

# Five Years of Data on the Plateau: Water Quality is Not Improving

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April 2024

# Nearing two decades of work here

The collage consists of seven vertical panels, each representing a different stage of the project. From left to right:

- Panel 1:** Features a photograph of a river with rocks. The text below the image is partially obscured but includes "F", "F", "T", "V", and "I". The Department of Ecology logo is at the bottom.
- Panel 2:** Features a photograph of water with a greenish tint. The text below includes "Low pH Total Maximum Daily Load (TMDL)". The Department of Ecology logo is at the bottom.
- Panel 3:** Features the Department of Ecology logo at the top. The text below includes "Pus", "Cre", "Cha", and "Two". A horizontal green line is present.
- Panel 4:** Features a photograph of a riverbank with green vegetation. The text below includes "Q", "P", and "Ef".
- Panel 5:** Features the Department of Ecology logo at the top. The text below includes "Low", "Daily", and "TMDL". A horizontal green line is present. Below the image is the text "Montl" and "Publ".
- Panel 6:** Features the Department of Ecology logo at the top. The text below includes "Lower White River pH Total Maximum Daily Load - Implementation Plan". Below the image is the text "Published December 2022" and "Publication 22-10-011a".

# Boise Creek – Highest Priority for FC TMDL

## Recommendations

### Cleanup priorities

The Boise Creek watershed is the number one priority cleanup basin for this Puyallup River Basin TMDL. King County and the city of Enumclaw should work together to locate and eliminate sources of fecal pollution (FC), particularly between CM 0.1 and 1.0.

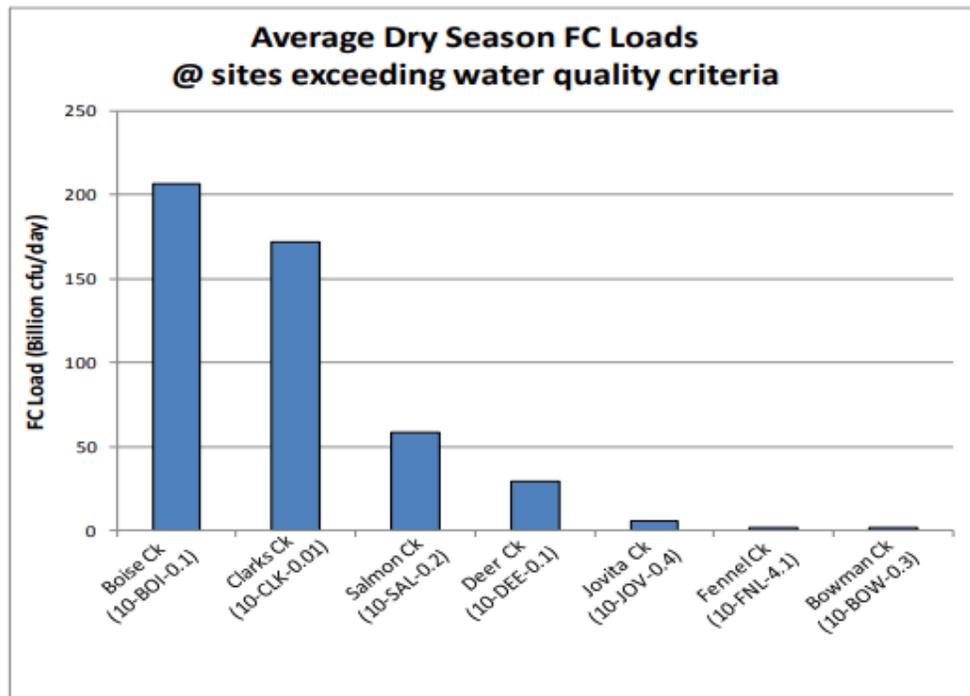


Figure 16. Average dry season FC loads for TMDL sites that exceeded water quality criteria.

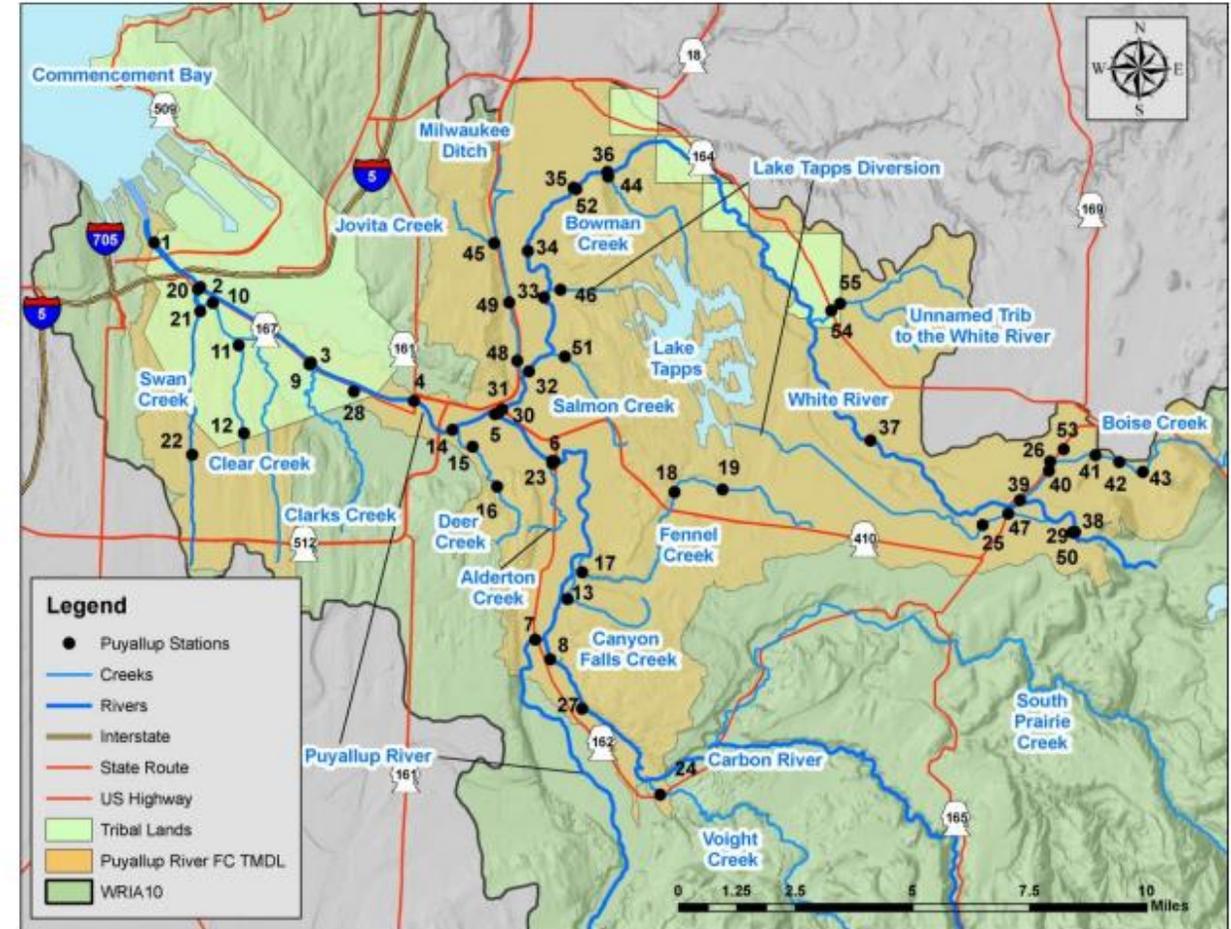
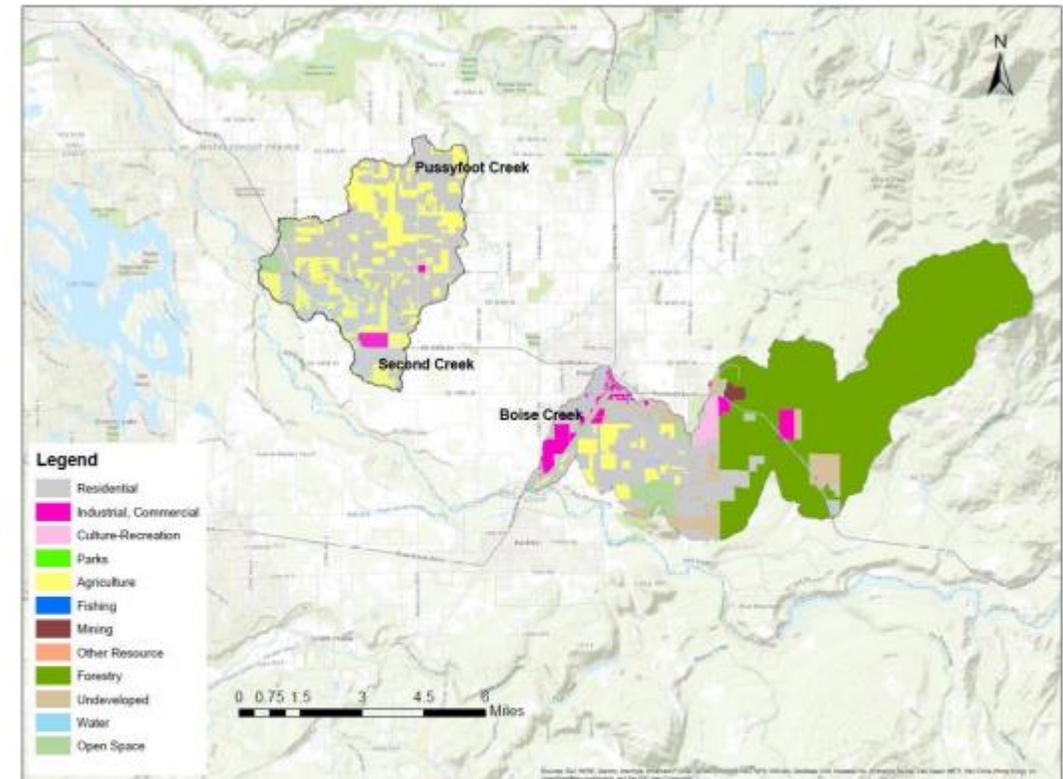


Figure 7. Map of Puyallup River watershed FC TMDL sampling stations.

# Boise, Pussyfoot & Second Creeks: Highest priority for nonpoint in WR pH TMDL

- Largest nonpoint reductions attainable in Boise, Pussyfoot and Second Creeks
- Established allocations for Soluble Reactive Phosphorus (SRP)



**Figure 2. Boise, Second, and Pussyfoot Creek land uses**

It is here that the biggest nonpoint load reductions are attainable as seen in the comparatively high anthropogenic nonpoint loading from the tributaries, Boise, Pussyfoot, and Second Creeks (Table 2). Three sub-watersheds in this middle reach, Boise, Pussyfoot, and Second Creeks (Figure 2) are the focus of the implementation plan that follows. Unless otherwise stated, the text that follows applies primarily to this middle reach, the Enumclaw plateau.

# TMDLs set Allocations/Targets

Puyallup Tribs FC TMDL Targets:

- Boise Creek dry season:
  - 92% reduction
- Boise Creek wet season
  - 61% reduction
- Pussyfoot Creek
  - 90% reduction

These % reductions are to get these streams to meet WQ criteria

WR pH TMDL Load Allocations:

Table E-31. Load allocations for nonpoint sources in the Lower White River pH TMDL.

~River Mile	Model Reach	Applicable Nonpoint Sources from Water Quality model	Nonpoint Reduction %	Medium Flow LA (lbs SRP/day)	Low Flow LA (lbs SRP/day)	Nonpoint Reduction Needed to meet LA (lbs SRP/ day)	
						Medium Flow	Low Flow
27	1	Red Creek	0%	0.230	0.116	0	0
23	5	Boise Creek	50% <sup>1</sup>	1.317	0.623	0.257	0.097
15.7	13	Second Creek (aka Trib15.7)	35% <sup>1</sup>	0.024	0.016	0.012	0.008
15.6	14	Pussyfoot Creek (aka Trib15.6)	35% <sup>1</sup>	0.141	0.098	0.051	0.035

35-50% reduction in anthropogenic SRP

## Status and Trends

4 sites

Monthly sampling all 10 years

Fecal Coliform + *E.coli*  
Ammonia  
Nitrate/Nitrite  
Total Persulfate Nitrogen  
Total Phosphorous  
Orthophosphate

Field parameters: Temp, Cond, DO, pH,  
Turbidity

## Implementation

All 26 sites

Bi-Monthly sampling years 1, 5, 10

Fecal Coliform + *E.coli*

Field parameters: Temp, Cond, DO, pH,  
Turbidity

SOURCE TRACING: Monitoring as needed for tracing sources of pollution and identifying likely causes.

2019-2020

2020-2023

2023-2024

2024-2028

2028-2029

Status and Trend  
Implementation

Status and Trend

Status and Trend  
Implementation

Status and Trend

Status and Trend  
Implementation

## My plea to you fine folks

- You know all sorts of stuff that I don't!
- Please use your expertise to consider what these trends and patterns could mean for sources.
- You don't need to share with the group, but connect the dots!

Example: One area consistently polluted; anything come to mind?  
Drainage infrastructure in areas with high wet season pollution?



Make this data MEAN something



# Status and Trends - Bacteria

What does five years of data tell us?



Observed FC (cfu /100 mL)		FC Reduction	FC Target Capacity (cfu /100 mL)	
Geo-mean	90th %tile		Geo-mean	90th %tile
68	248	20%	55	200
58	251	20%	47	200
401	2435	92%	33	200
724	1556	87%	93	200
105	462	57%	45	200
99	507	61%	39	200
295	586	66%	100	199
194	876	77%	44	200
70	507	61%	27	200
57	614	67%	18	200
52	351	43%	30	200
86	274	27%	63	200
39	476	58%	17	200
32	1475	86%	4	200
203	2057	90%	20	200

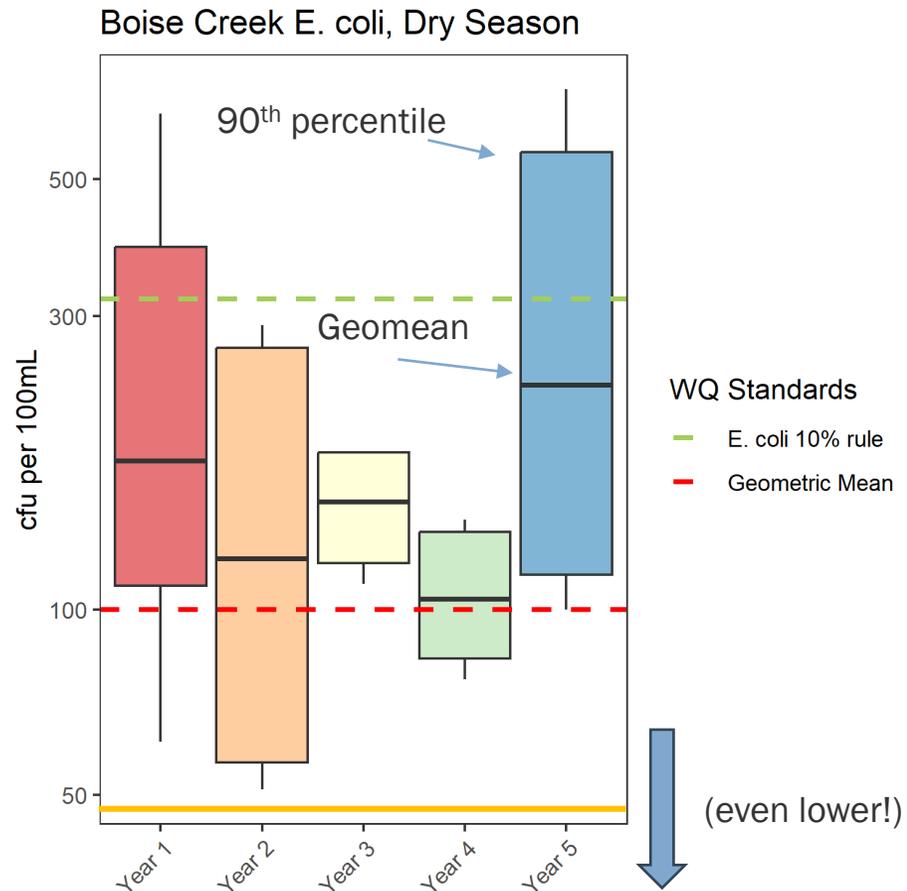
# Using *E. coli*... for now

- *E. coli* maybe more useful for implementation purposes (KC data)
- Comparing against current WQ Criteria (*E. coli*) **first** and, if meeting, **then** ask if meeting TMDL targets (FC)
- FC still used for TMDL targets

**Table ES-2. FC reductions and target capacity for the White River and its tributaries.**

Station ID	Site Description	Observed FC (cfu /100 mL)		FC Reduction	FC Target Capacity (cfu /100 mL)	
		Geo-mean	90th %tile		Geo-mean	90th %tile
<b>Dry Season (July – October)</b>						
10-WHT-0.1	White River at mouth	68	248	20%	55	200
10-WHT-1.4	White River at 142nd	58	251	20%	47	200
10-BOI-0.1	Boise Creek at mouth	401	2435	92%	33	200
10-BOI-1.0	Boise Creek at 252nd	724	1556	87%	93	200
10-BOI-2.2	Boise Creek at 276th	105	462	57%	45	200
10-BOW-0.3	Bowman Creek at Kersey Way	99	507	61%	39	200
10-JOV-0.4	Jovita Creek at West Valley Hwy E	295	586	66%	100	199
10-SAL-0.2	Salmon Creek at East Valley Hwy	194	876	77%	44	200
<b>Wet Season (November to June)</b>						
10-BOI-0.1	Boise Creek at mouth	70	507	61%	27	200
10-BOI-1.0	Boise Creek at 252nd	57	614	67%	18	200
10-MIL-2.2	Milwaukee Ditch near Hwy 167	52	351	43%	30	200
10-SAL-0.2	Salmon Creek at East Valley Hwy Trib to White R at Auburn Riverside	86	274	27%	63	200
10-TAS-0.01	HS	39	476	58%	17	200

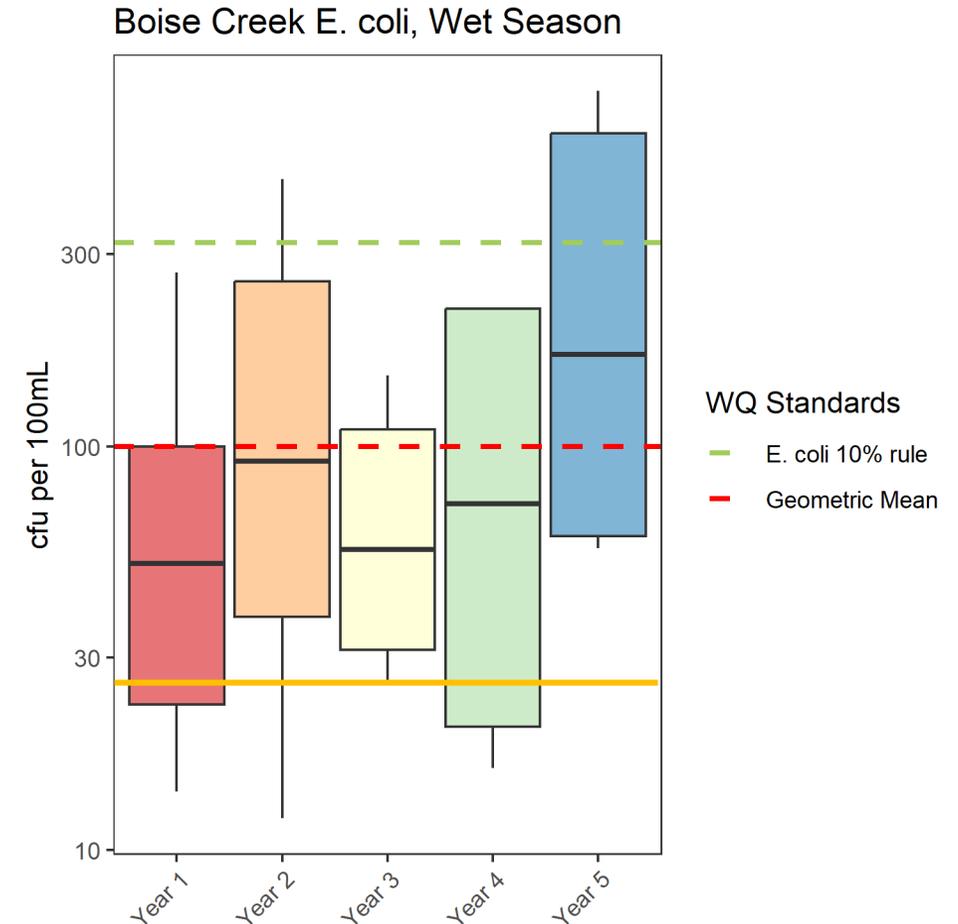
# No Improvement in Boise Creek, Dry Season



- Haven't met WQ Criteria yet!
- These criteria are much less protective than the Puyallup FC TMDL WQ targets
- Year 4 missed most of summer, when concentrations are highest
- Dry season indicative of livestock access to streams, runoff from irrigation/land application, late summer runoff events.

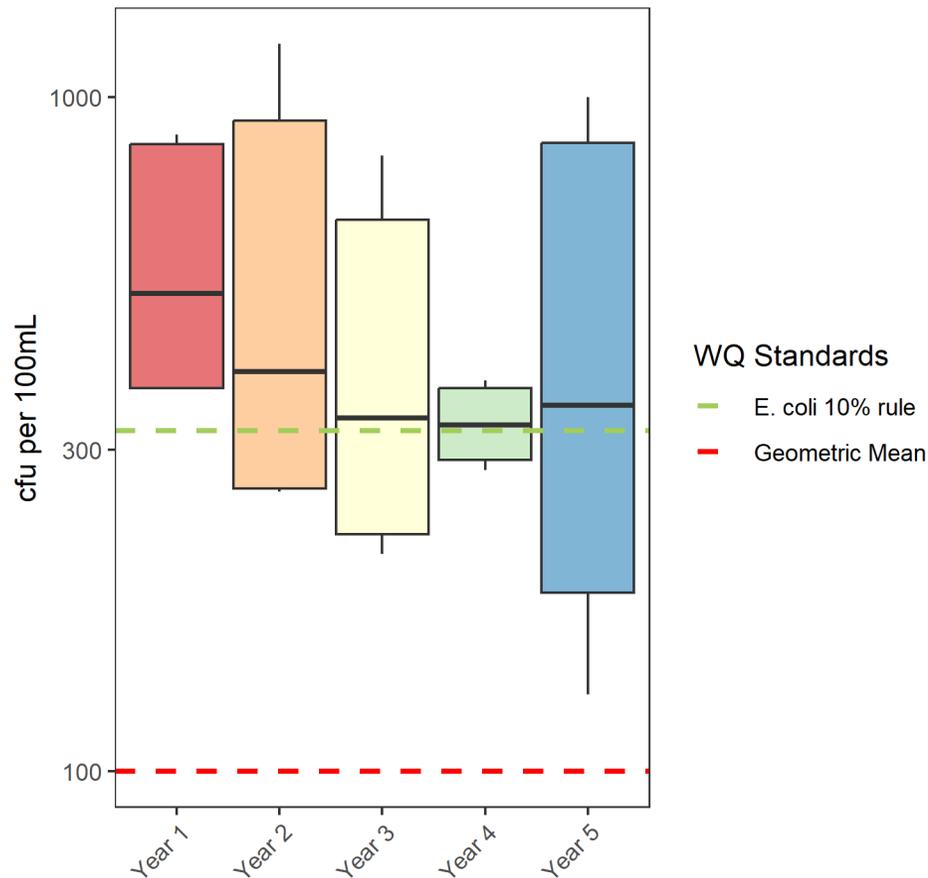
# No Improvement in Boise Creek, Wet Season

- Years 1-4 meeting WQ criteria
  - (Definitely *not* meeting FC target from TMDL, however)
- Year 5 wet season incomplete, could look different
- No trend

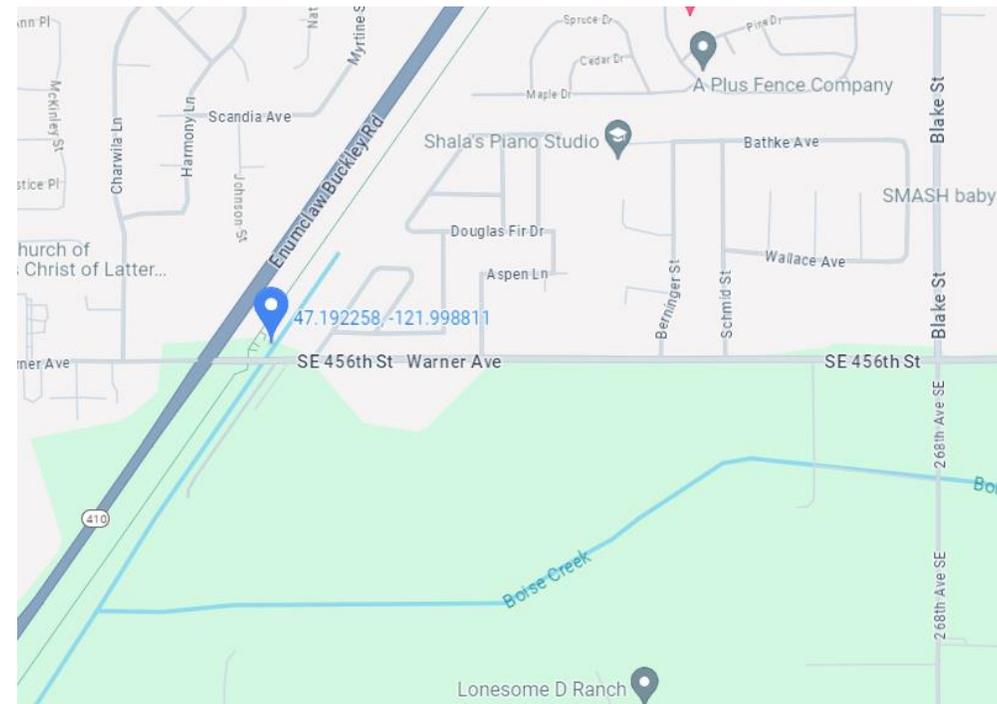


# No Improvement in Boise Creek Tributary, Dry Season

Boise Creek Tributary E. coli, Dry Season

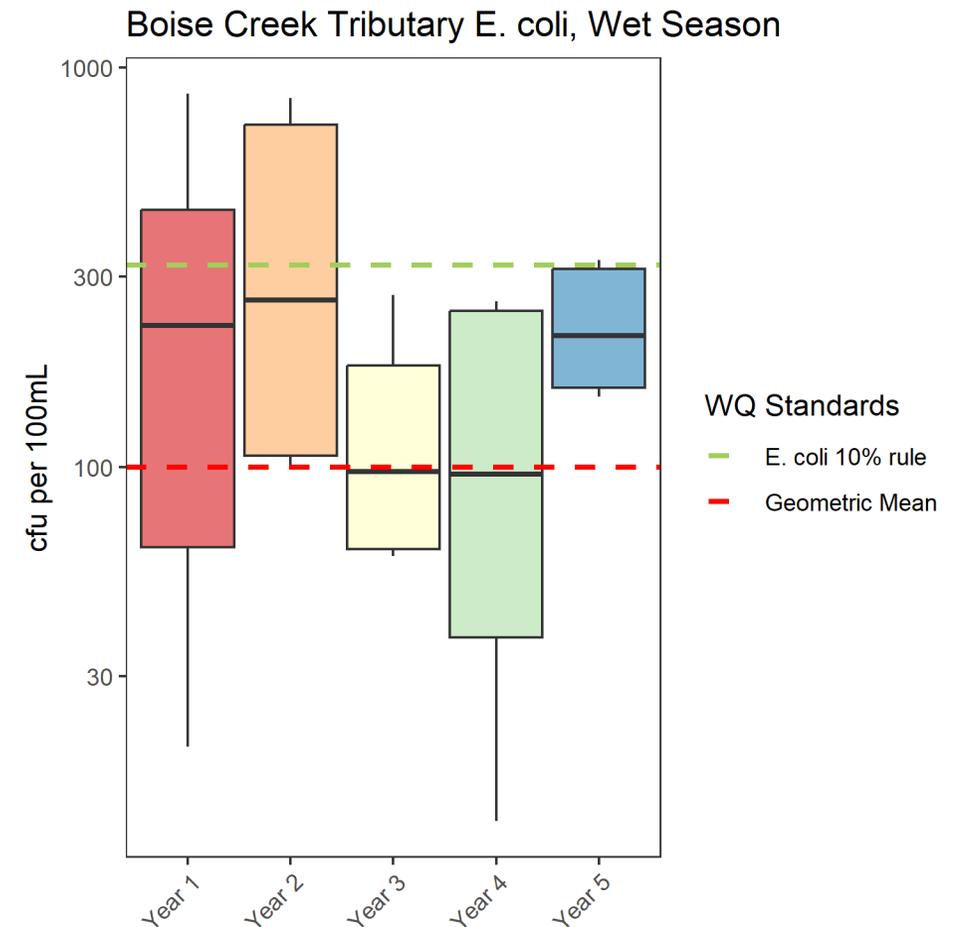


- No trend
- Elevated concentrations
- Very low flows in dry season

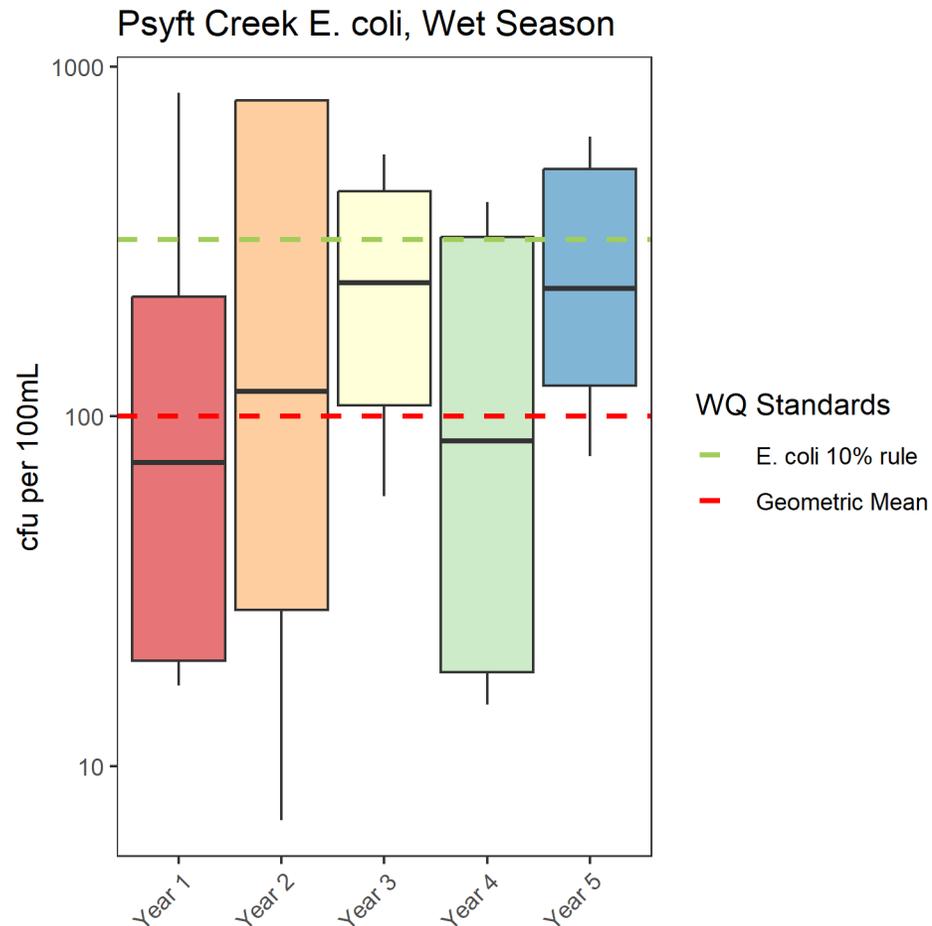


# No Improvement in Boise Creek Tributary, Wet Season

- Year 5 incomplete
- Met criteria years 3 & 4
  - Does not have TMDL target
- Considerably higher flows in wet season



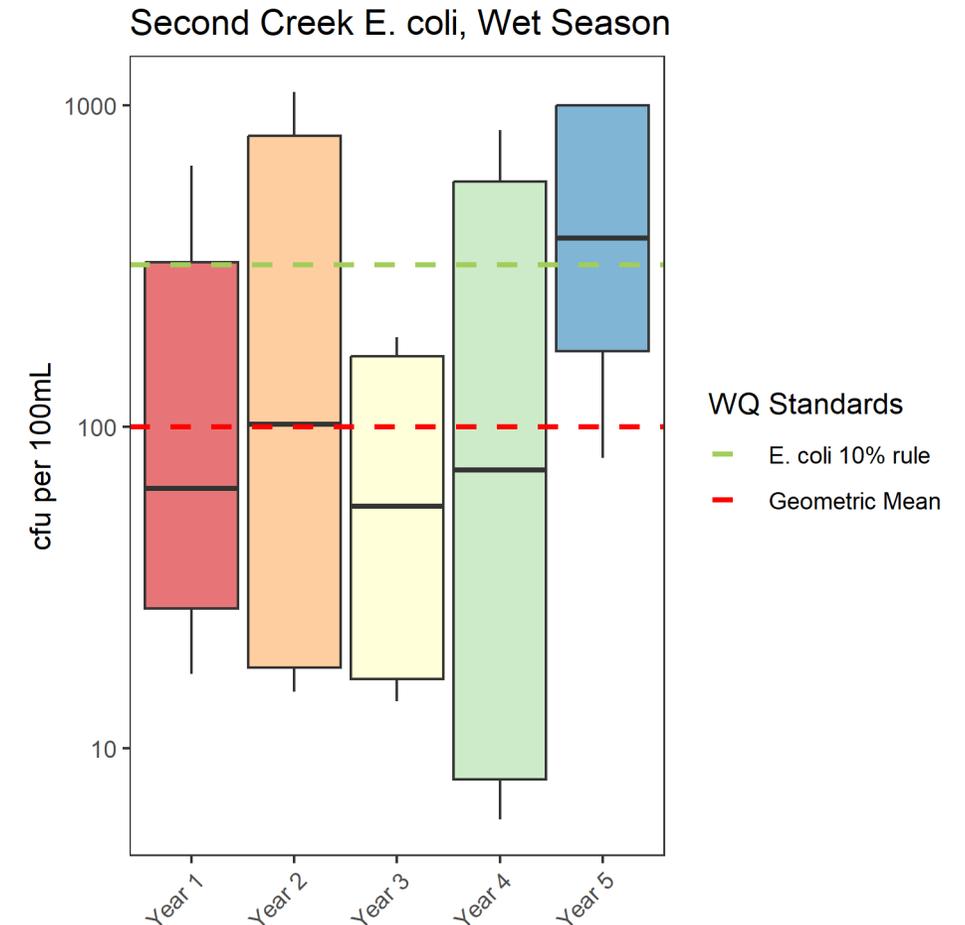
# No Improvement Pussyfoot Creek, Wet Season



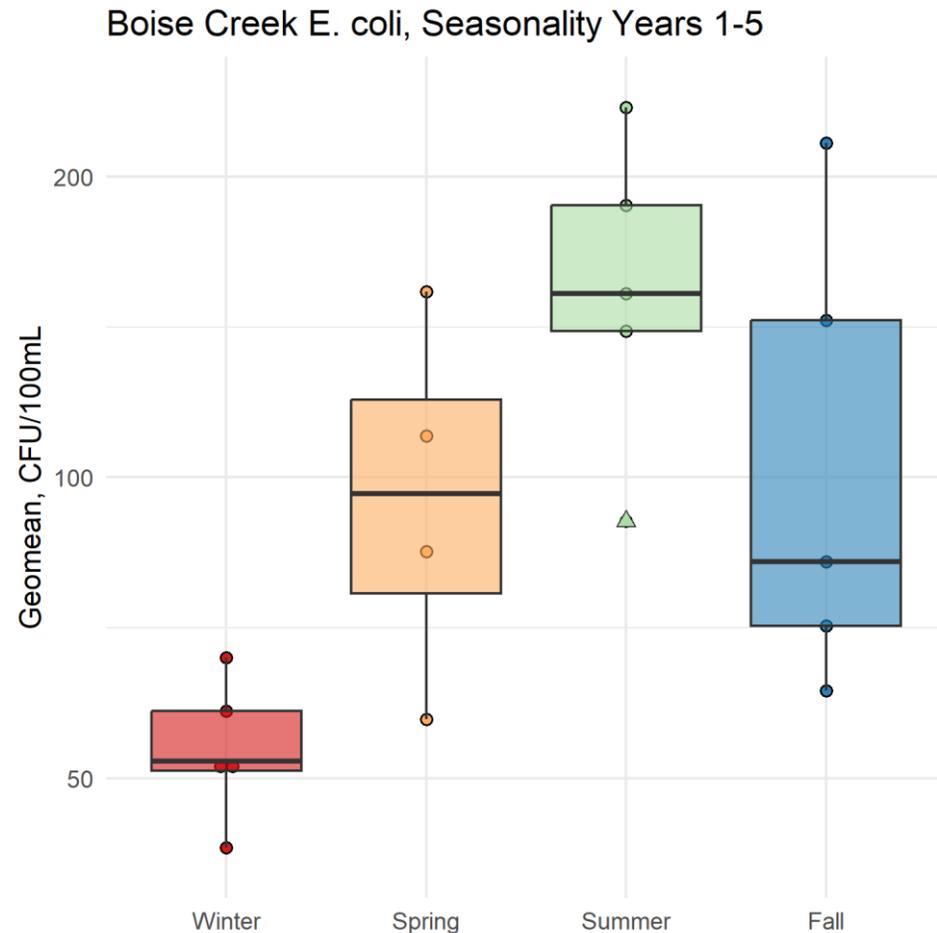
- No sign of improvement over five the five-year period
- Year 5 still ongoing

# No Improvement Second Creek, Wet Season

- No sign of improvement over five the five-year period
- Year 5 ongoing



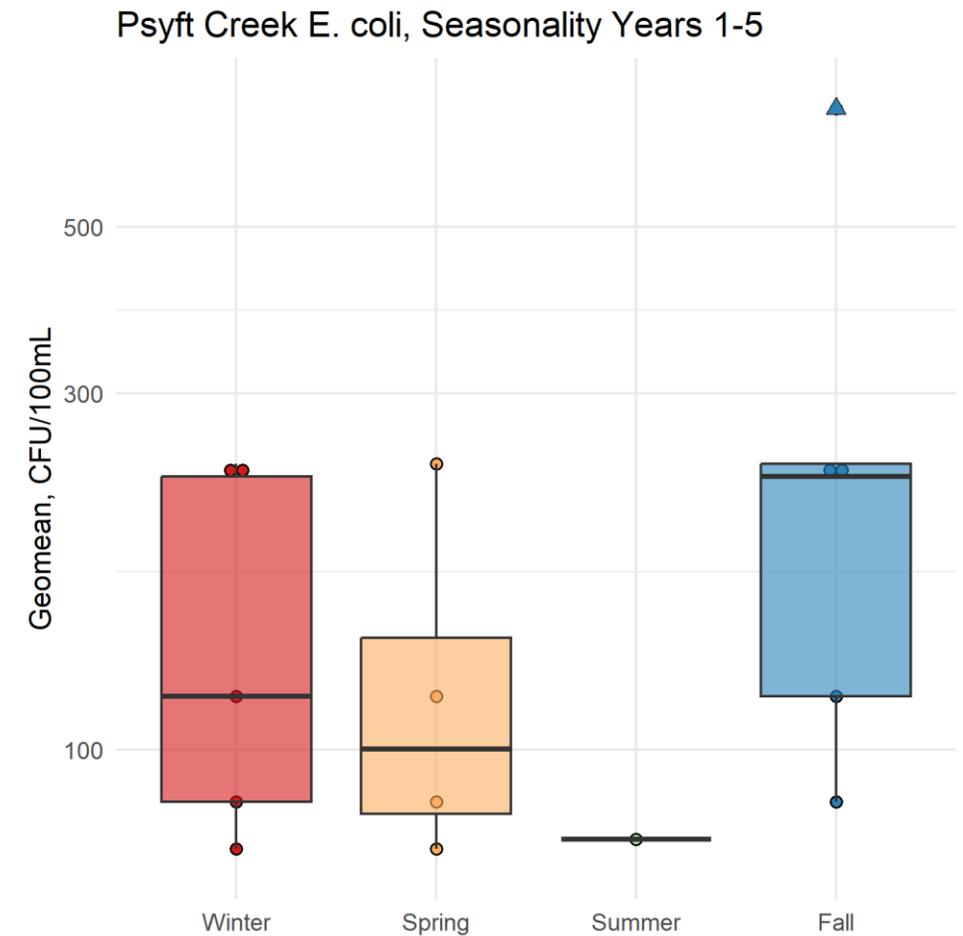
# Boise Creek most Polluted in Summer



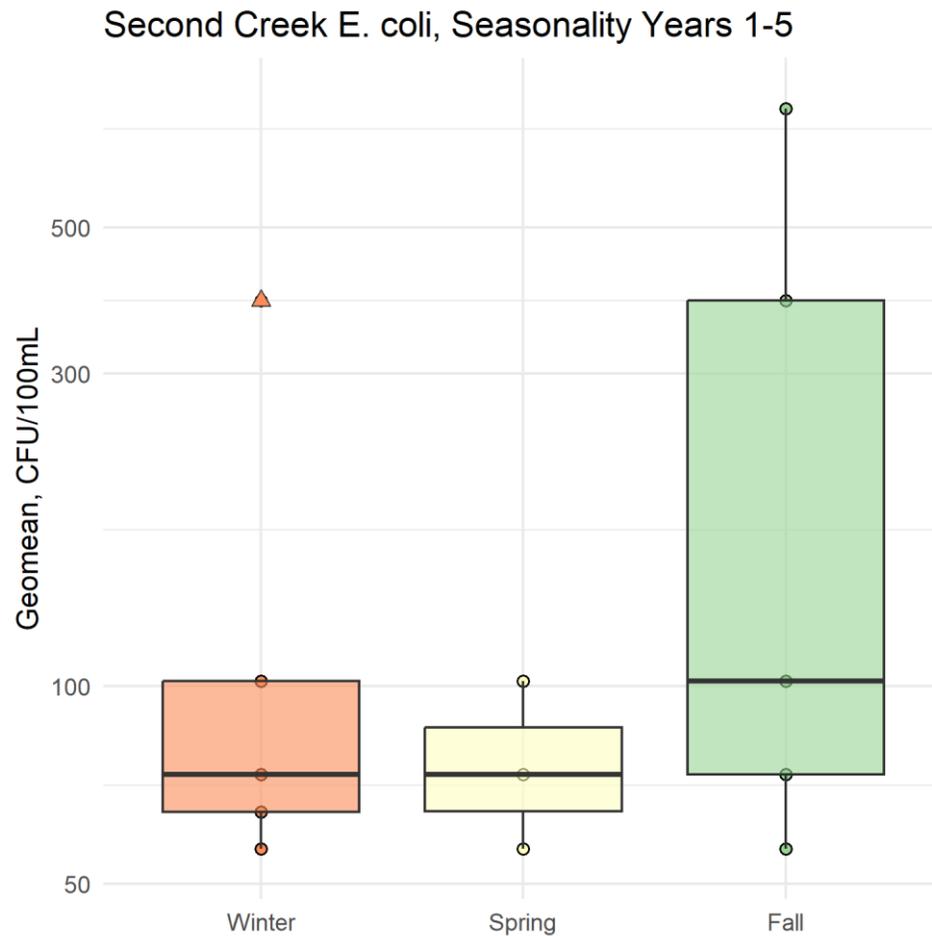
- Consistently highest concentrations in summer
- Dilutes in winter

# Pussyfoot Creek, Less Seasonality

- Fall has highest hits (look at median geomean) with first flushes of the season
- Winter and spring maintain higher levels through the wet season



# Second Creek, Fall Runoff then Dilution



- Considerably more diluted in winter and spring compared with Pussyfoot
- Year 5 winter likely to move the needle up in Second Creek

## Takeaways- Bacteria

- Boise Creek:
  - Not meeting WQ criteria in the dry season.
  - Wet season typically meeting WQ criteria, year 5 TBD
    - Still not meeting FC TMDL targets
  - Summer has consistently highest concentrations
- Pussyfoot & Second Creeks:
  - Neither consistently meeting WQ criteria
  - No trends showing improvement
  - Pussyfoot Creek maintains higher concentrations through winter/spring
  - Second Creek historically flushes out/dilutes after fall runoff

# Status and Trends - Nutrients

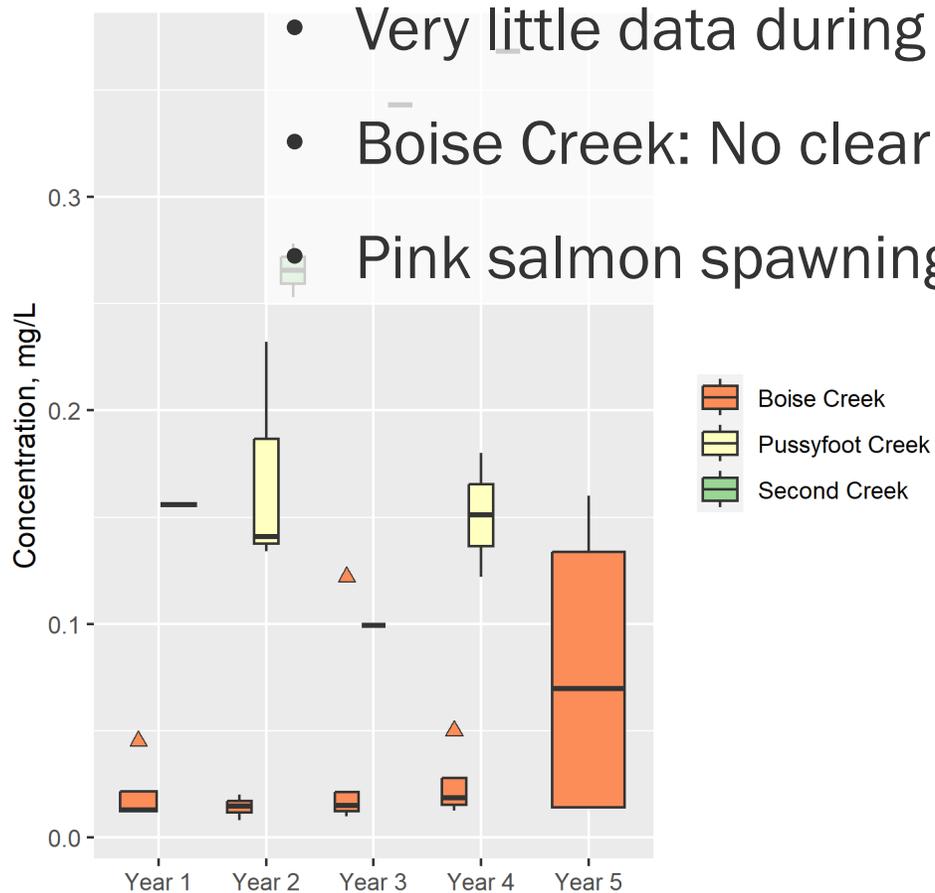
Are we seeing reductions yet?



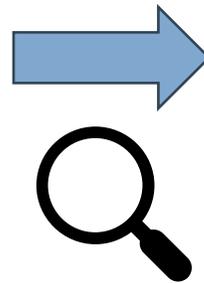
Year 3 (2025)	Year 3 (2025)
Implementation Progress Milestones	Implementation Progress Milestones
Priority Reach	BMPs Installed*
A	≈ 60 %
E	≈ 40 %
B	≈ 20 %
Load Reduction Milestone	Load Reduction Milestone
Boise, Pussyfoot, Second Creek mouths**	≈ 33 % SRP nonpoint load reduced

# No Improvement in Orthophosphate, Critical Period (May-Oct)

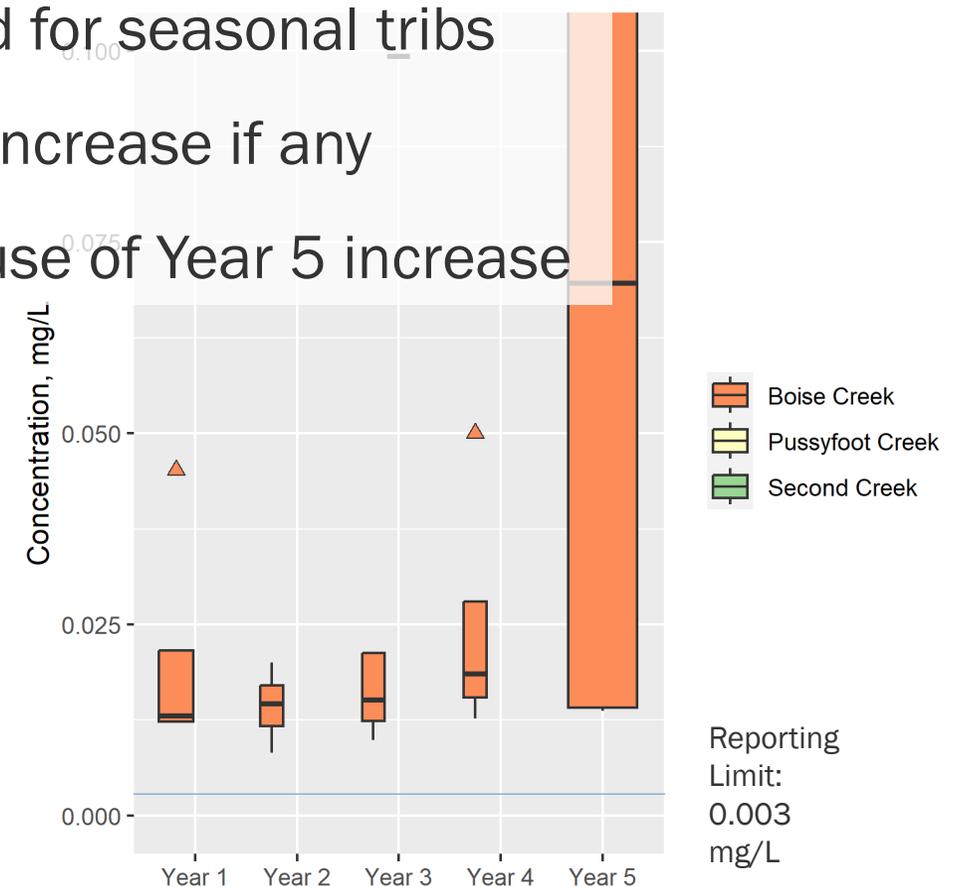
Ortho-Phosphate, Critical Season Years 1-5



- Very little data during Critical Period for seasonal tribs
- Boise Creek: No clear trend; slight increase if any
- Pink salmon spawning possible cause of Year 5 increase

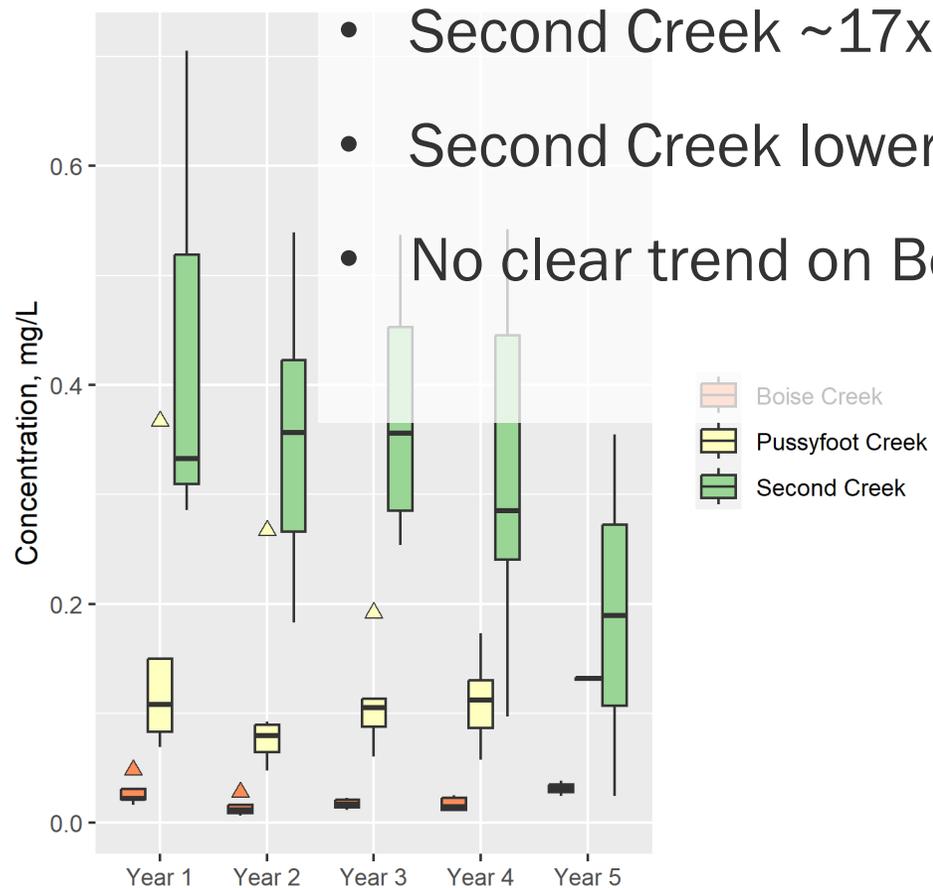


Ortho-Phosphate, Critical Season Years 1-5

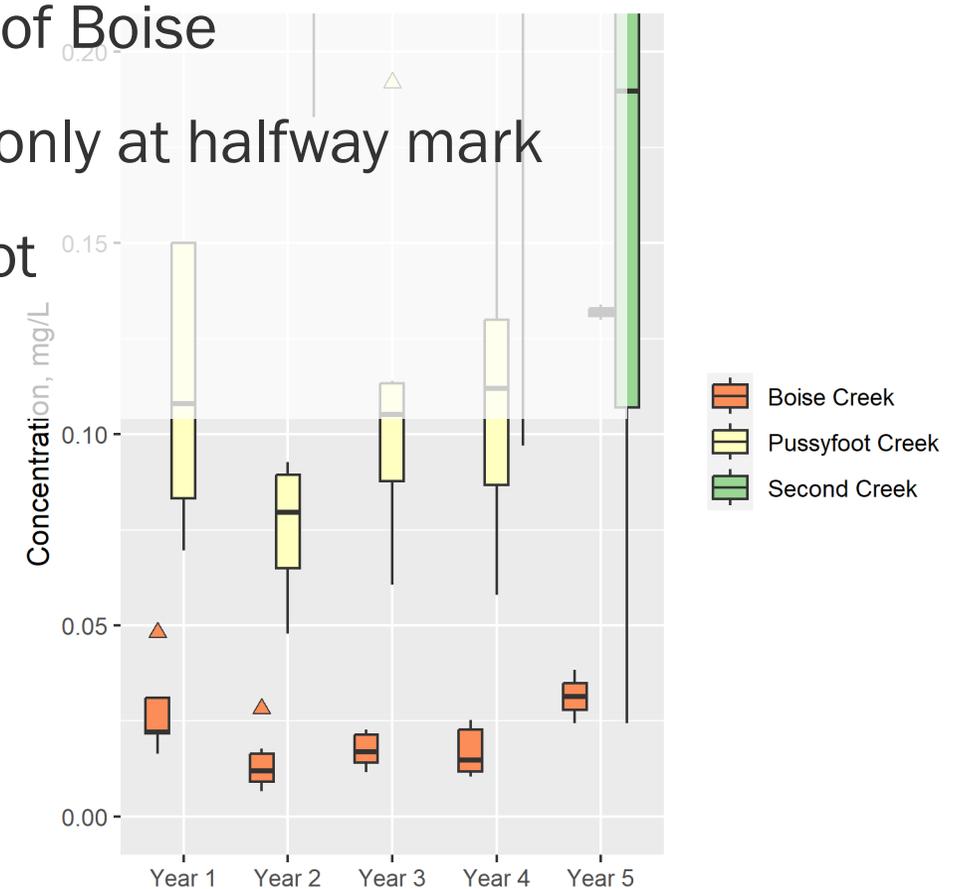


# Minimal/No Improvement in Orthophosphate, Non-Critical Period (Nov-April)

Ortho-Phosphate, Non-Critical Season Years 1-5

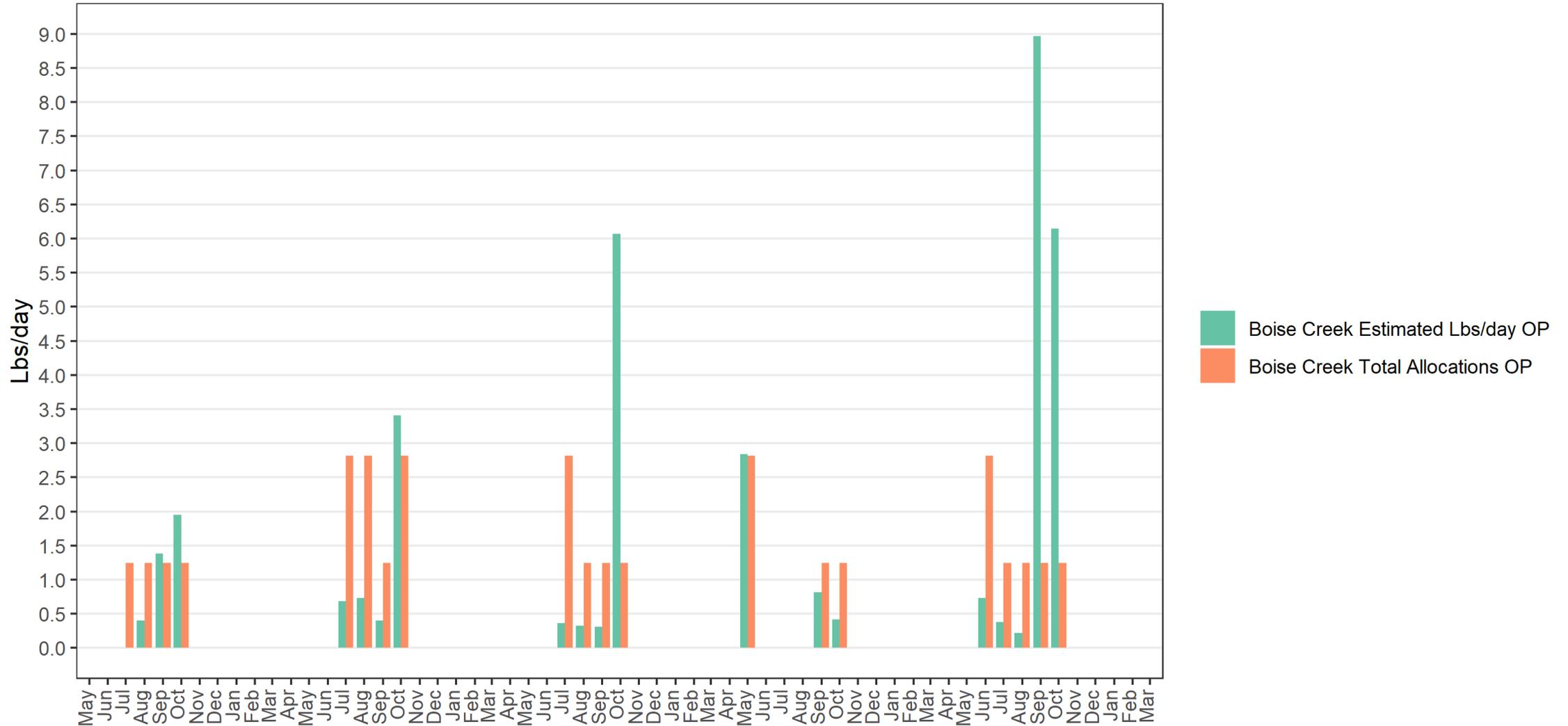


Ortho-Phosphate, Non-Critical Season Years 1-5



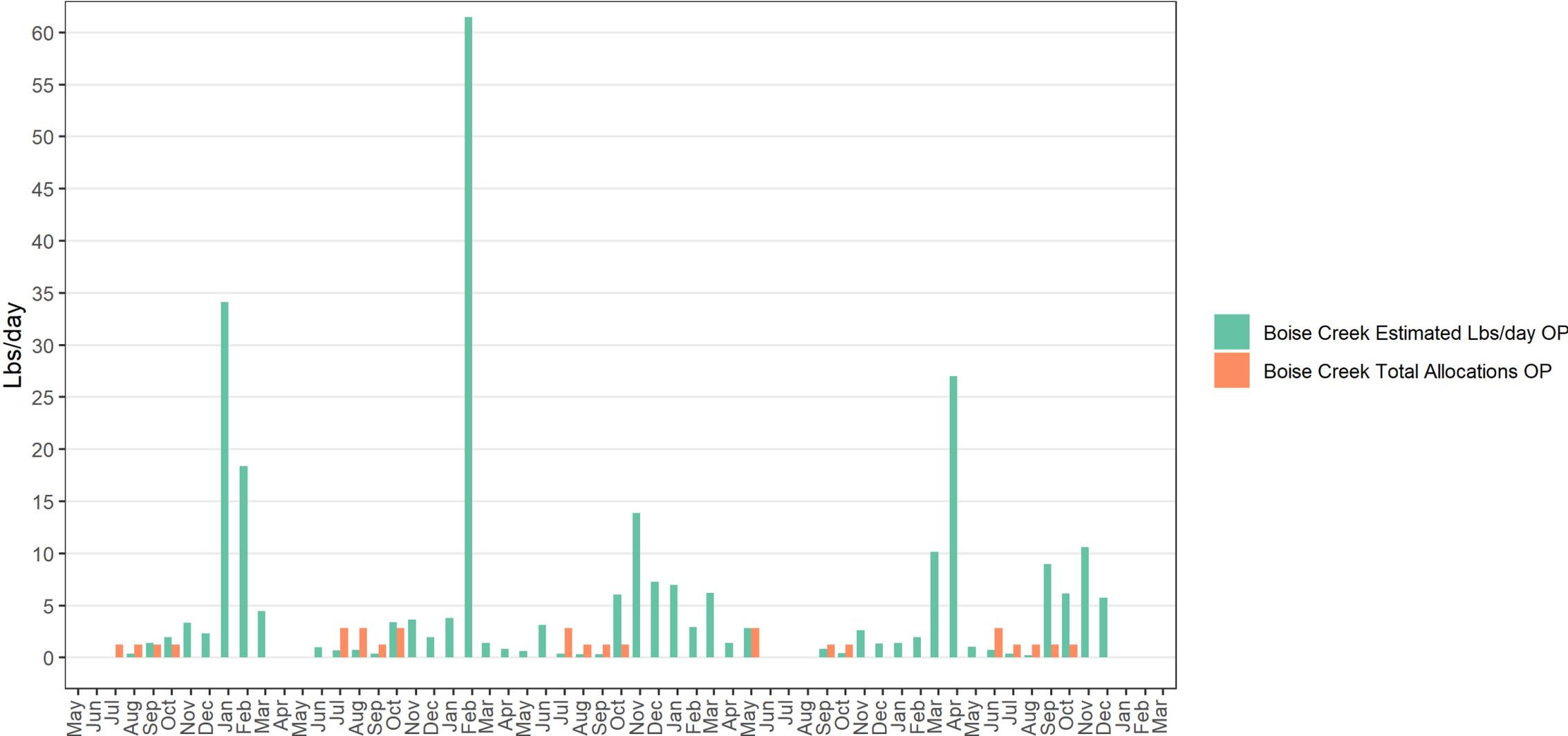
# No encouraging (estimated\*) trend of exceeding load allocations for SRP (OP)

Boise Creek Orthophosphate and WR TMDL Allocations



# OP loading outside of the Critical Period

Boise Creek Orthophosphate and WR TMDL Allocations



# Takeaways- Nutrients

- Not on track to hit milestone, but... there's still time!

Year 3 (2025)	Year 3 (2025)
Implementation Progress Milestones	Implementation Progress Milestones
Priority Reach	BMPs Installed*
A	≈ 60 %
E	≈ 40 %
B	≈ 20 %
Load Reduction Milestone	Load Reduction Milestone
Boise, Pussyfoot, Second Creek mouths**	≈ 33 % SRP nonpoint load reduced

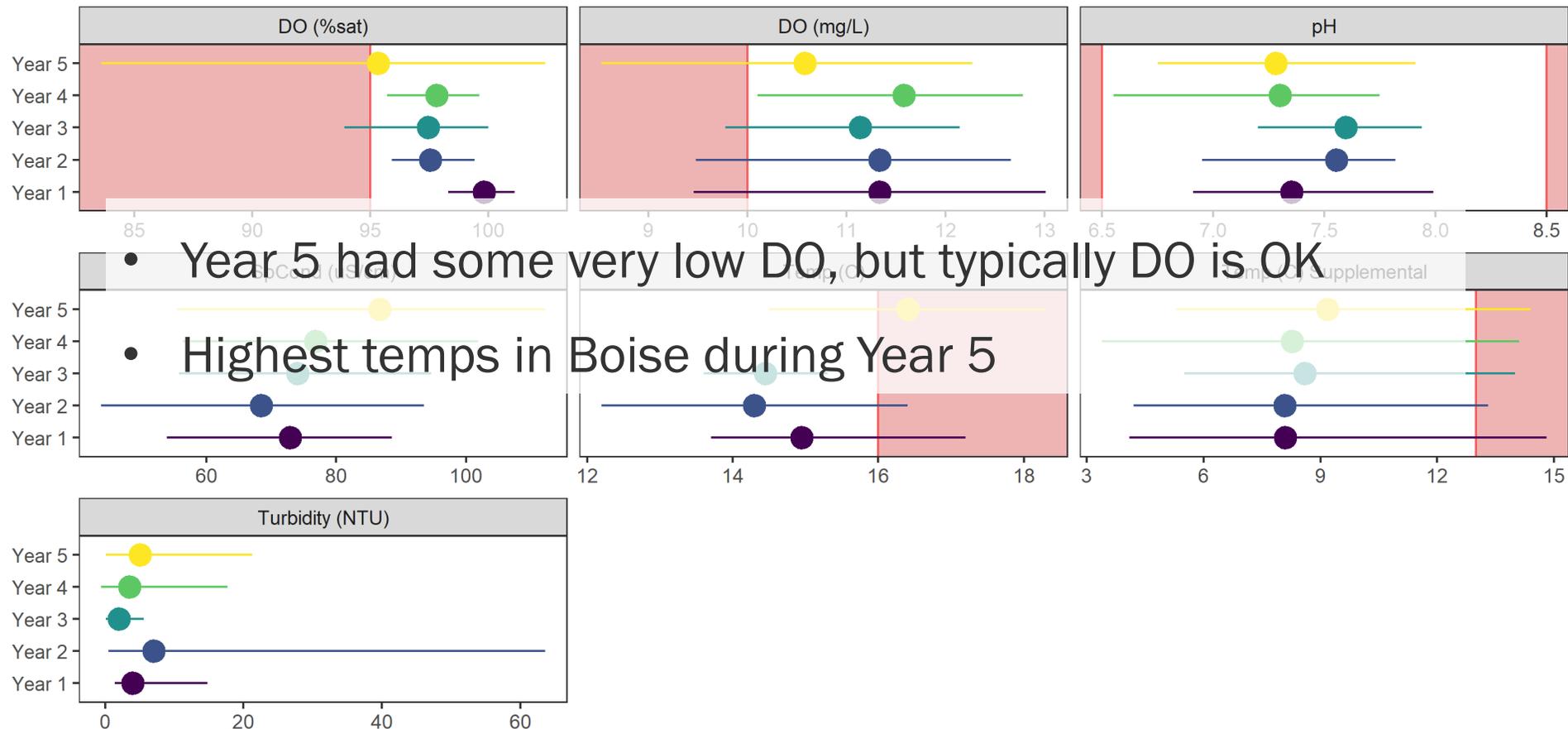
# Status and Trends – Field Measurements

Any notable trends?



# YSI Measurements – Boise Creek

Boise Creek In-Situ Parameters: Mean and Range, Years 1 through 5

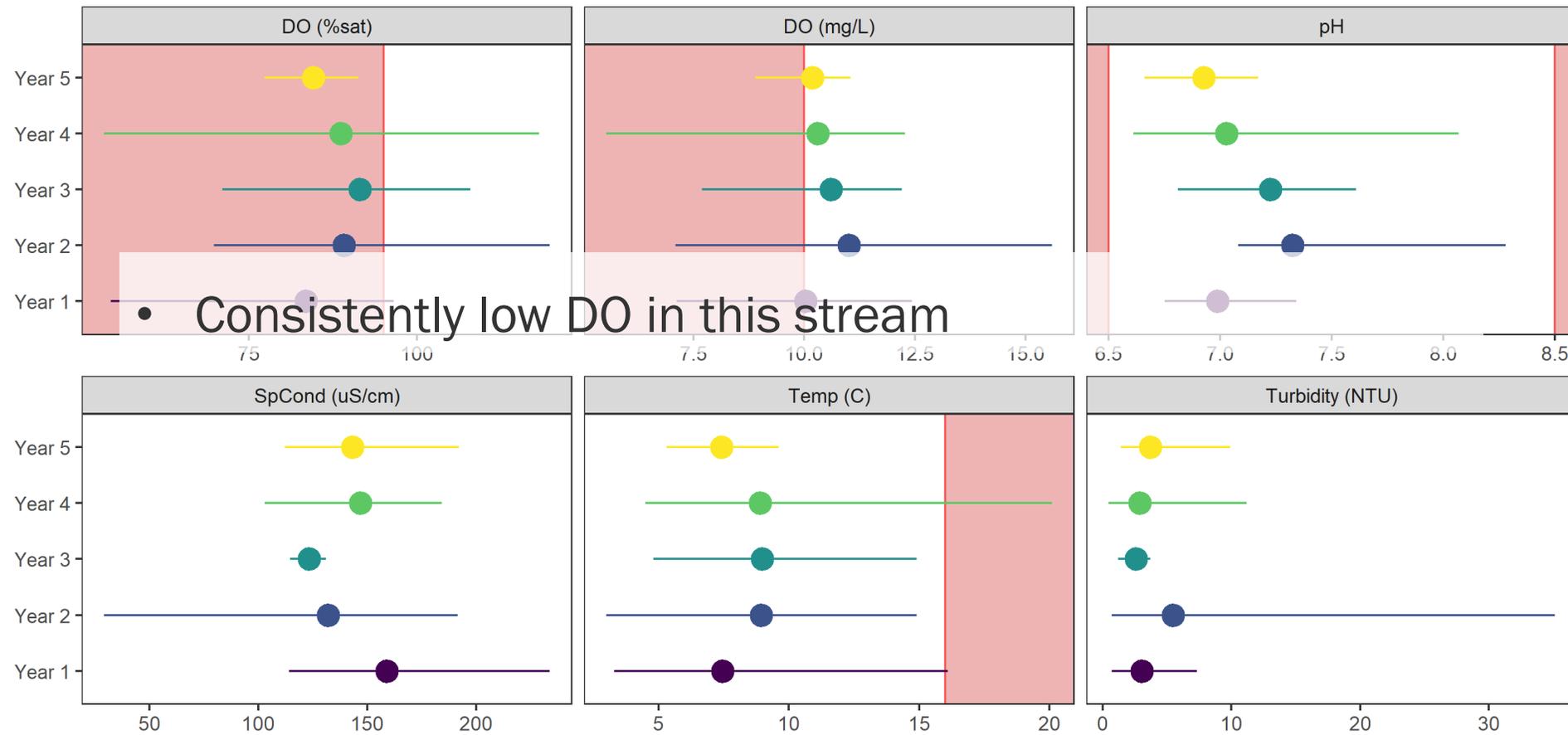


- Year 5 had some very low DO, but typically DO is OK

- Highest temps in Boise during Year 5

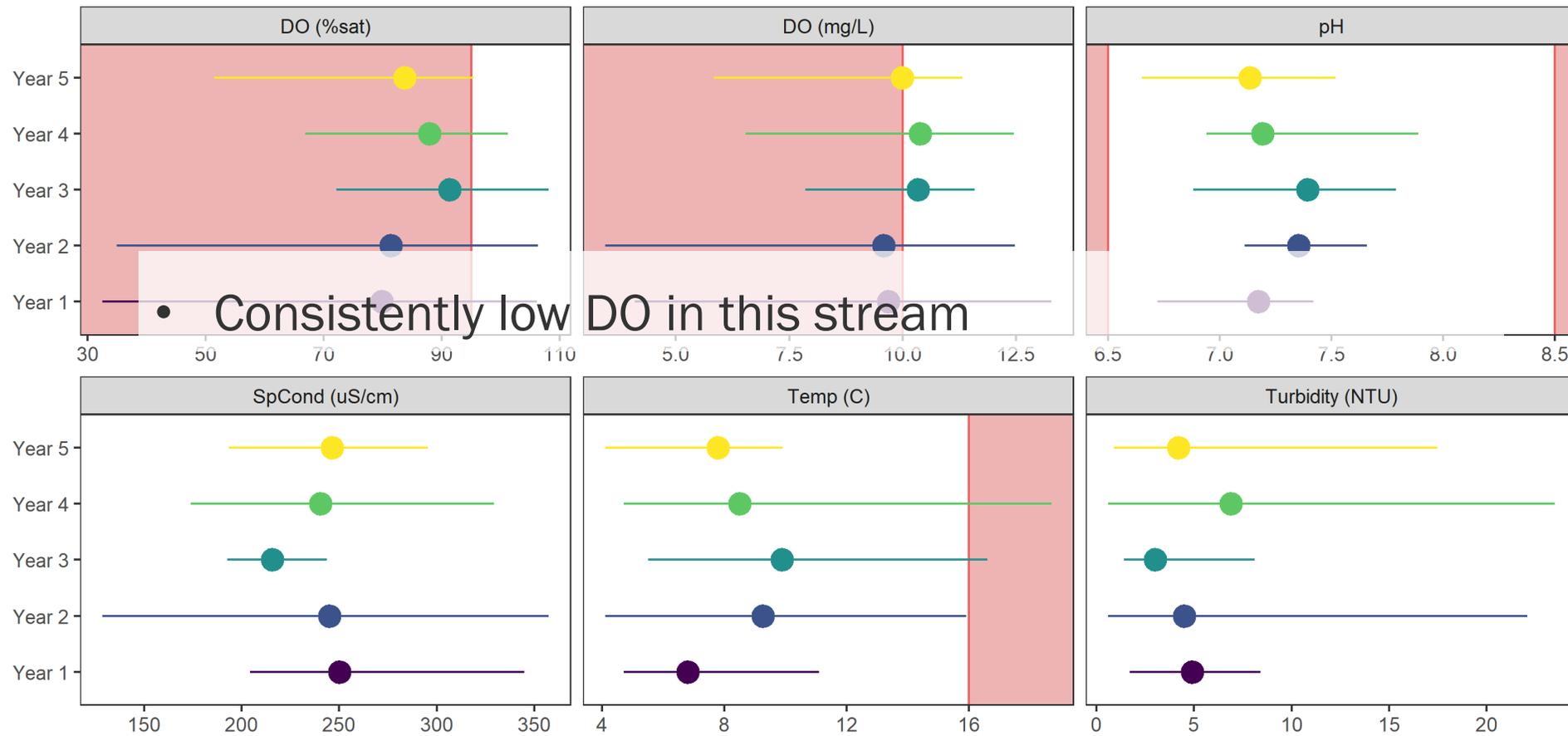
# Field Measurements – Pussyfoot Creek

Pussyfoot Creek In-Situ Parameters: Mean and Range, Years 1 through 5



# Field Measurements – Second Creek

Second Creek In-Situ Parameters: Mean and Range, Years 1 through 5



## Takeaways- Field Measurements

- Year 5 stands out on Boise Creek for DO
- Pussyfoot & Second Creeks consistently low DO



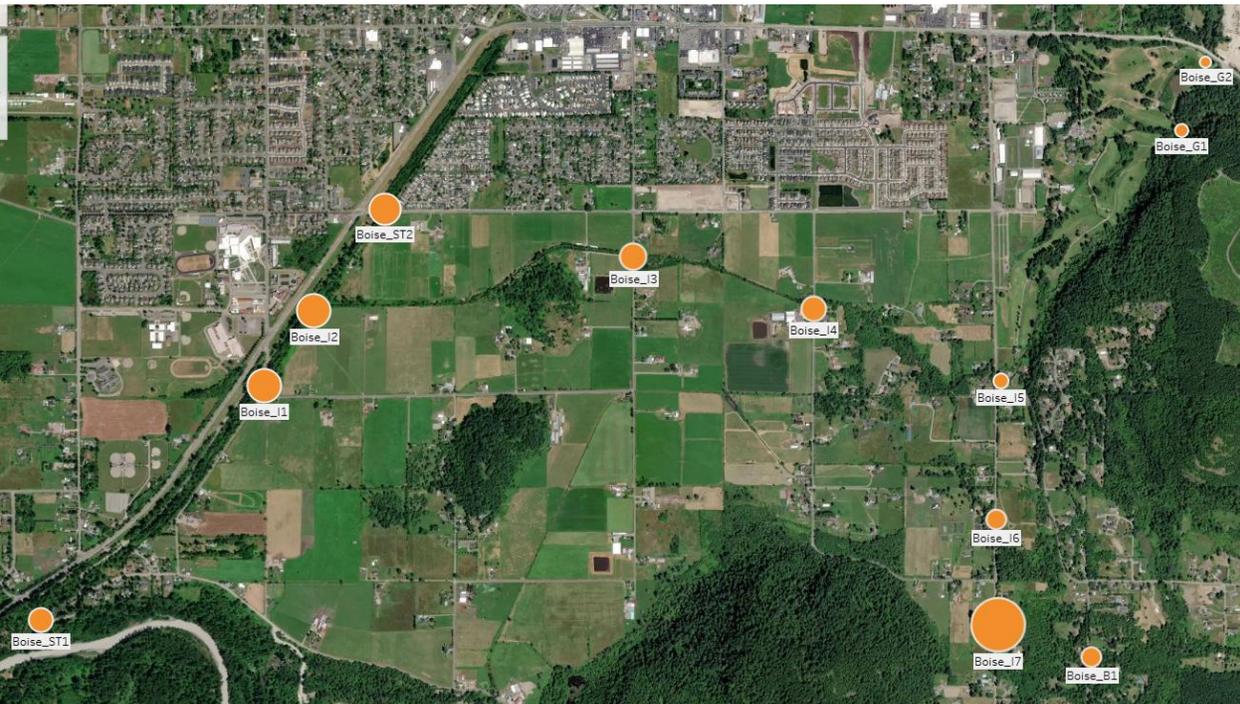
# Implementation Sites – Bacteria, Year 5

Where are the hot spots?

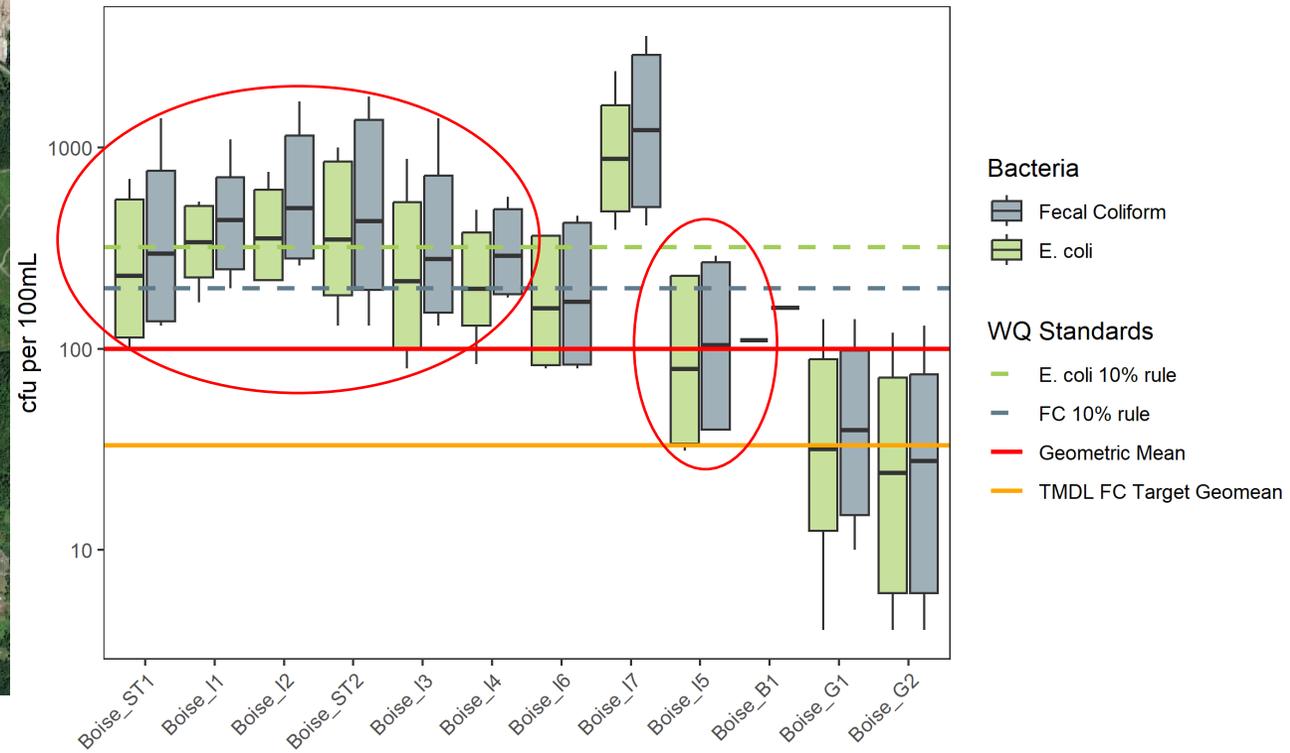


# Pollution Starts at the Plateau

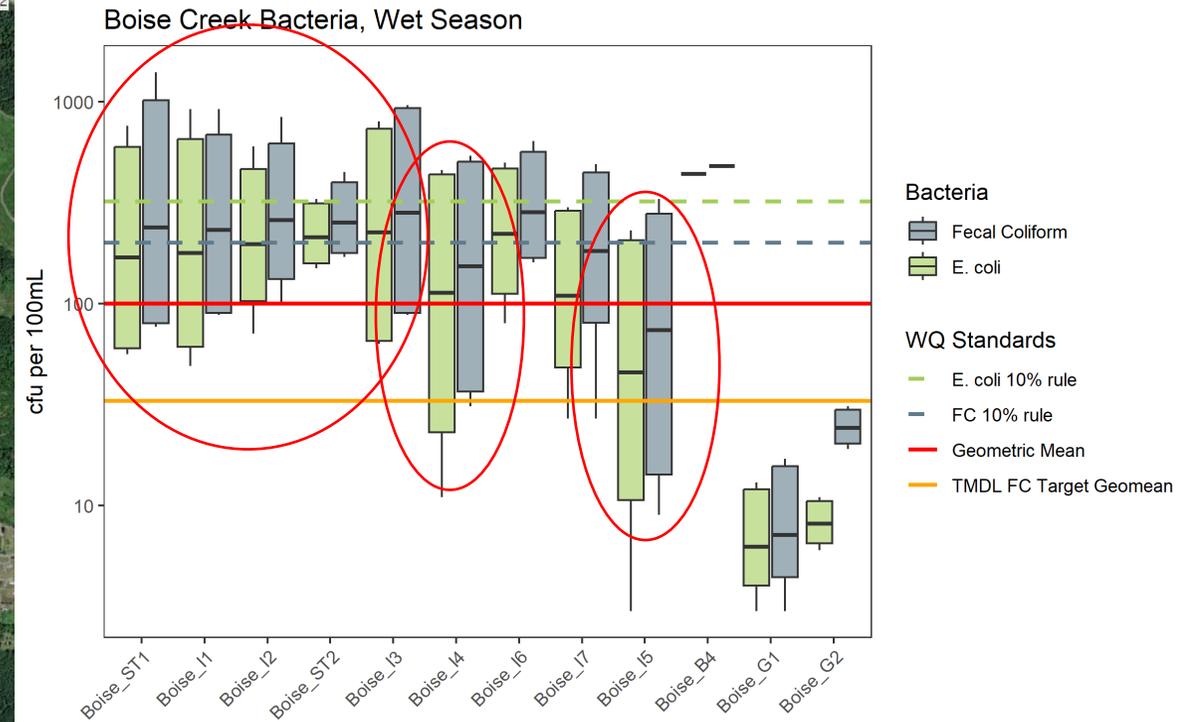
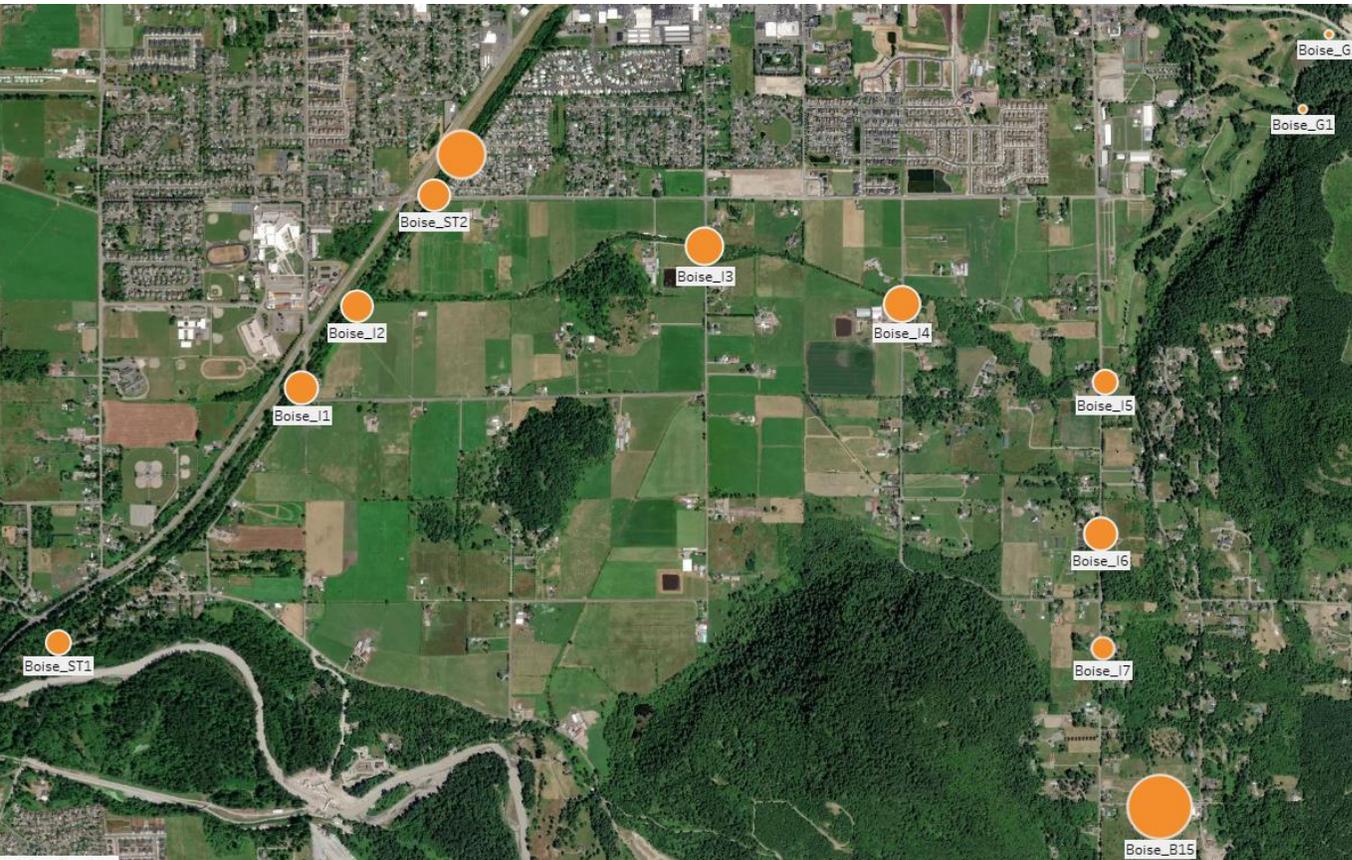
## Boise Creek, Dry Season



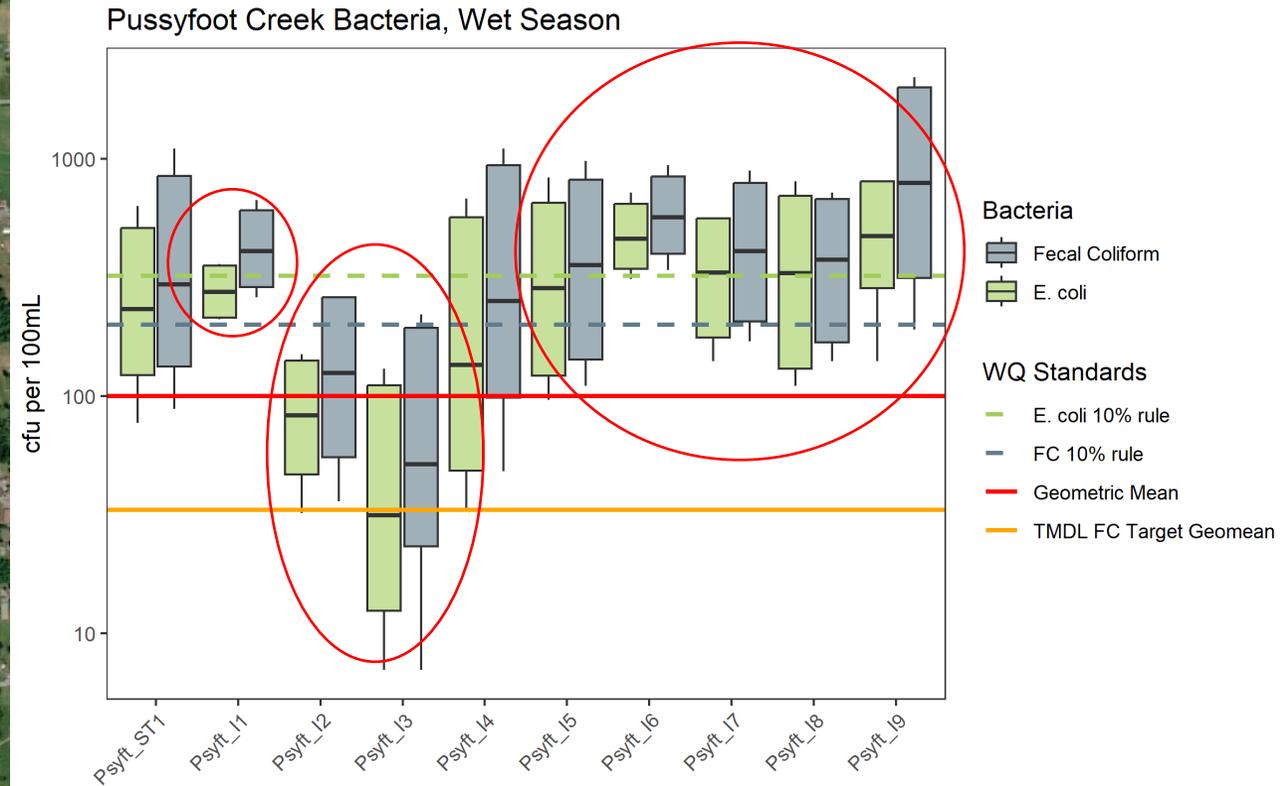
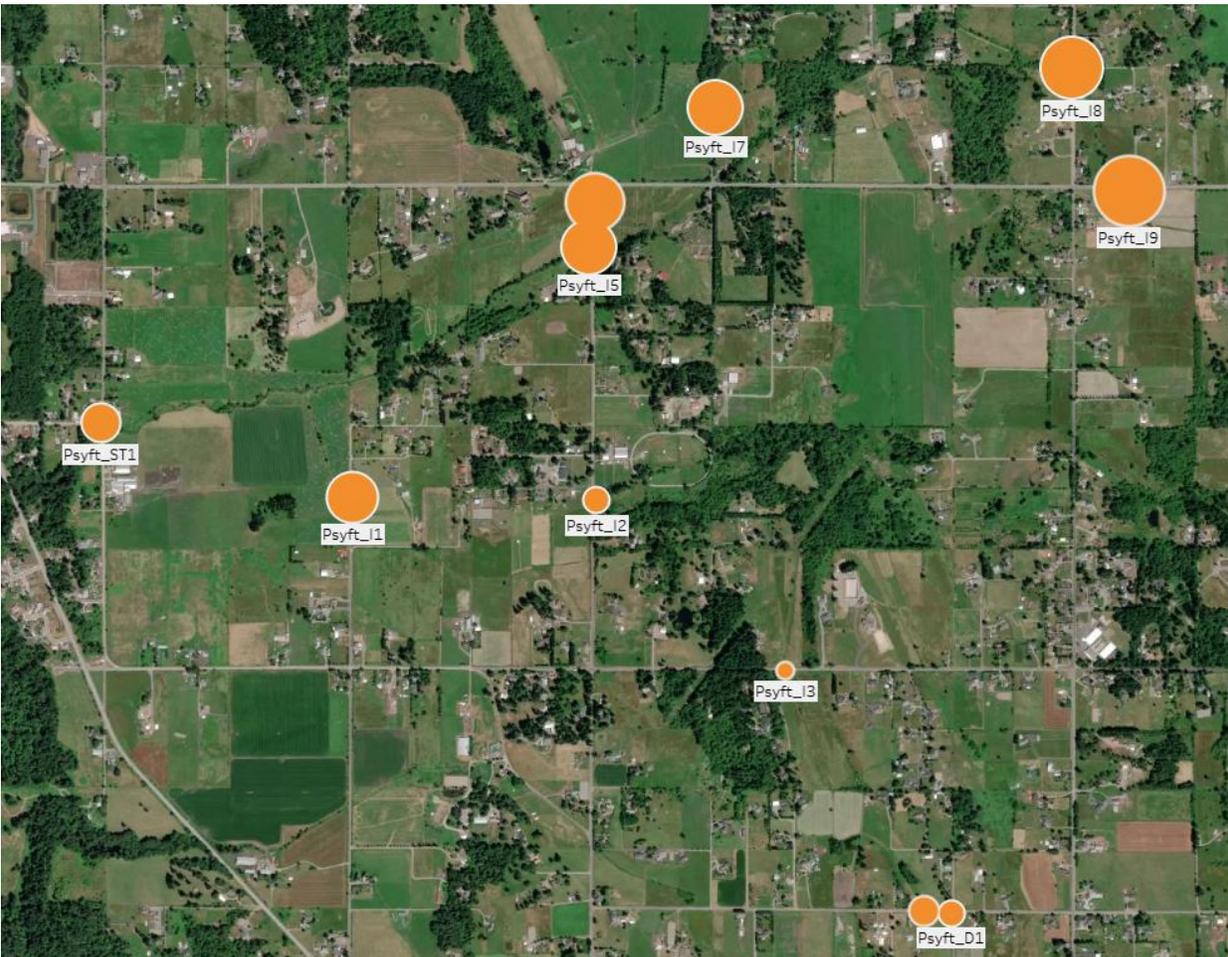
Boise Creek Bacteria, Dry Season



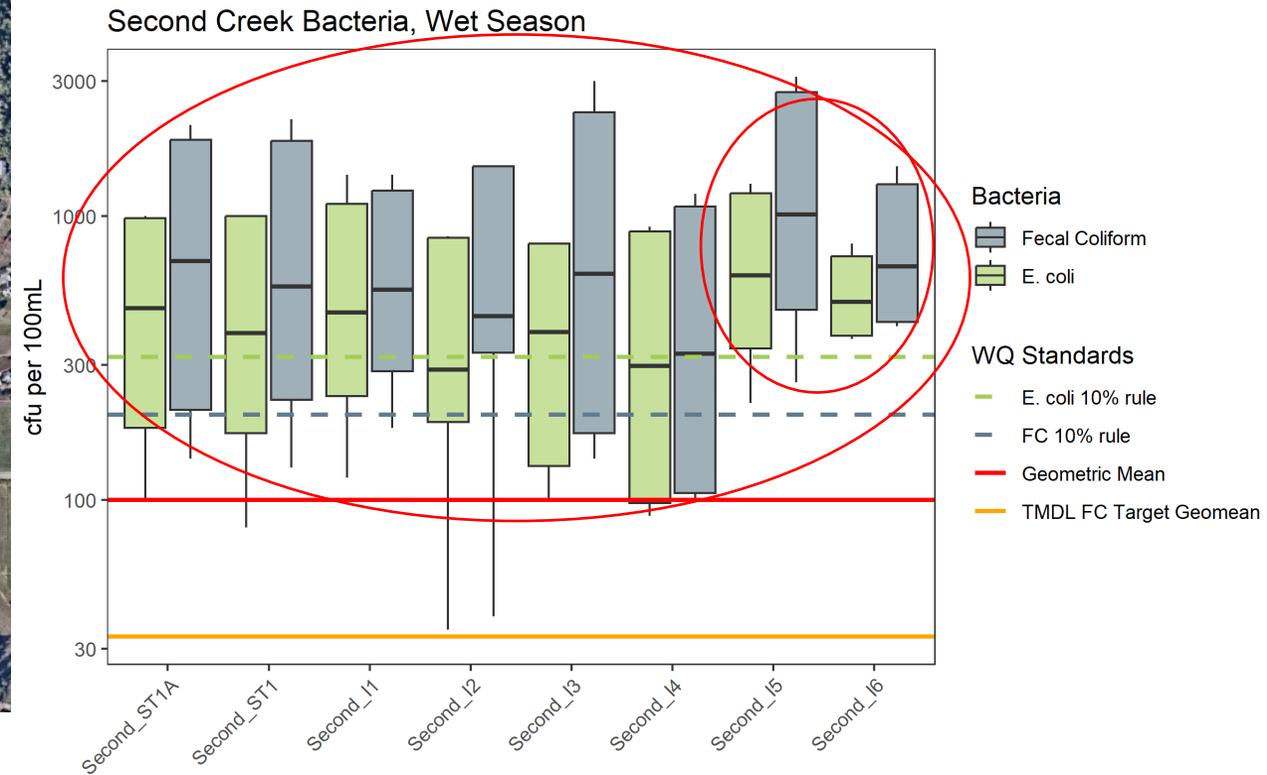
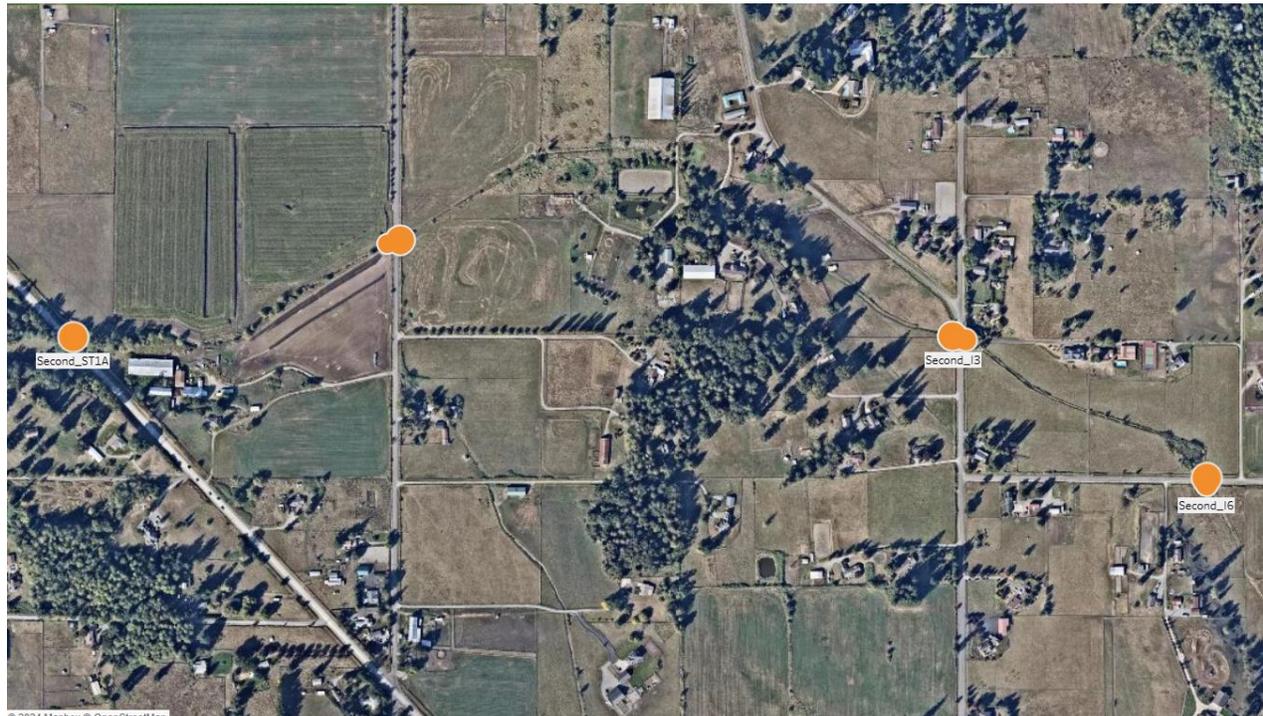
# Similar Story in the Wet Season



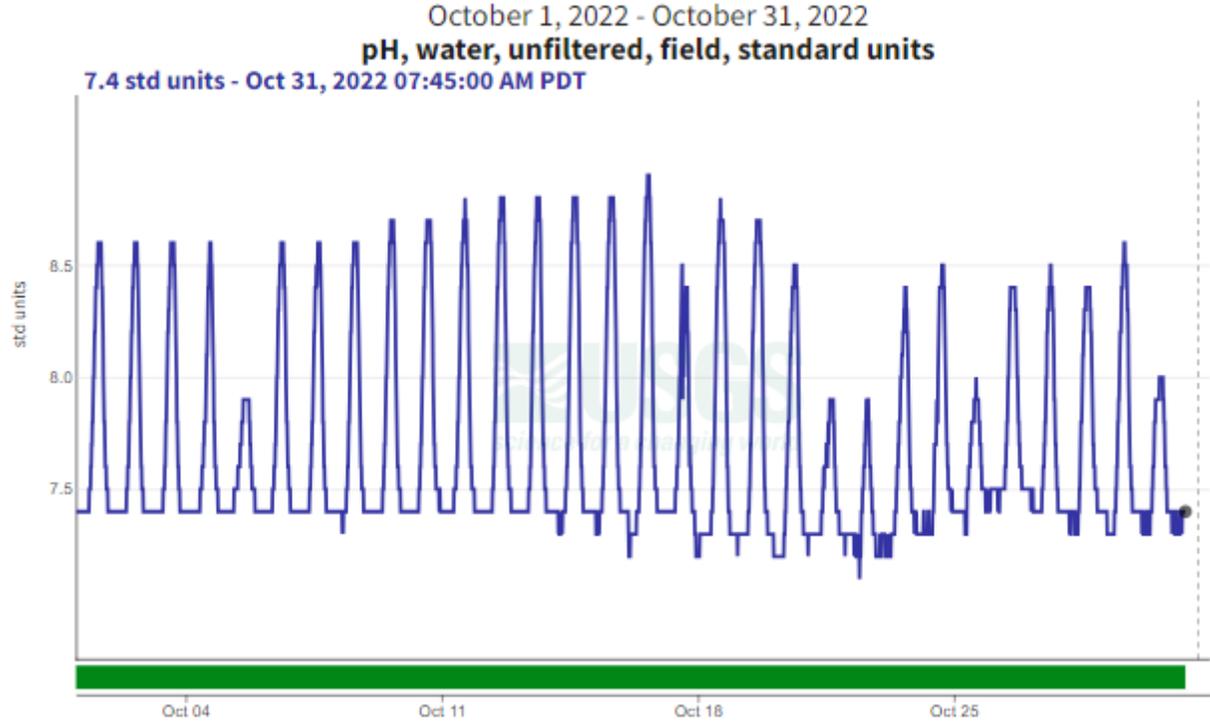
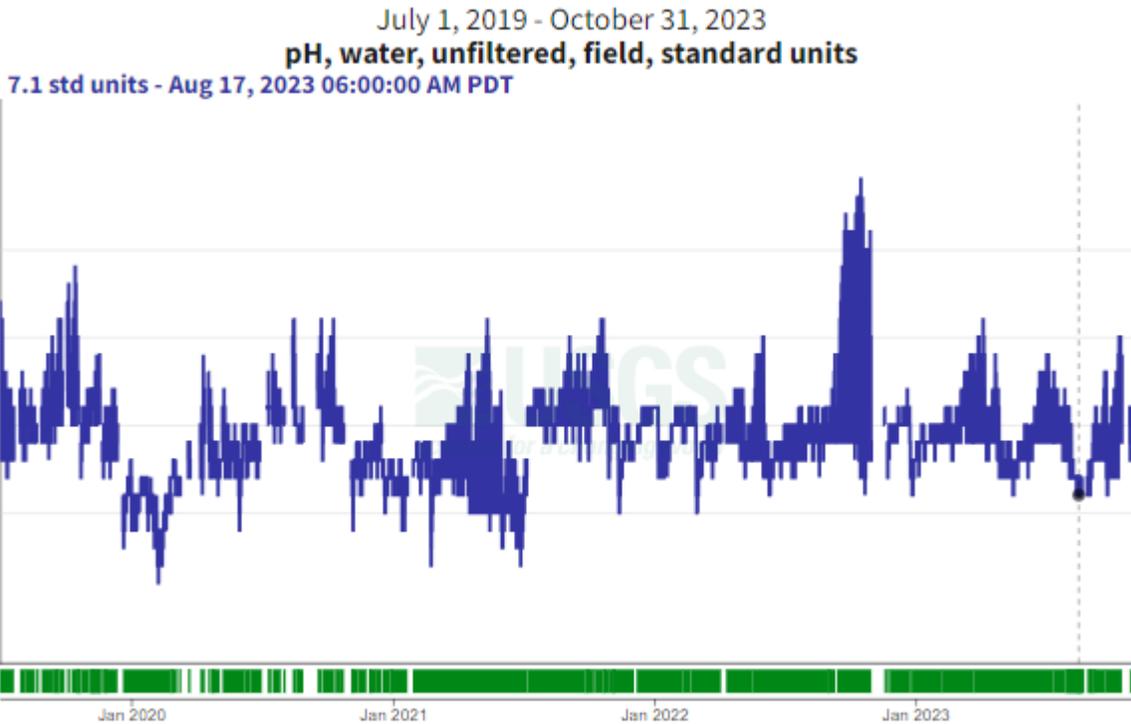
# Data Points to North Fork of Pussyfoot Creek



# Second Creek Almost Uniformly Polluted



# 2022 pH Exceedance on White River



# Summary: Not seeing improvement yet

- **Bacteria, Status and Trends**

- Seeing no improvement over five years at any of the long-term sites

- **Bacteria, Implementation Sites**

- Seeing sharp increase in Boise between 284<sup>th</sup> and 268<sup>th</sup>
- North fork Pussyfoot is the priority in that basin, particularly furthest upstream
- Second Creek polluted top to bottom, but seems worst at the top (upstream of 424<sup>th</sup>)

- **Nutrients**

- No improvement in OP over five years at any of the long-term sites
- Exceeding critical season load allocations, based on estimates

- **Dissolved Oxygen**

- Year 5 in Boise Creek had very low DO
- Consistently low DO in Pussyfoot and Second Creeks

# Reports Available / Questions

## Puyallup River Tributaries Effectiveness Monitoring Annual Report: July 2022 – June 2023 (Year 4)



### Abstract

The Department of Ecology recently completed the fourth year of a ten-year water quality effectiveness monitoring study on three tributaries to the White River in King County. Monthly monitoring continued at the four long-term status and trends sites located in the drainages of Boise, Pussyfoot and Second Creek, which all flow directly into the White River (tributary to the Puyallup River). This report summarizes bacteria, nutrients, and conventional water quality parameter results from September 2022 through June 2023. Due to a position vacancy, no data was collected in July and August of Year 4. Additional bacteria samples were collected to support source identification efforts by the City of Enumclaw and Ecology's nonpoint staff. More details concerning site locations, sample frequency, methods, etc. are described in the study's [Quality Assurance Project Plan](#)<sup>1</sup> (Brownlee 2019).

### Report Summary

- Ecology collected samples and measurements once a month at the two Boise Creek status and trend sites from September 2022 through June 2023. Monitoring started in December at Pussyfoot and Second Creek sites due to dry (Pussyfoot Creek) and stagnant (Second Creek) conditions in November. Second Creek was sampled through May, before it ran dry, while Pussyfoot Creek was sampled through June.
- The Boise Creek status and trends site met water quality criteria for *E. coli* during fall and winter seasons, but still exceeded fecal coliform targets set by the Puyallup River watershed TMDL for fecal coliform.
- The status and trends site for Second Creek was moved to the downstream location due to favorable sampling conditions.
- November, January, and March had lower-than-average flows in Boise Creek, while April had significantly higher flows than average (U.S. Geological Survey)
- Second Creek continues to have the highest total nitrogen and phosphorus levels, followed by Pussyfoot Creek.
- Boise Creek tributary, Pussyfoot Creek and Second Creek sites failed to meet the water quality criteria for dissolved oxygen on at least one occasion during Year 4.

<sup>1</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/1910040.html>

## Puyallup River Tributaries Effectiveness Monitoring Quarterly Report: July – September, 2023 (Year 5)



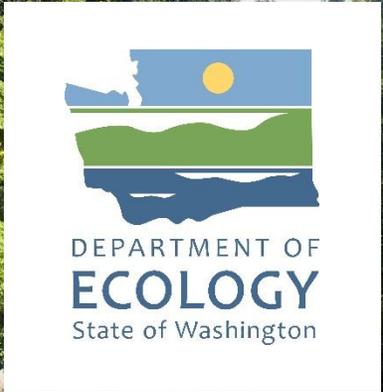
### Abstract

Starting July of 2023, The Department of Ecology initiated the second intensive year of sampling for the 10-Year Puyallup River Tributaries Effectiveness Monitoring project. This report summarizes bacteria, nutrients, and conventional water quality parameter results from the first quarter (July through September, 2023) of Year 5. Sampling only occurred on the Boise Creek stations during this period, due to Pussyfoot and Second creeks being seasonally dry. The first, fifth and tenth years of this project include a greater frequency and spatial resolution of data collection; these years are referred to as Implementation years. During the years between Implementation years, referred to as Status and Trends monitoring years, only one downstream site on each of the three tributaries (Boise Creek, Second Creek and Pussyfoot Creek) is routinely monitored, with one additional upstream site on Boise Creek. During the Implementation monitoring, there are nine sites on Boise Creek, eight sites on Second Creek, and ten sites on Pussyfoot Creek. This increase in spatial resolution allows project partners to identify portions within each watershed where data may suggest pollution sources are entering the stream. More details concerning site locations, sample frequency, methods, etc. are described in the study's [Quality Assurance Project Plan](#)<sup>1</sup> (Brownlee 2019).

### Report Summary

- Ecology collected samples and measurements twice per month at the nine established Boise Creek sites, except for Boise\_I6 in August due to construction. Two additional sites on the Enumclaw Golf Course were sampled routinely as well. The remaining 18 sites on Second and Pussyfoot Creeks were dry for each visit during this period.
- Boise Creek sites Boise\_G1, Boise\_G2 and Boise\_I5 were the only sites to meet water quality criteria for *E. coli*.
- Large increase of turbidity following the completion of the Boise Creek restoration project on the Enumclaw golf course.
- All sites failed to meet the criteria for dissolved oxygen on at least one occasion.

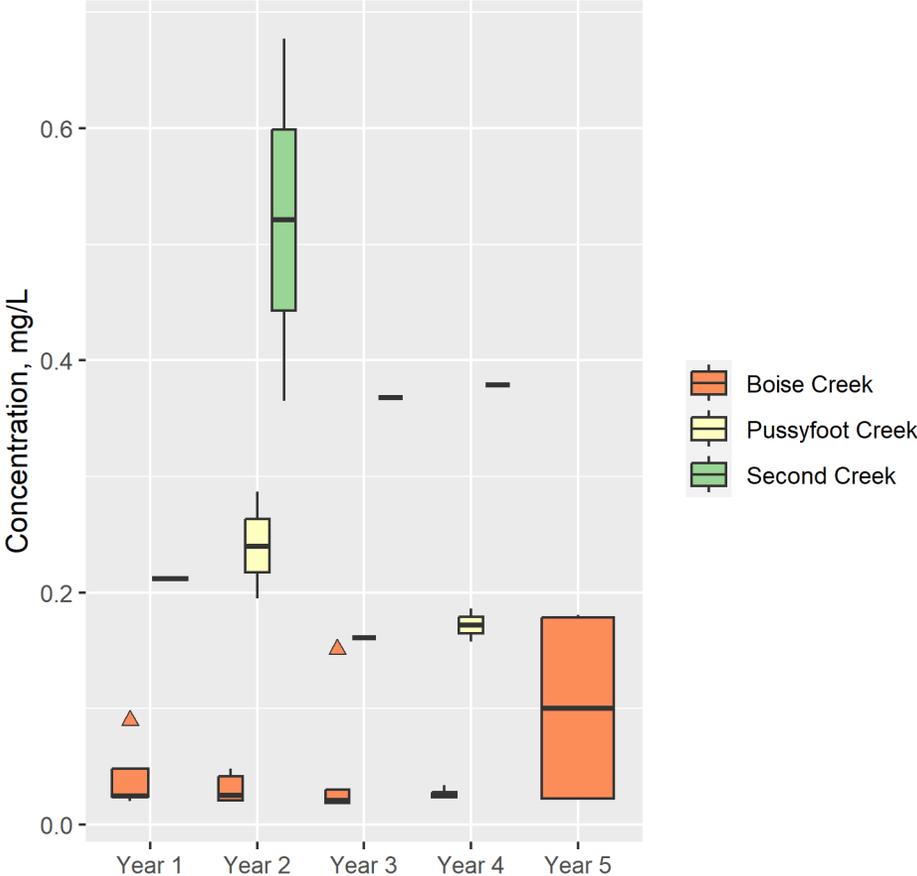
<sup>1</sup> <https://apps.ecology.wa.gov/publications/SummaryPages/1910040.html>



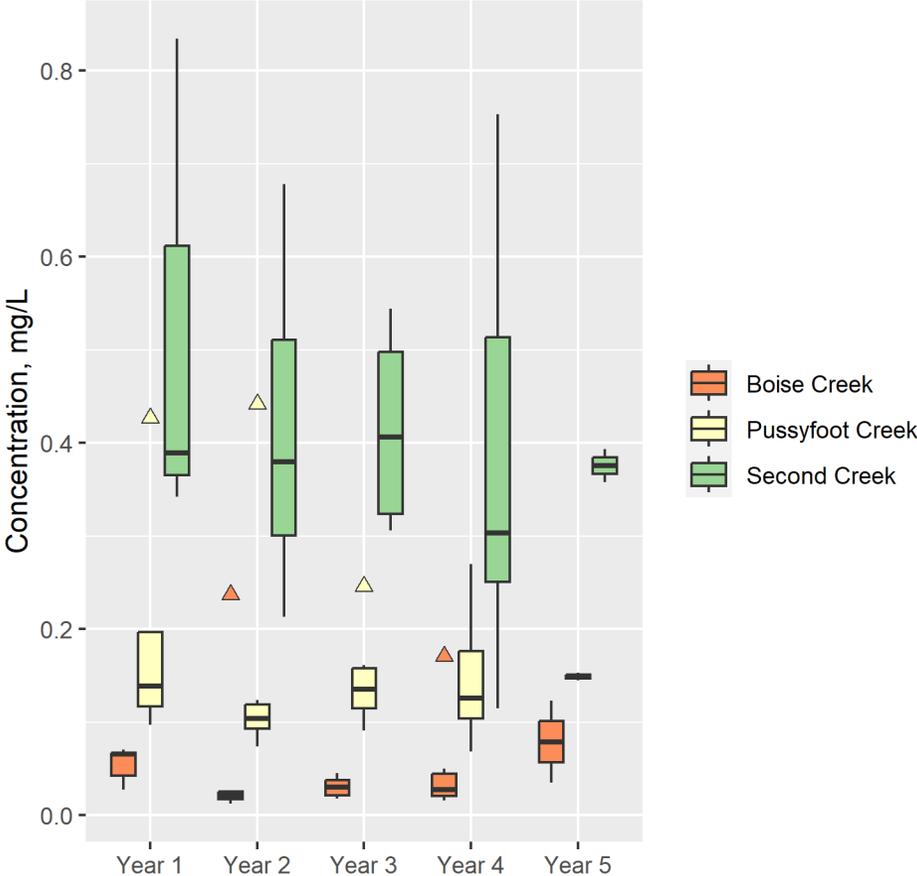
Thank you

# Total Phosphorus

Total Phosphorus, Critical Season Years 1-5

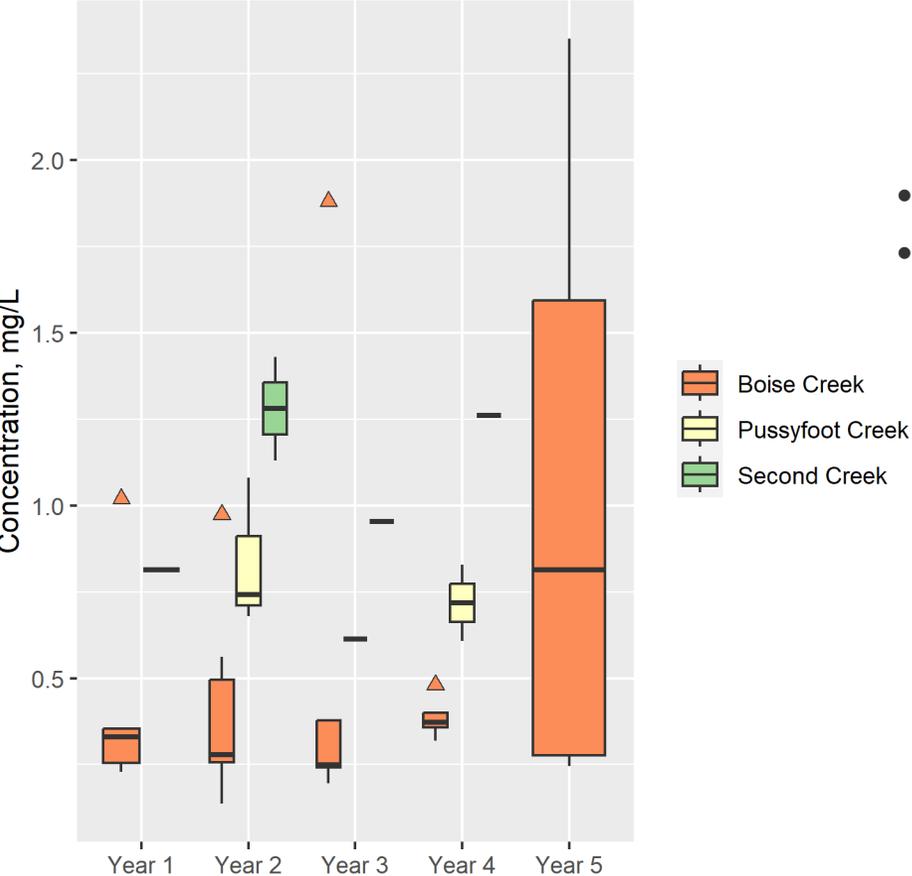


Total Phosphorus, Non-Critical Season Years 1-5



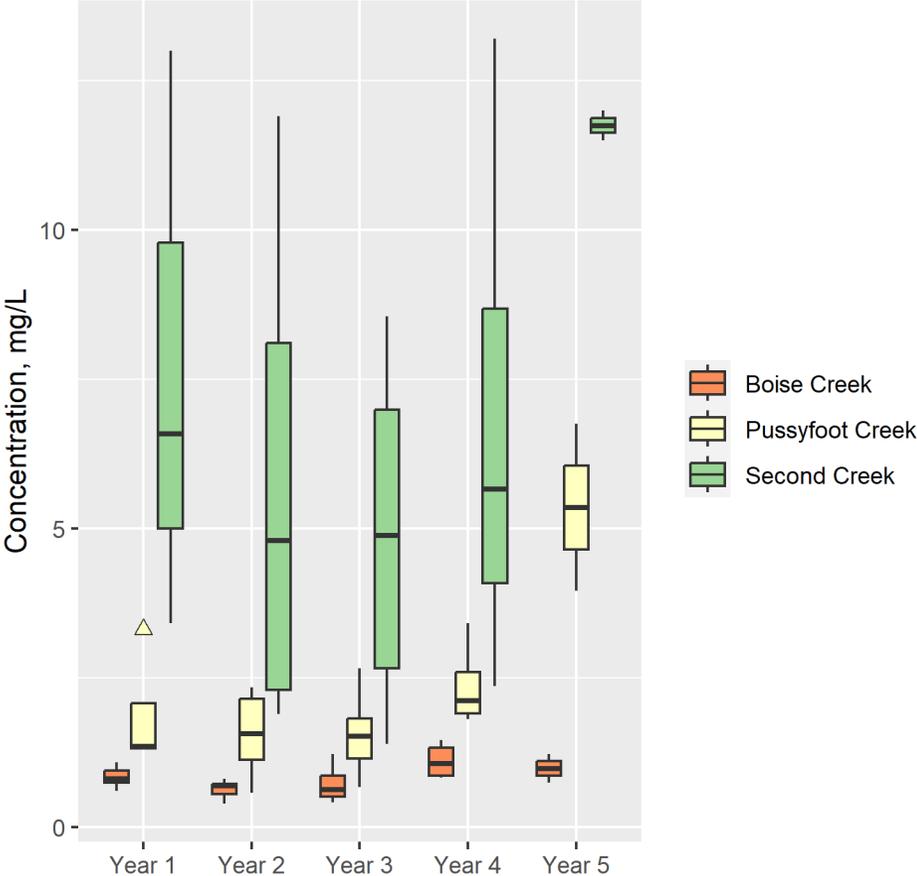
# Total Persulfate Nitrogen

Total Persulfate Nitrogen, Critical Season Years 1-5

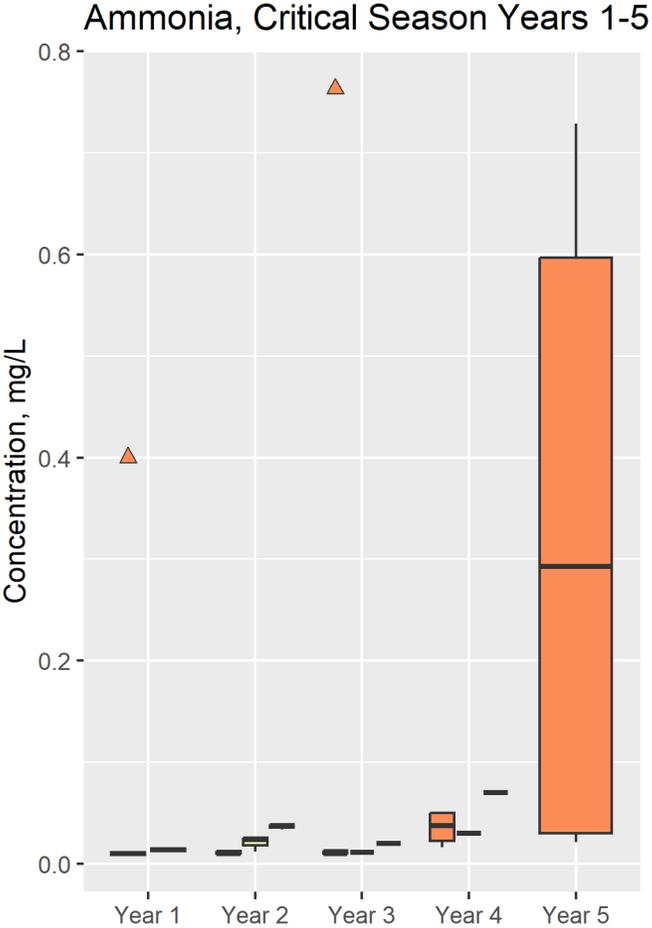


- No clear trends in Boise
- Pussyfoot Year 5 bump, but season incomplete

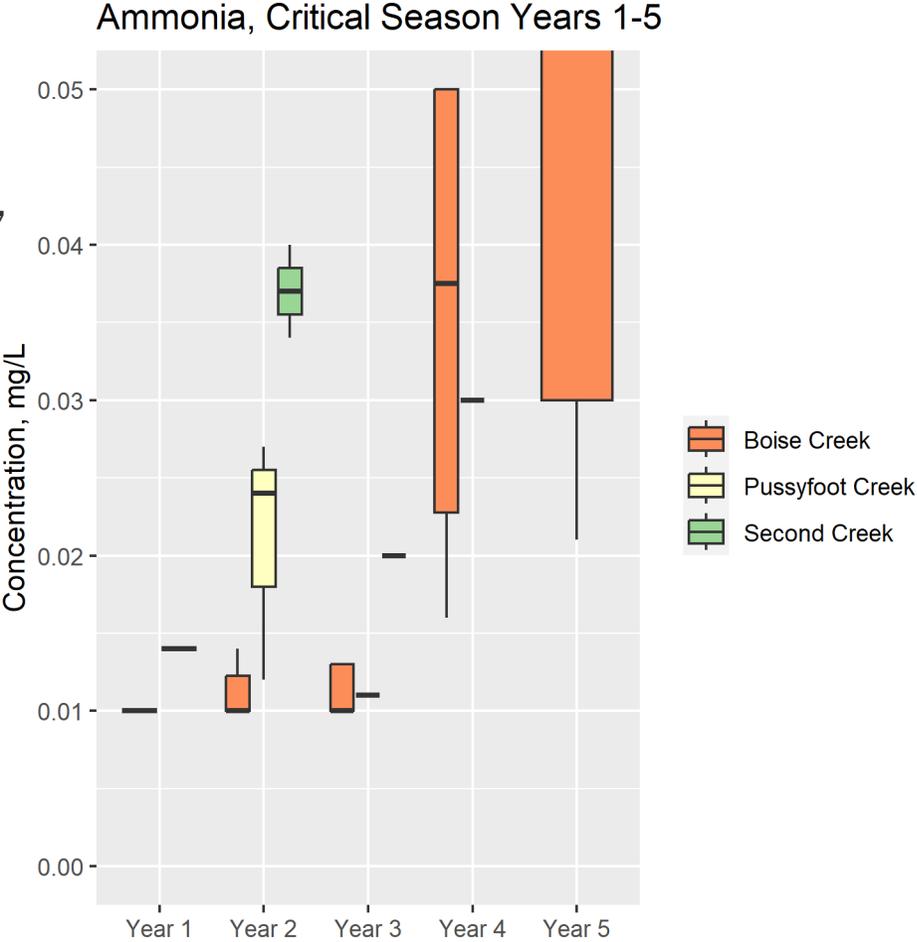
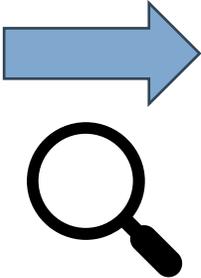
Total Persulfate Nitrogen, Non-Critical Season Years 1-5



# Ammonia, Critical Period

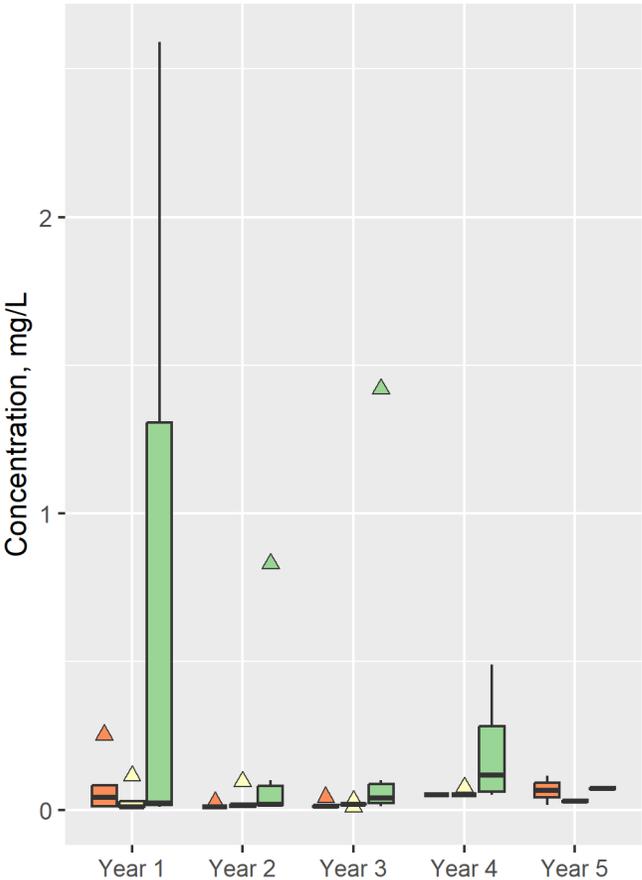


- Year 4 increase in Boise Creek, unique to ammonia

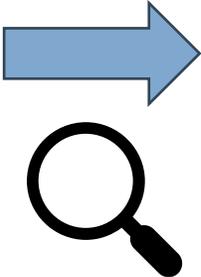


# Ammonia, Non-Critical Period

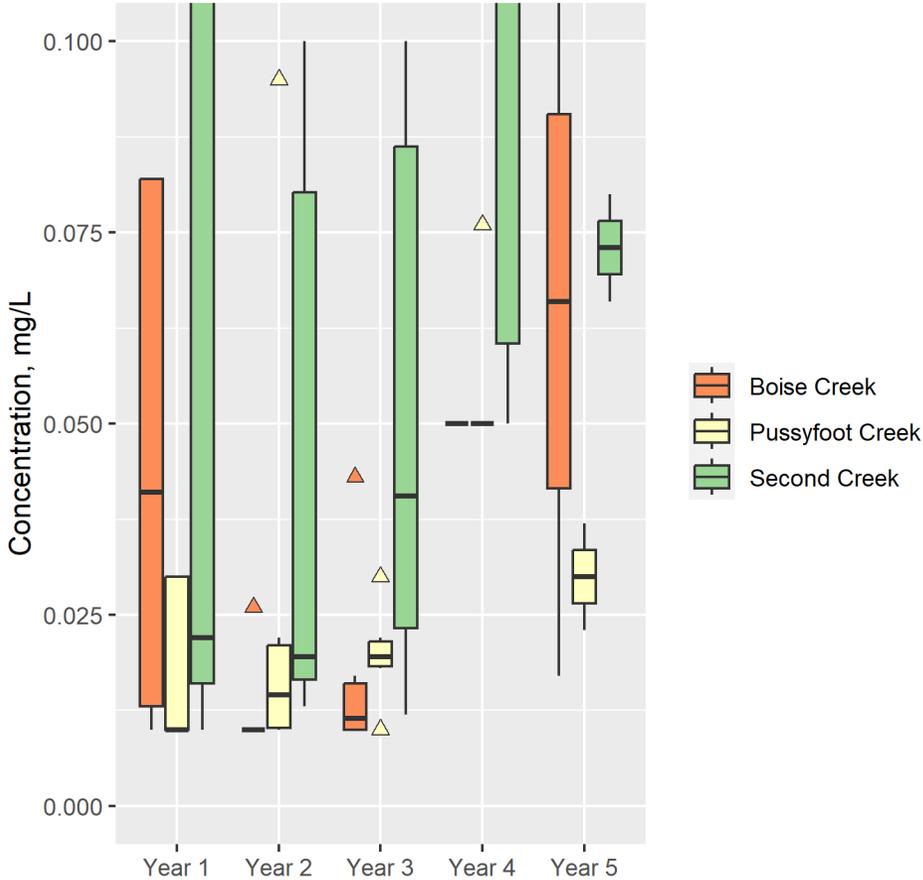
Ammonia, Non-Critical Season Years 1-5



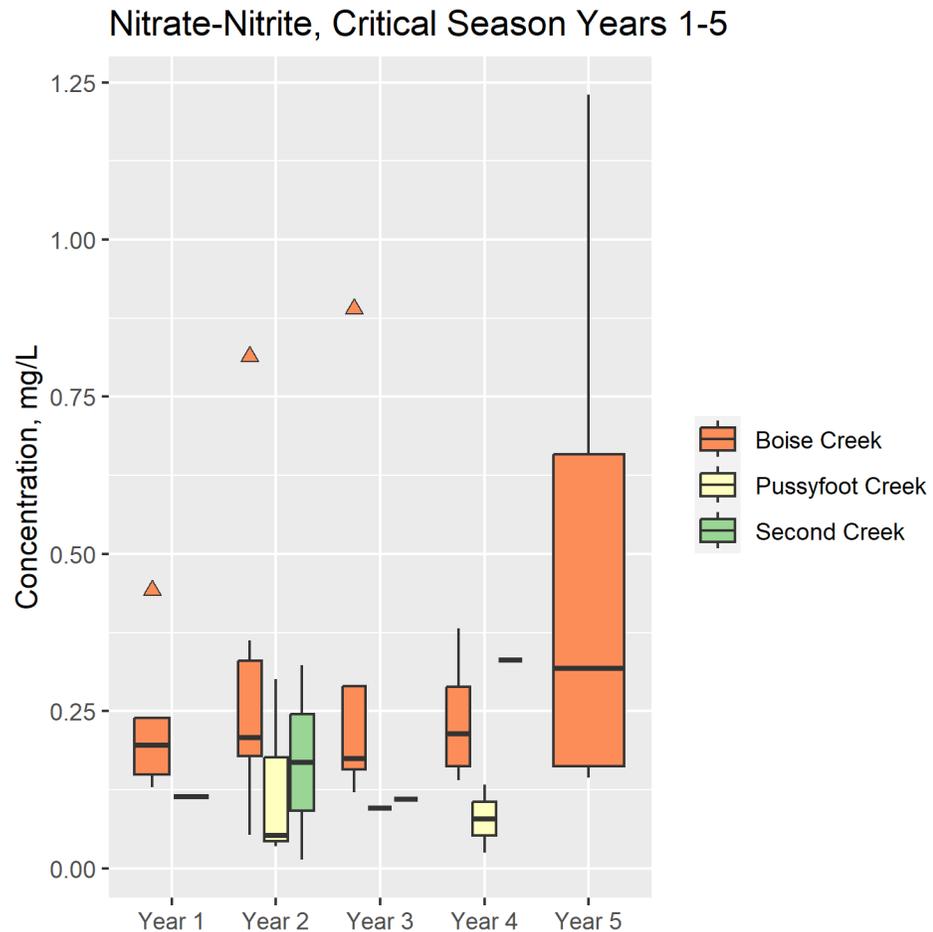
- Highly variable in Second Creek
- Year 4 contract lab, higher MRL



Ammonia, Non-Critical Season Years 1-5



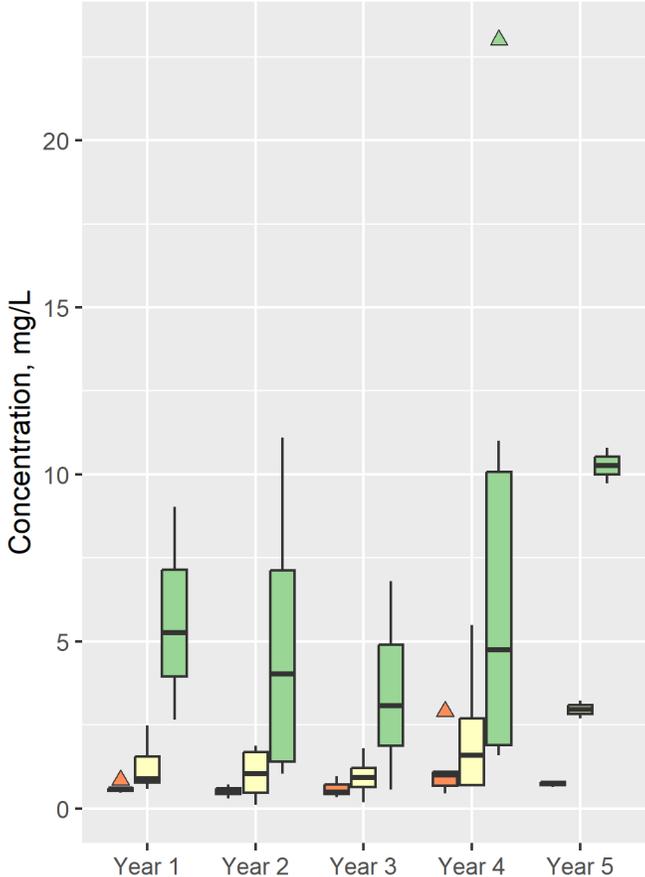
# Nitrate + Nitrite, Critical Period



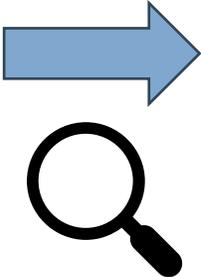
- No Clear Trends over time
- Limited number of samples from seasonal tribs

# Nitrate + Nitrite, Non-Critical Period

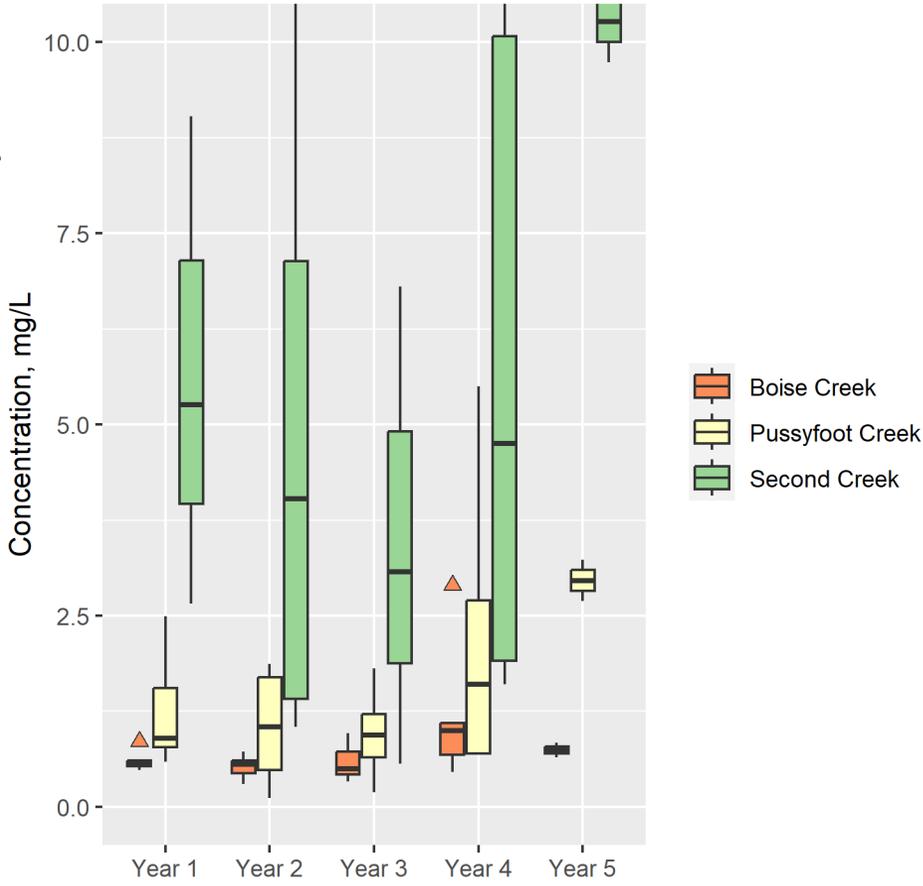
Nitrate-Nitrite, Non-Critical Season Years 1-5



- Second Creek significantly higher concentrations, greater variability

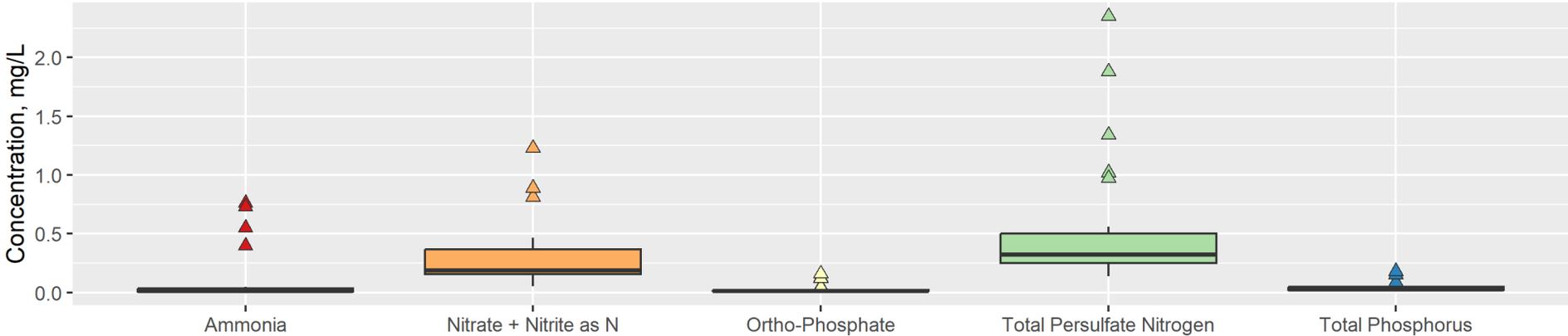


Nitrate-Nitrite, Non-Critical Season Years 1-5

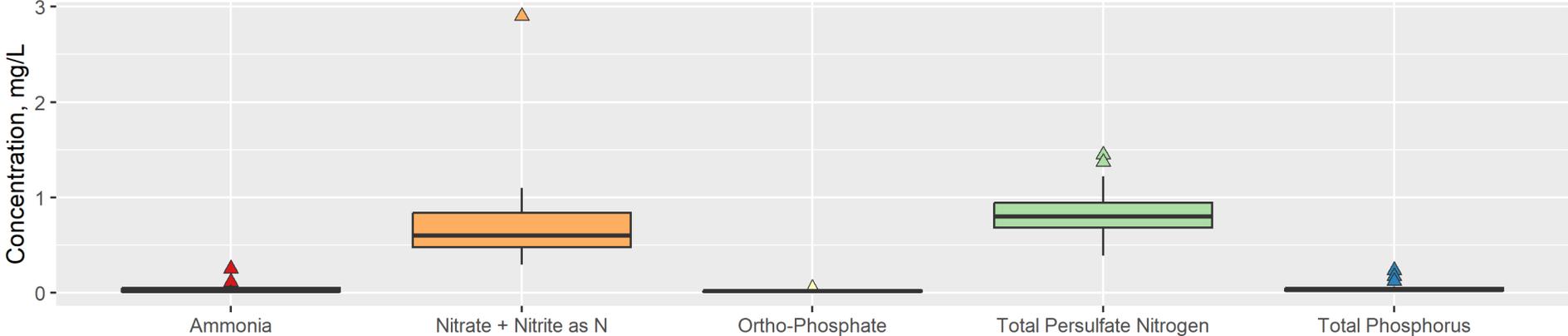


# Boise Creek, Nutrient Comparison

Boise Creek Nutrient Comparison, Critical Season Years 1-5

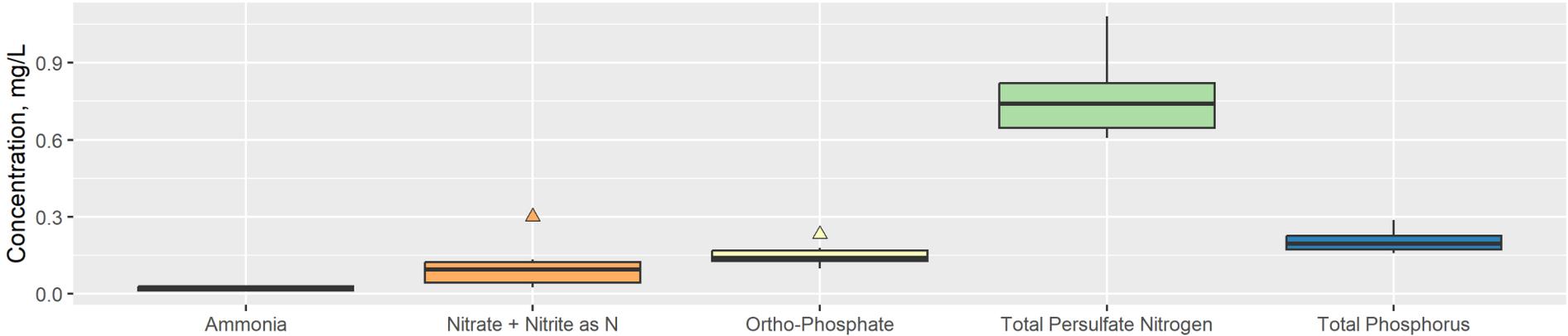


Boise Creek Nutrient Comparison, Non-Critical Season Years 1-5

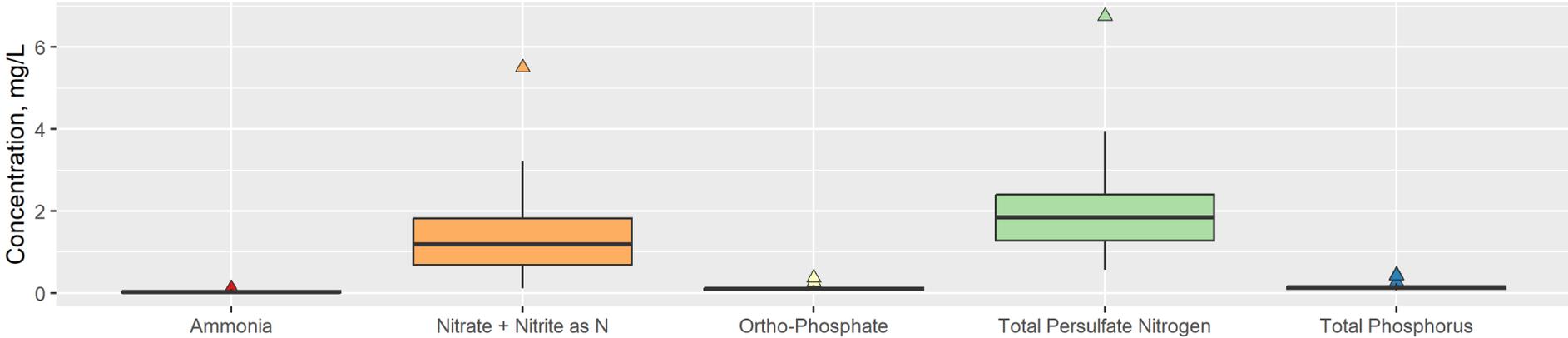


# Pussyfoot Creek, Nutrient Comparison

Psyft Creek Nutrient Comparison, Critical Season Years 1-5



Psyft Creek Nutrient Comparison, Non-Critical Season Years 1-5



# Second Creek, Nutrient Comparison

