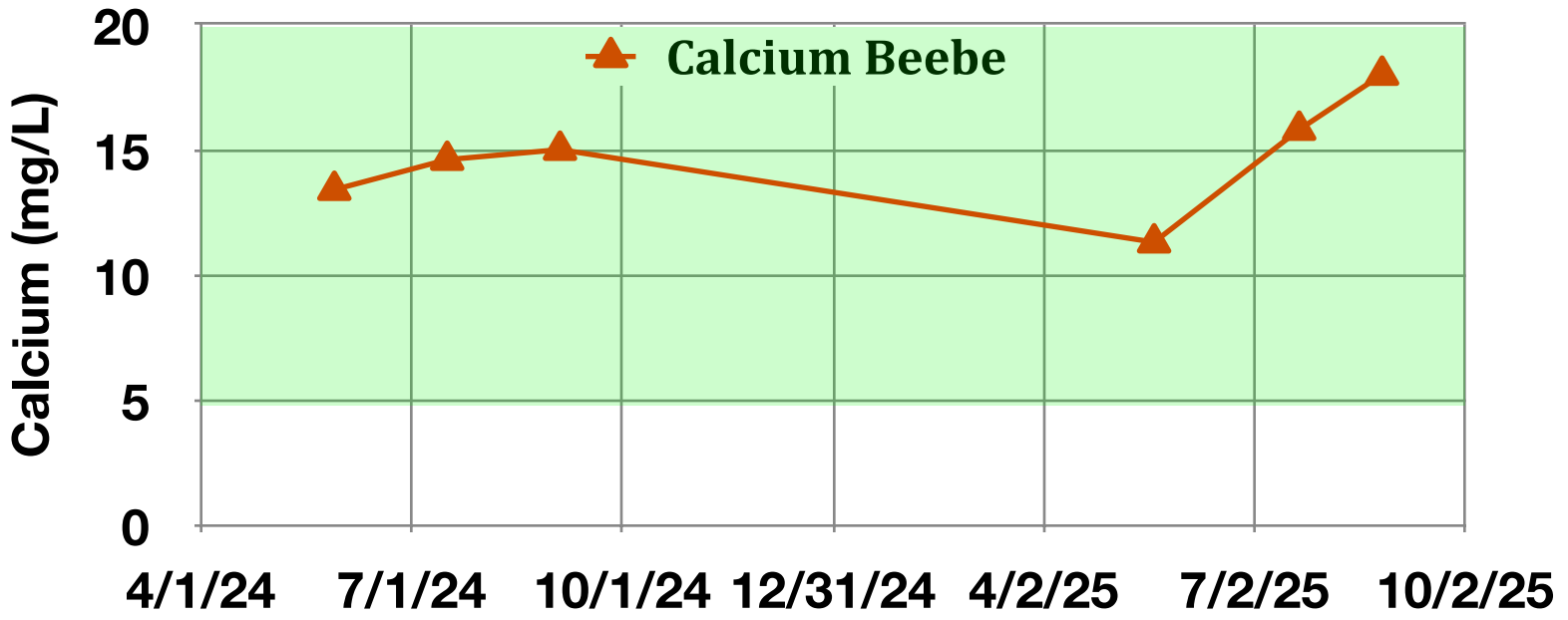
### Sulfate, 2024 - 2025



# 18. Calcium

Calcium is at an acceptable level for organisms in lakes.

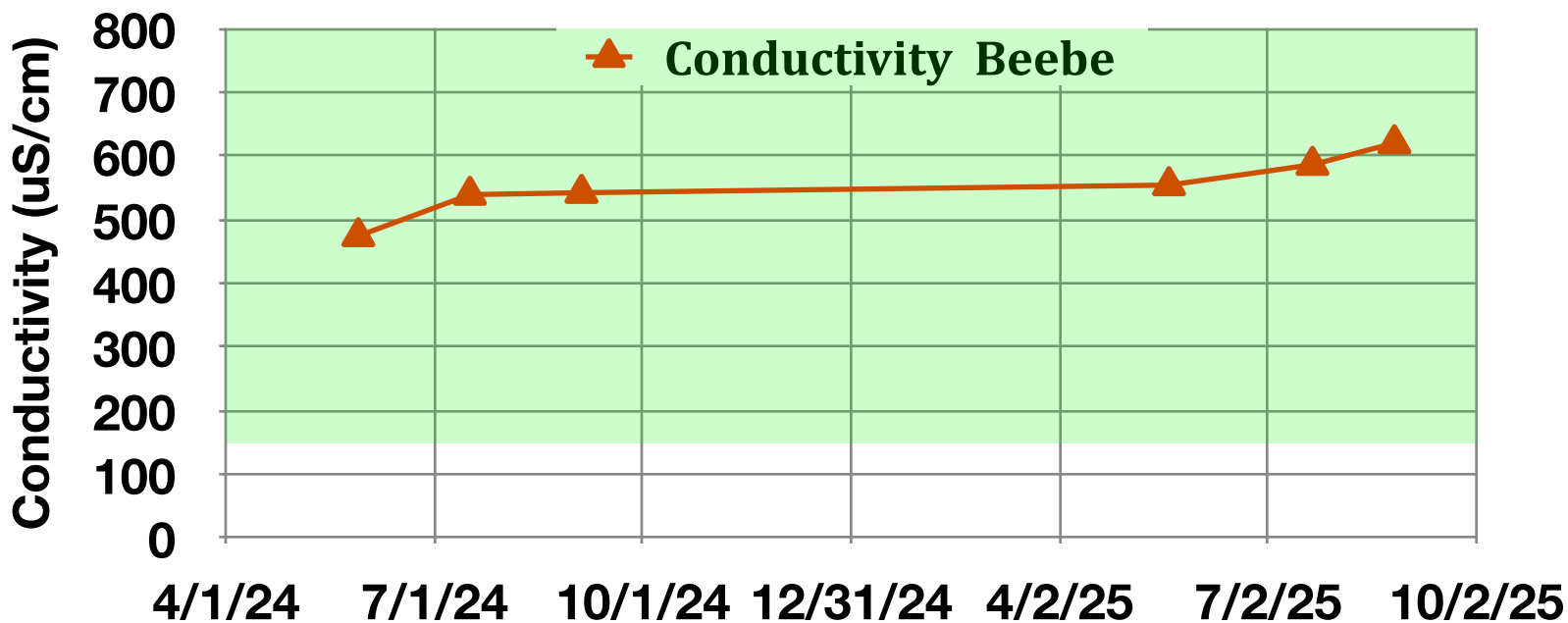
### Calcium, 2024 - 2025



# 19. Conductivity

Lakes that support good populations of fish have conductivities in the range 150 to 800  $\mu\text{S}/\text{cm}$ .

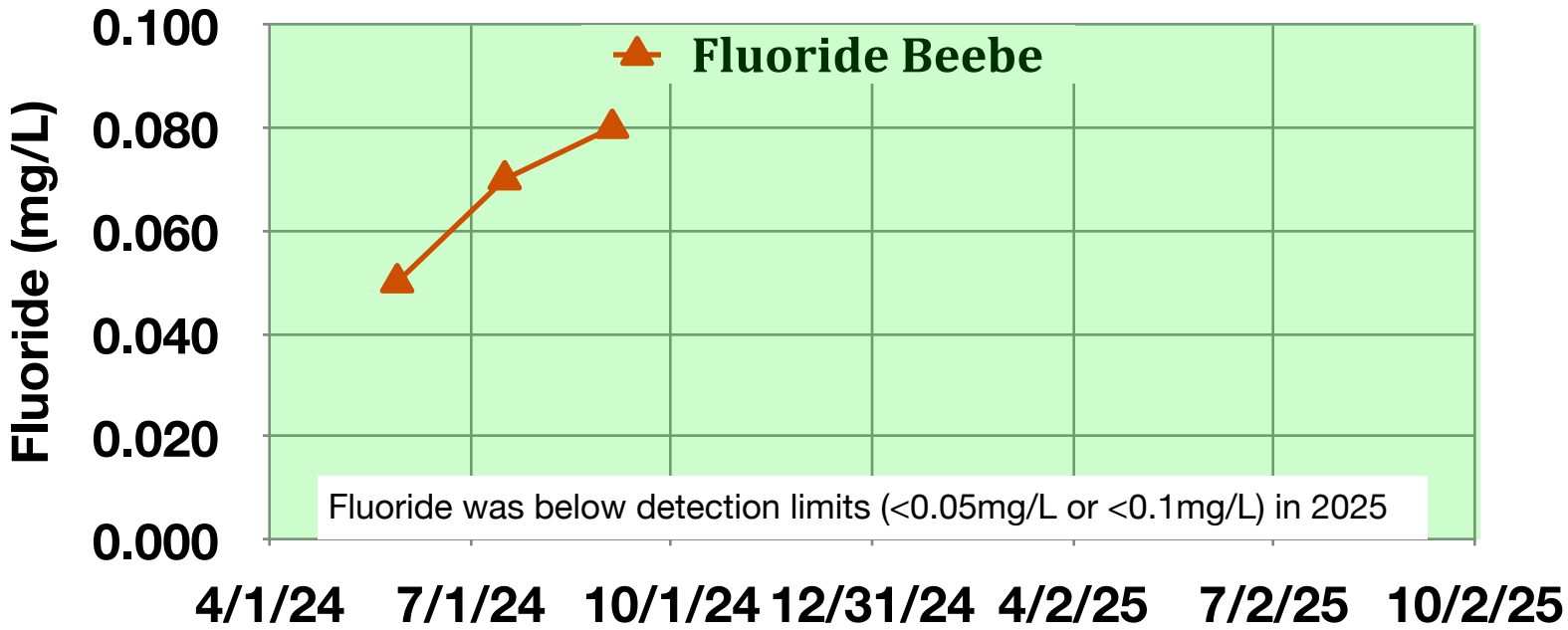
### Conductivity, 2024 - 2025



# 20. Fluoride

Fluoride is at a very low level. EPA has a secondary standard for fluoride of 2.0 mg/L.

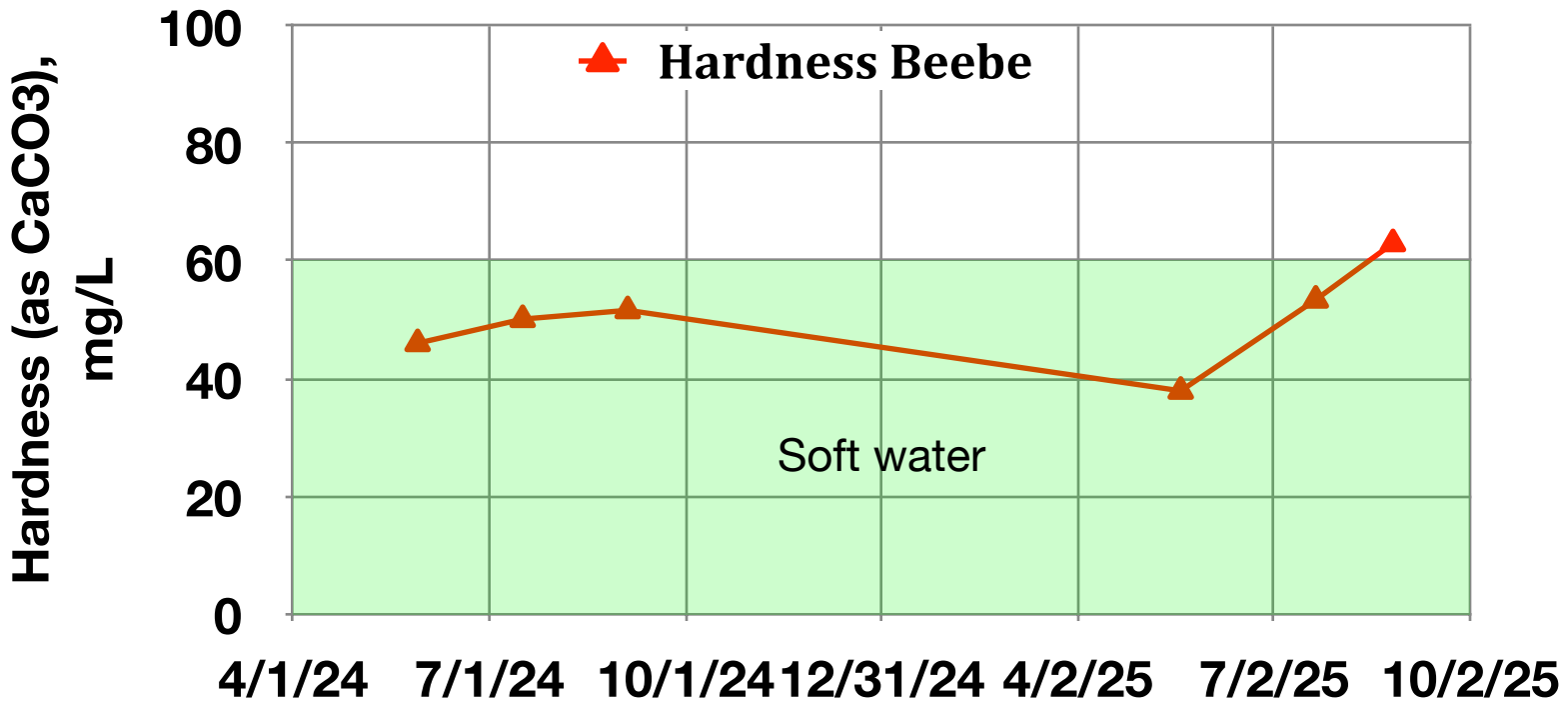
### Fluoride, 2024 -2025



# 21. Hardness

Lake Quannapowitt water is near the top of the soft water range (in green). General guidelines for classification of waters are: 0 to 60 mg/L as calcium carbonate is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and more than 180 mg/L as very hard.

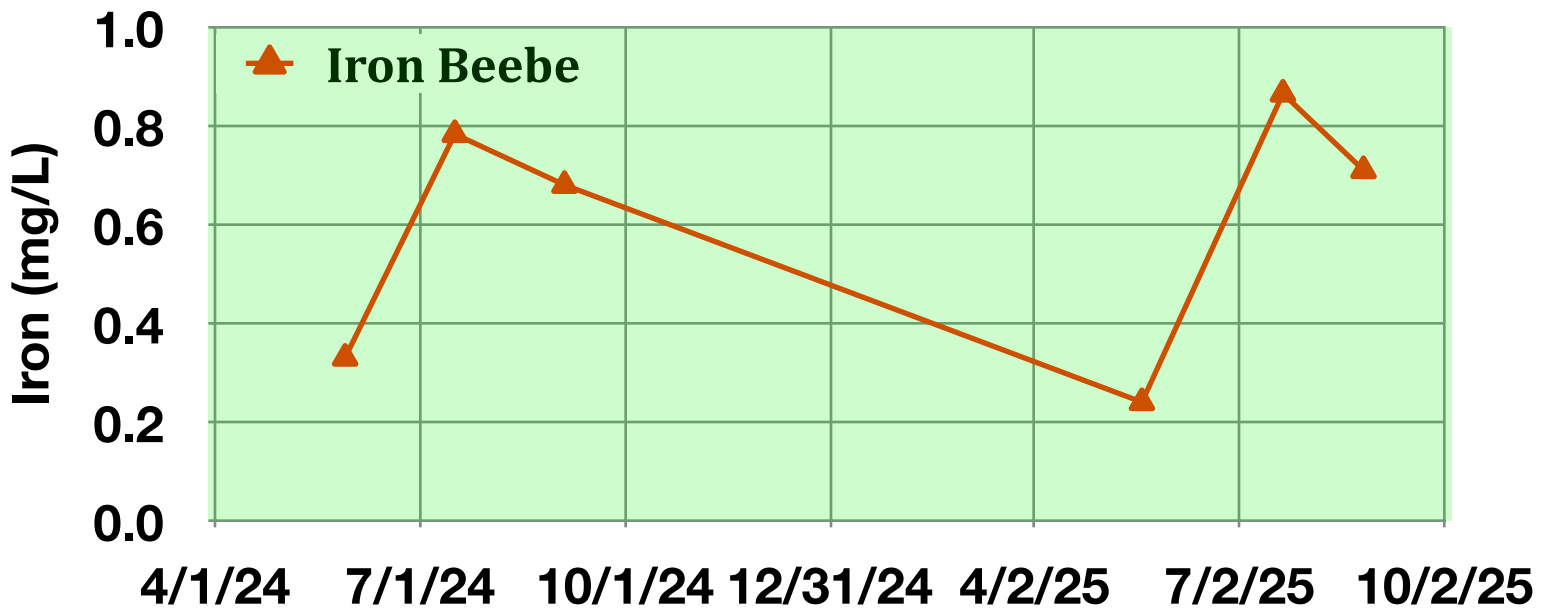
### Hardness (as CaCO<sub>3</sub>), 2024 - 2025



## 22. Iron

Iron levels are usually below 10 mg/L in water. Water with an iron level above 0.3 mg/L is usually considered objectionable in drinking water.

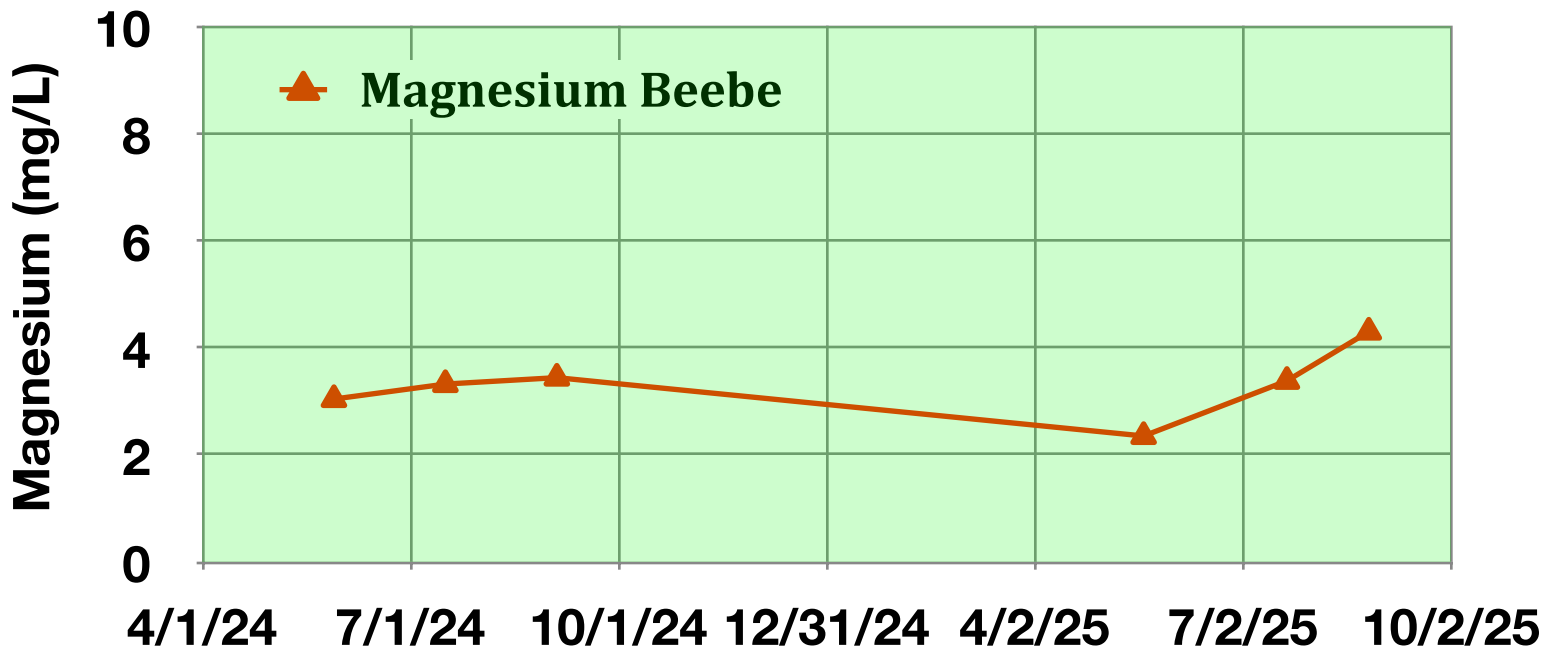
**Iron, 2024 -2025**



# 23. Magnesium

Recommended value of magnesium in drinking water is 10-40 mg/L.

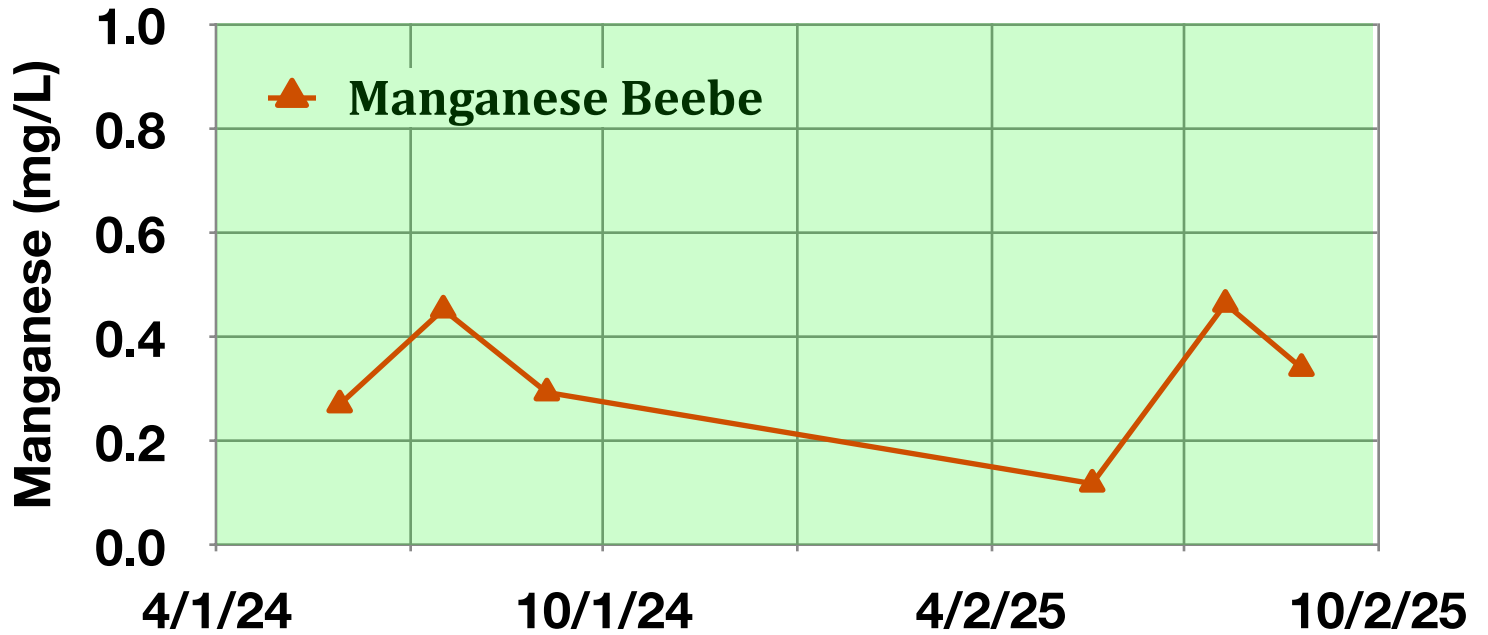
### Magnesium, 2024 - 2025



# 24. Manganese

Recommended drinking water level is less than 0.3mg/L.

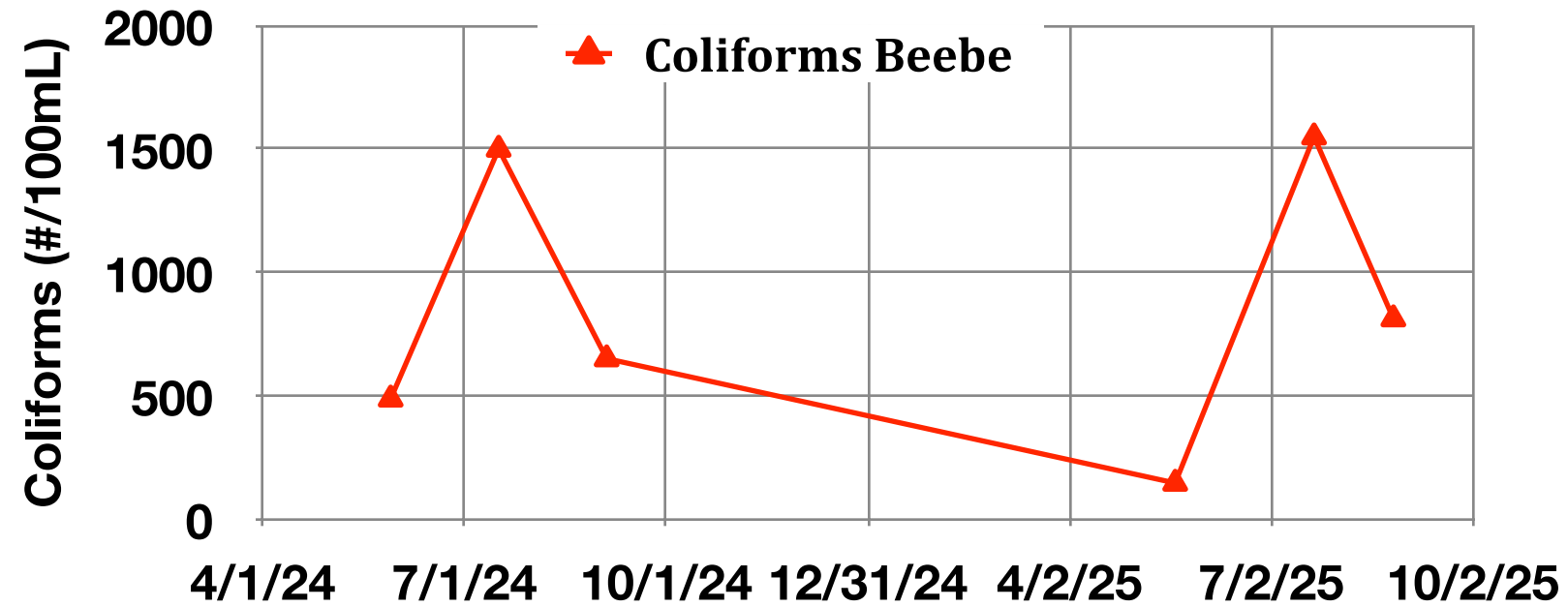
### Manganese, 2024 - 2025



# 25. Total Coliforms

No recommended levels found for total coliform in lakes.

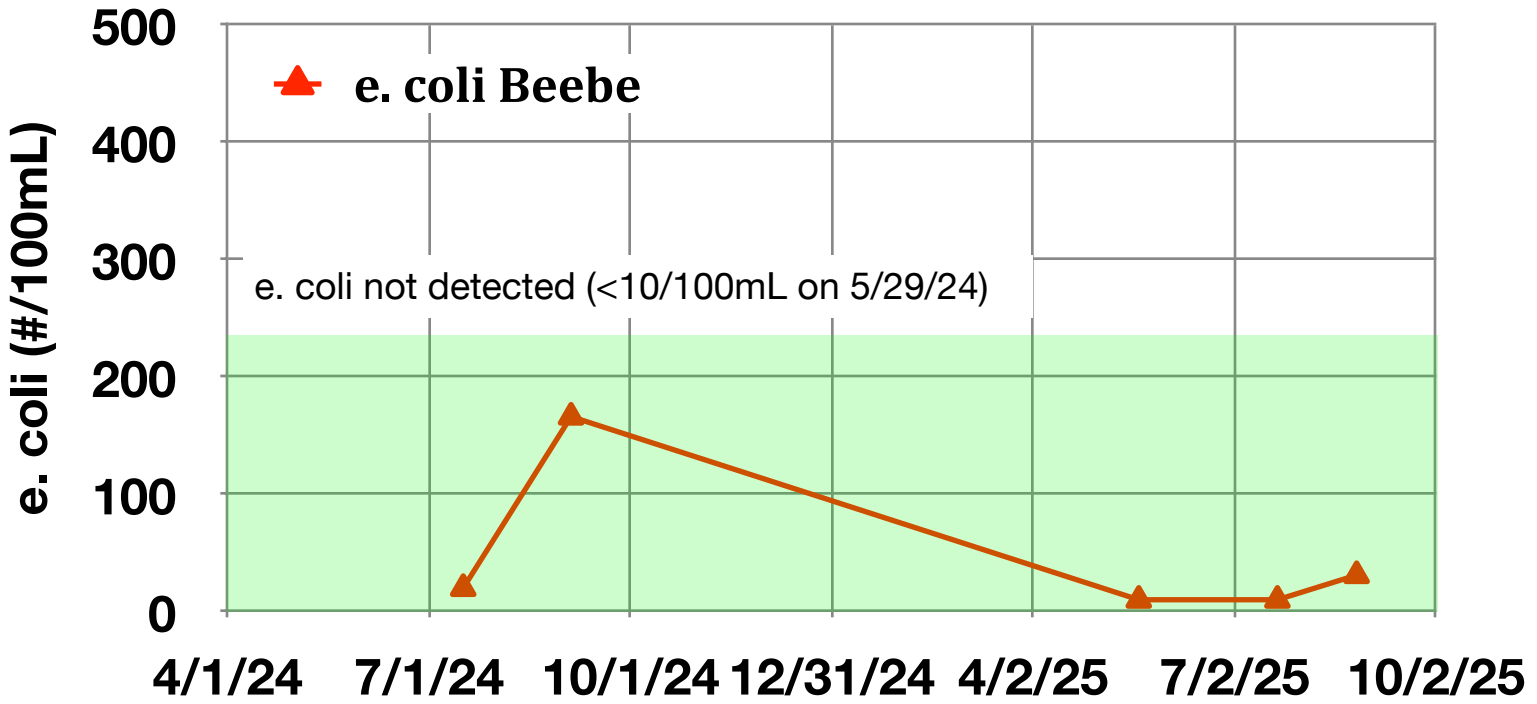
### Coliforms, 2024 - 2025



# 26. e. Coli

The accepted level of e. coli at a freshwater beach for a single sample is 235 cfu/100 ml of water or below (from mass.gov). [cfu = colony forming

### e. coli, 2024 - 2025

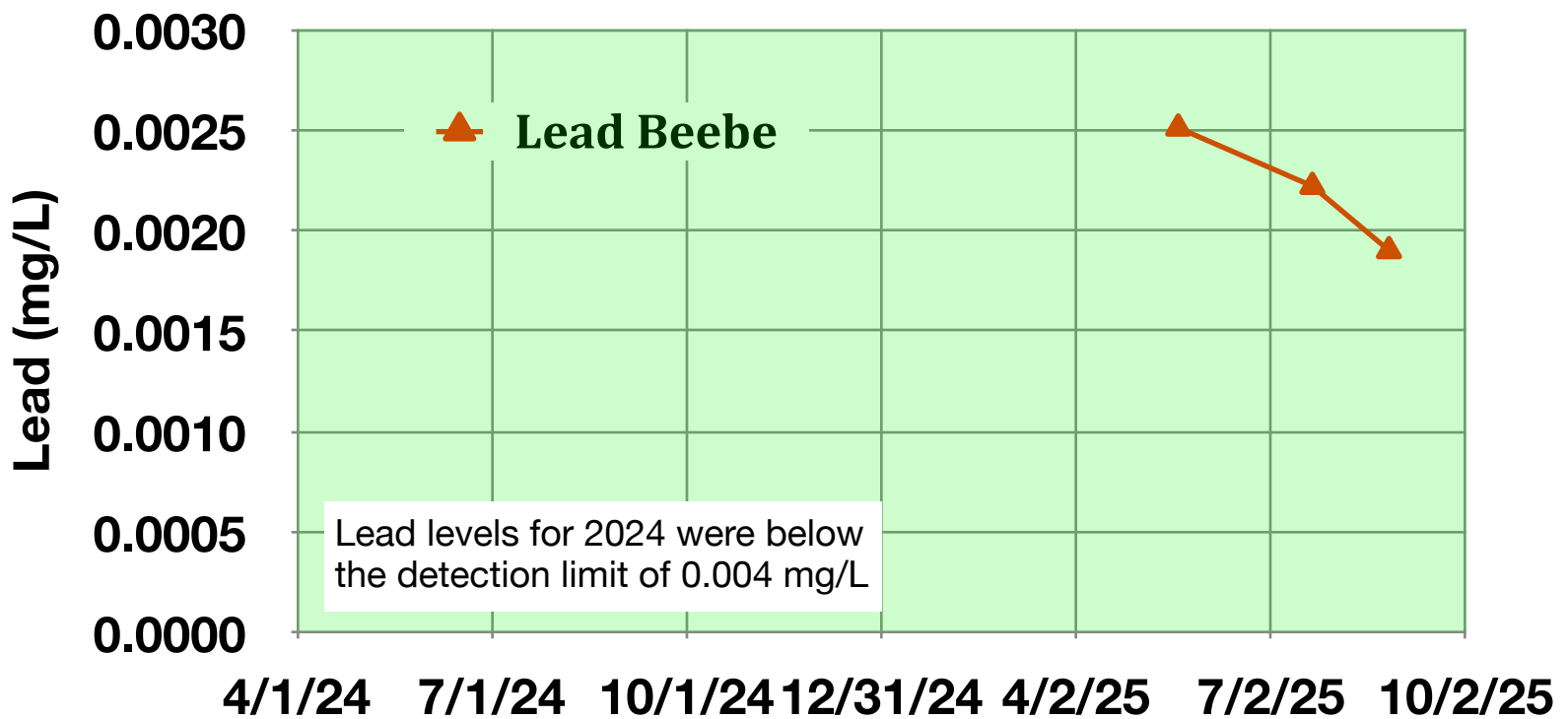


# 27. Lead

Lead levels in Lake Quannapowitt are very low. They are significantly lower than the EPA Action Level for public drinking water of 0.015mg/L.

For aquatic life protection, the EPA provides National Recommended Water Quality Criteria for lead in fresh water which are dependent on water hardness, as hardness affects lead's toxicity to aquatic organisms. The criteria use complex formulas based on hardness to determine safe limits, with the goal of protecting the ecosystem.

### Lead, 2024 - 2025



## 28. Total Dissolved Solids

Typical Total Dissolved Solids in lakes are 0.05 g/L to 0.25 g/L. Average for Lake Q is about 0.3 g/L

