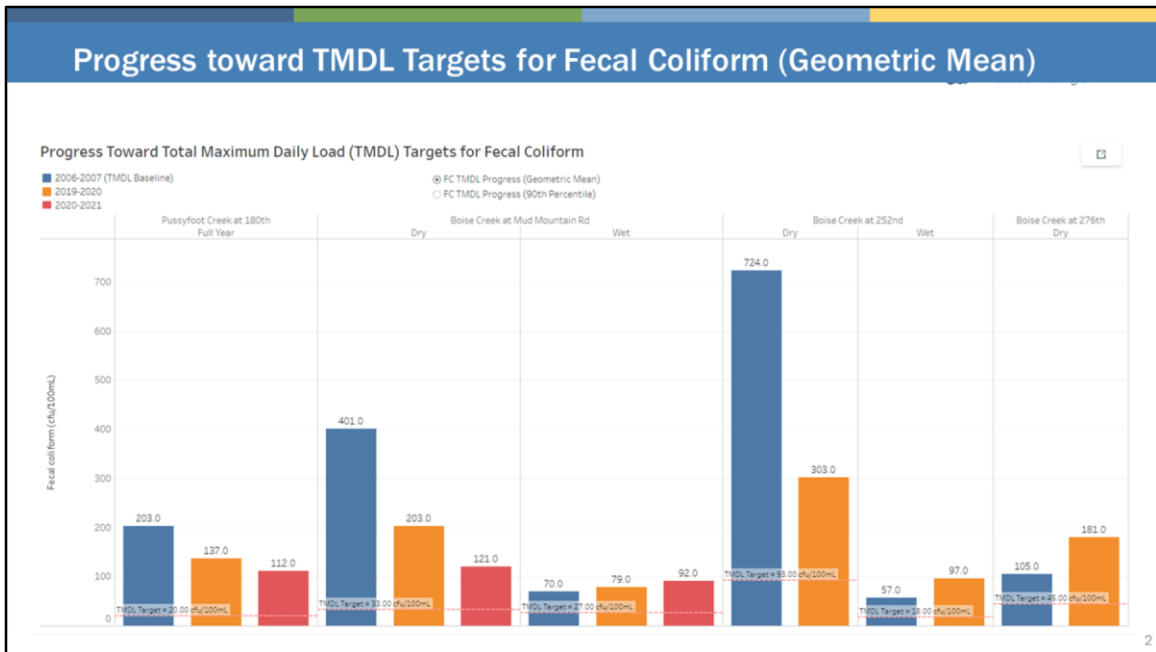




Puyallup River Tributaries Effectiveness Monitoring

Molly Gleason

Progress toward TMDL Targets for Fecal Coliform (Geometric Mean)



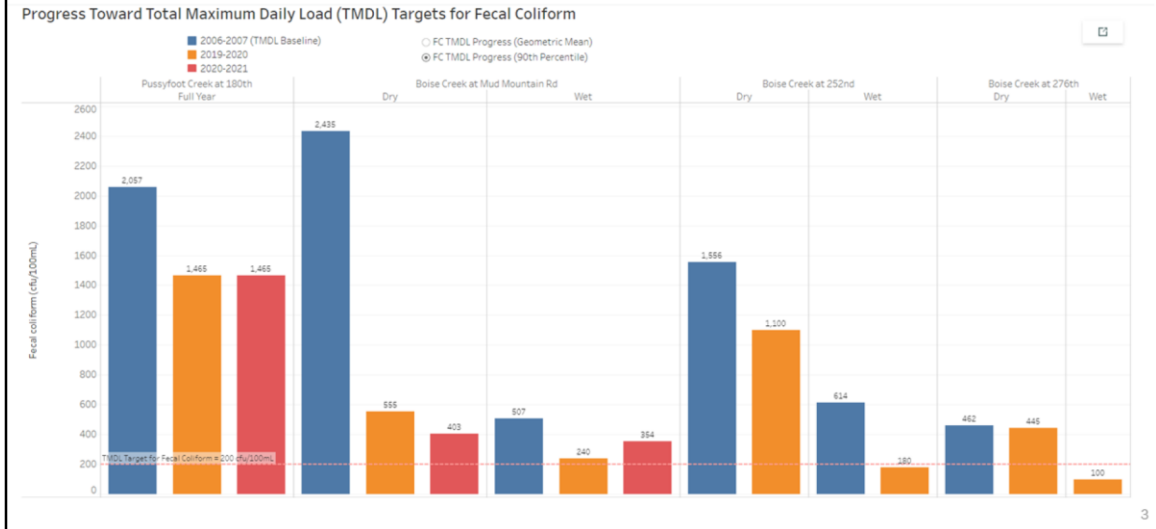
The Puyallup River Watershed Fecal Coliform Total Maximum Daily Load (TMDL) set individual targets for Boise Creek sites and a Pussyfoot Creek site based on season (Mathieu and James, 2011). These targets represent the target fecal coliform (FC) capacity, which takes into account the state’s water quality criteria for FC (e.g. the geometric mean should not be above 100 cfu/100mL and no more than 10% of the samples should be above 200 cfu/100mL). The target capacity also takes into account the FC levels necessary to handle FC loads and still provide the designated beneficial uses. **Essentially, these targets provide a measure of the loading capacity during the most critical period.** Sites with lower targets have a greater margin of safety for FC loading. **The Puyallup River watershed FC target capacities are expressed not as loads. Instead, they are expressed as concentration statistics which relate and are comparable to the state’s FC criteria stated above. In addition, bacteria standards have changed as of 2020 and no longer rely on FC as the main bacteria indicator; however, since the TMDL was approved before the standards changes the TMDL targets that use FC as a bacteria indicator still remain in place.**

The TMDL found that Boise Creek had the highest FC loading and geometric mean, particularly during the dry seasons. Boise Creek is represented by the three sites on the right that are in order of downstream to upstream. There have been improvements in the dry season at least for the lower stretches of Boise Creek (i.e. Boise Creek at Mud Mountain Rd and Boise Creek at 252nd), while the wet season levels have been steady. Both Boise Creek at Mud Mountain Rd and Boise Creek at 252nd are downstream of the city of Enumclaw. It is possible that projects such as decommissioning of on-site septic systems (OSS) and connection of more properties to the City’s sewer system might have had an impact on dry season bacteria sources.

There was no wet season targets set by the TMDL for Boise Creek at 276th site (shown on the far right), since the site met standards. An evaluation of the 2019-2020 data confirmed that this site currently meets standards for wet season. Yet, here were was an increase in FC levels in the dry season. This site is further upstream than other the Boise Creek sites evaluated by the TMDL and is located near a connecting southern tributary. Based on 2019-2020, this southern tributary has been shown to have consistently high bacteria during the summer months.

Pussyfoot Creek was an also evaluated by the TMDL. Since it is an ephemeral creek that flows mostly during the wet season, targets were set for a full year. The geometric means for Pussyfoot Creek were relatively high for a creek with more wet season flow.

Progress toward TMDL Targets for Fecal Coliform (90th Percentile)



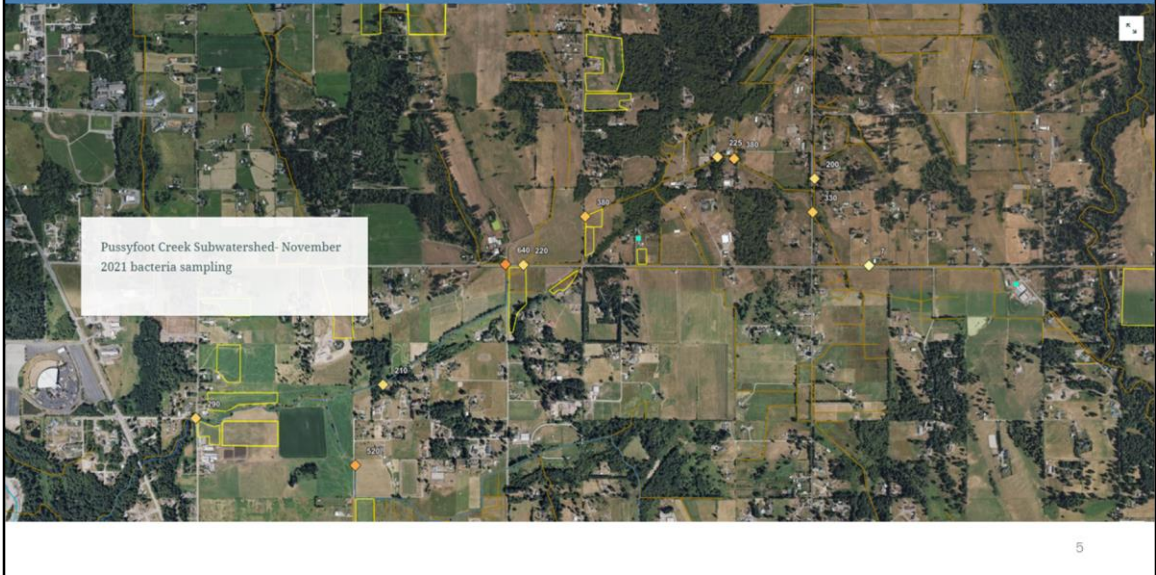
In Washington State FC TMDL studies, the upper limit statistic (i.e. not more than 10% of the samples shall exceed) has been interpreted to be comparable to the 90th percentile value of the log normalized values. The TMDL also uses 90th Percentile as a metric for targets. The 90th percentile represents the upper distribution of results, and the TMDL specified that no more than 10% of results should be higher than 200 cfu/100mL. The evaluation of the 90th Percentile metric shows improvement in dry season FC levels for lower Boise Creek. The upstream sites met targets during the wet season. Pussyfoot Creek has the highest 90th percentile calculated for the 2019-2021 sampling period. Wet season rain events and runoff events may drive these periodically high bacteria levels.

Current Fecal Coliform Reductions Needed to meet TMDL Targets



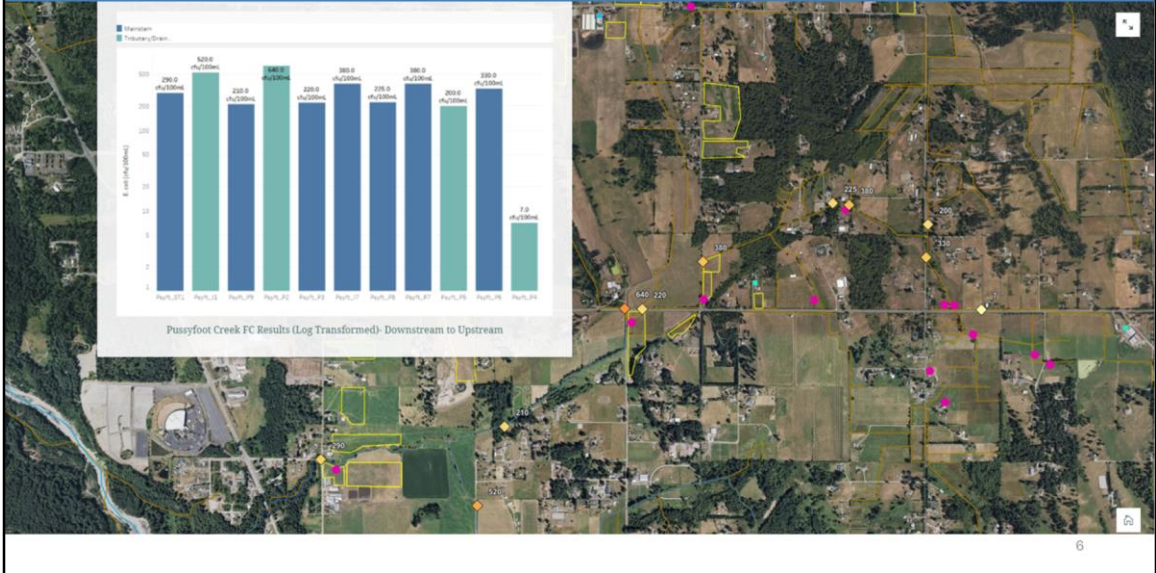
Percent reductions reflect the estimated level of source control needed to meet water quality standards for FC and TMDL targets. The map above displays the current reductions needed to meet the TMDL targets for each site based on season. The updated percent reductions were calculated based on 2019-2020 FC data. Despite the improvements in dry season levels in Boise Creek, further reductions are necessary to meet the targets. Pussyfoot Creek is farthest away from the TMDL targets. Anne has been focusing her work in in the upper mainstem of Pussyfoot Creek to address the elevated bacteria levels in this tributary and work towards reduce nonpoint sources in this tributary. In summary, the current results show that progress needs to be made on FC reduction.

Pussyfoot Creek November 2021 E. coli Sampling



This past quarter was the start of sampling during the wet season. The plateau experienced atmospheric river rain events in the middle and end of November. Ecology did a Puyallup sub-watershed wide sampling effort following the rain event.

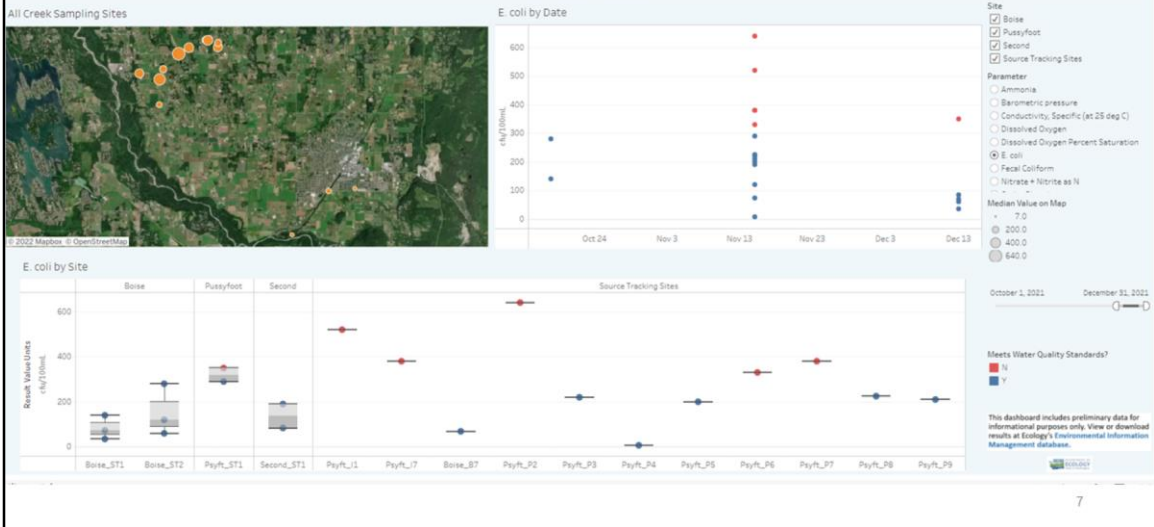
Pussyfoot Creek November 2021 E. coli Sampling



Sampling was completed at the tail end of the rain event, and therefore, the results were not as elevated.. There wasn't too much distinction between these sites along the mainstem (show in dark blue on the chart), yet there were slightly elevated results collected at several drainages (colored in bright blue in this chart). The South Fork Pussyfoot site (Psyt_1_1) has relatively high levels compared to the Pussyfoot Creek mainstem. This site in the past has had high wet season bacteria levels in 2019.

Oct-Dec 2021 Quarter: E. coli Results

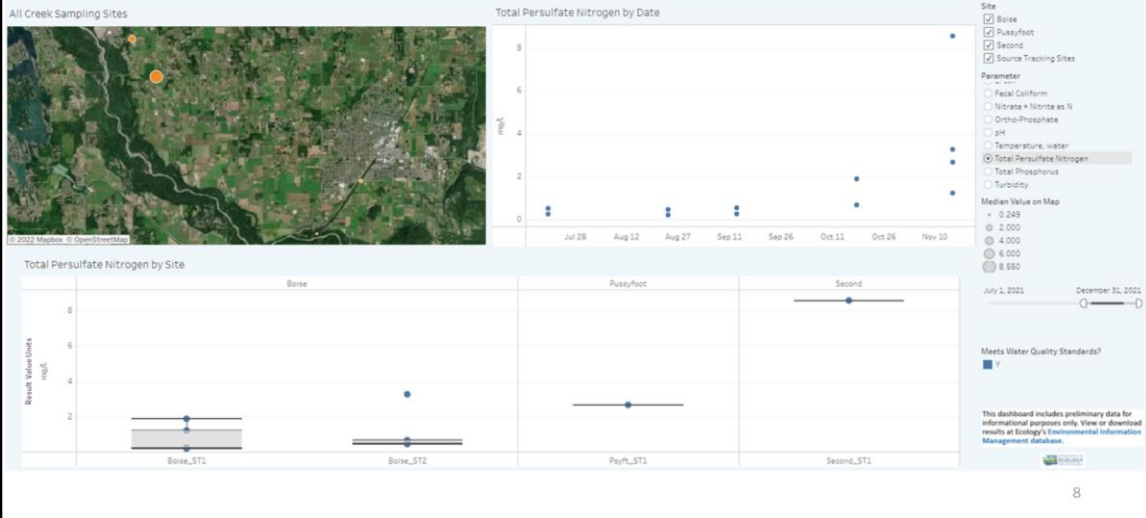
Puyallup River Tributaries Effectiveness Monitoring- Years 2-3 (2020-2022)
Provisional Sampling Results



The updated bacteria standards state that a single *E. coli* sample should not be over 320 cfu/100mL. For this past winter quarter, *E. coli* impairments were found at Pussyfoot Creek sites, for the November and December sampling events.

July-Nov 2021 Quarters: Total Nitrogen

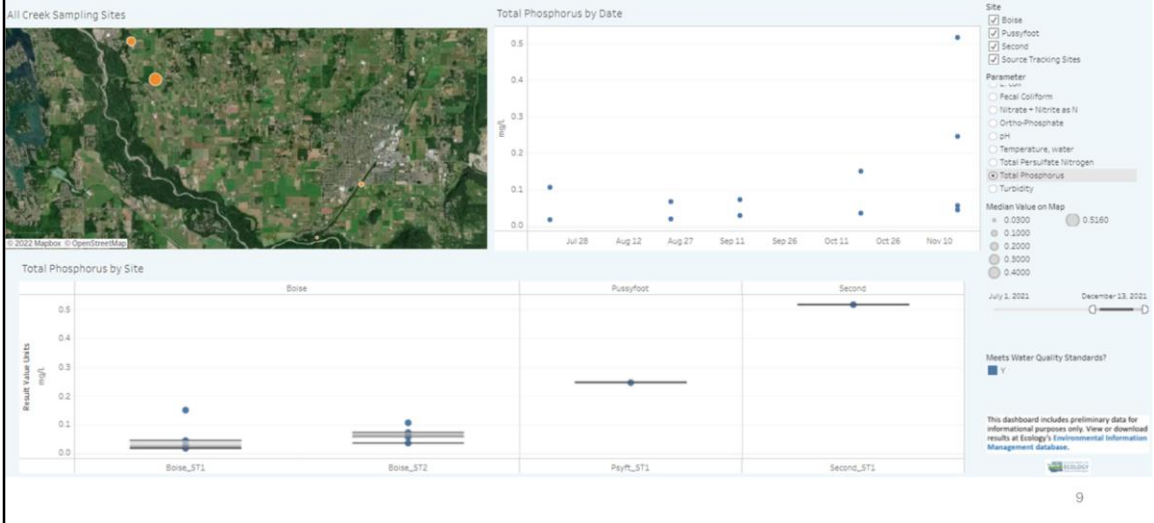
Puyallup River Tributaries Effectiveness Monitoring- Years 2-3 (2020-2022)
Provisional Sampling Results



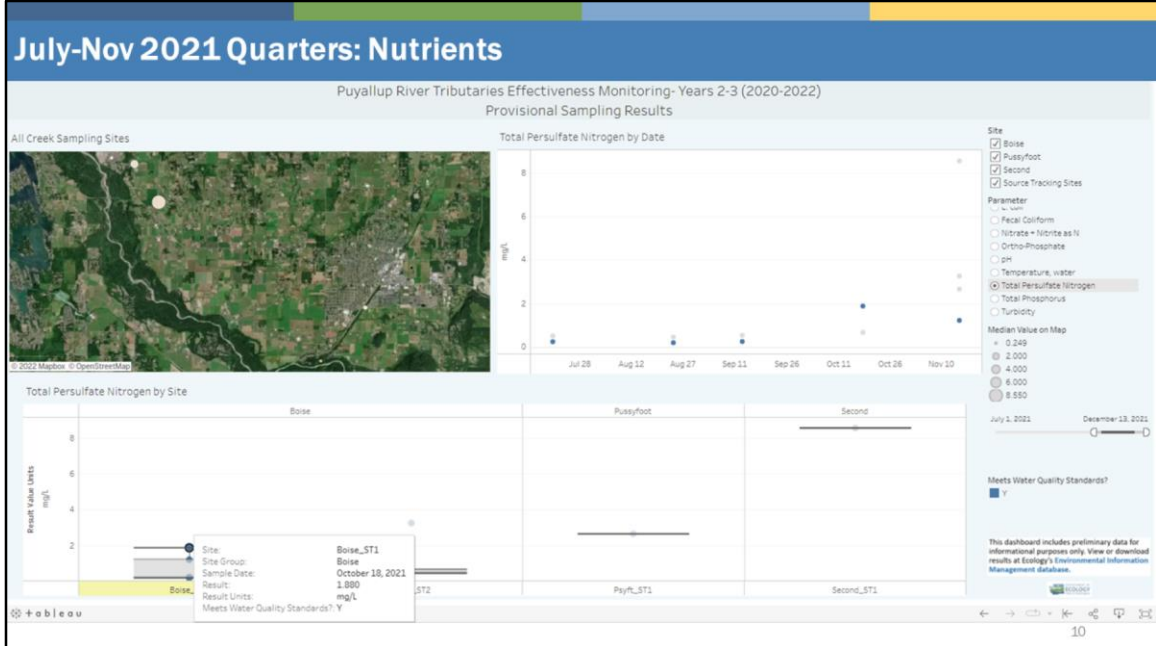
Focusing on the past two quarters (July-Sept and Oct-Dec), the greater rainfall in November generated increases in uptakes in total nitrogen and total phosphorus. Second Creek had the highest total nitrogen (8.55 mg/L), followed by the upstream Boise Creek site (3.2 mg/L). There was also a similar increase for total phosphorus in November; with Second Creek and Pussyfoot with high total phosphorus in this watershed.

July-Nov 2021 Quarters: Total Phosphorus

Puyallup River Tributaries Effectiveness Monitoring- Years 2-3 (2020-2022)
Provisional Sampling Results



There was also a similar increase for total phosphorus in November. Second Creek had the highest total phosphorus levels (0.51mg/L) and Pussyfoot had the second highest levels (0.25mg/L) in November.



The Boise Creek tributary that flows from the City of Enumclaw's this stormwater flume site has tended to have the highest bacteria and nutrient levels than the downstream Boise Creek site closest to the White River. But for the first time this monitoring year, this downstream site had higher nutrients (i.e. total nitrogen and total phosphorus) in October. The reason for higher nutrients may be from a more natural cause. From September to October, salmon were making their way up Boise Creek. Salmon carcasses were scattered upstream and downstream at the Boise Creek site. The decomposition of salmon may be a natural source of nutrients in the stream. The input of nutrients from salmon decaying organic matter has been documented in Puget Sound:

- Bilby, R.E., B.R. Fransen, and P.A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: Evidence from stable isotopes. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 164-173.
- Cederholm, C.J., D.B. Houston, D.L. Cole and W.J. Scarlett. 1989. Fate of Coho salmon (*Oncorhynchus kisutch*) carcasses in spawning streams. *Canadian Journal of Fisheries and Aquatic Sciences* 46(8): 1347-1355.
- Cederholm C. J., M.D. Kunze, T. Murota, A. Sibatani. 1999. Pacific salmon carcasses: Essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. *Fisheries* 24: 6-15.
- Kline, T.C., J.J. Goering, O.A. Mathisen, P.H. Poe, P.L. Parker. 1990. Recycling of elements transported upstream by runs of Pacific salmon. 1. Delta-N-15 and Delta-C-13 evidence in Sashin Creek, southeastern Alaska. *Canadian Journal of Fisheries and Aquatic Sciences* 47: 136-144.

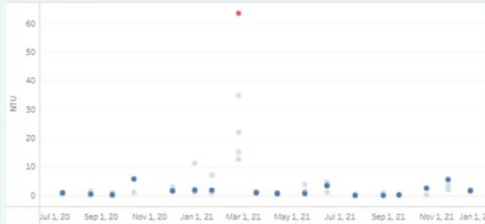
Oct-Dec 2021 Quarters: Turbidity

Puyallup River Tributaries Effectiveness Monitoring- Years 2-3 (2020-2022)
Provisional Sampling Results

All Creek Sampling Sites



Turbidity by Date



Site

- Boise
- Pussyfoot
- Second
- Source Tracking Sites

Parameter

- Fecal Coliform
- Nitrate + Nitrite as N
- Ortho-Phosphate
- pH
- Temperature, water
- Total Perchlorate Nitrogen
- Total Phosphorus
- Turbidity

Median Value on Map

- 0.700
- 1.000
- 1.500
- 2.150

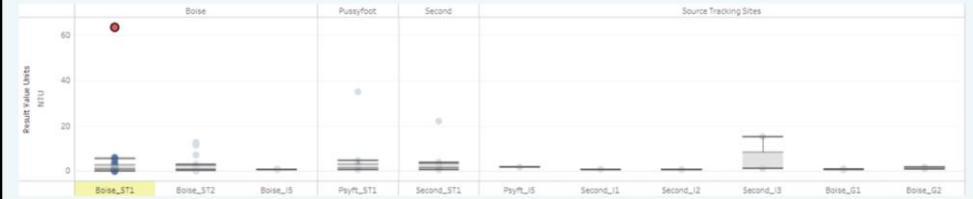
July 13, 2020 December 13, 2021

Meets Water Quality Standards?

- N
- Y

This dashboard includes preliminary data for informational purposes only. View or download results at Ecology's Environmental Information Management database.

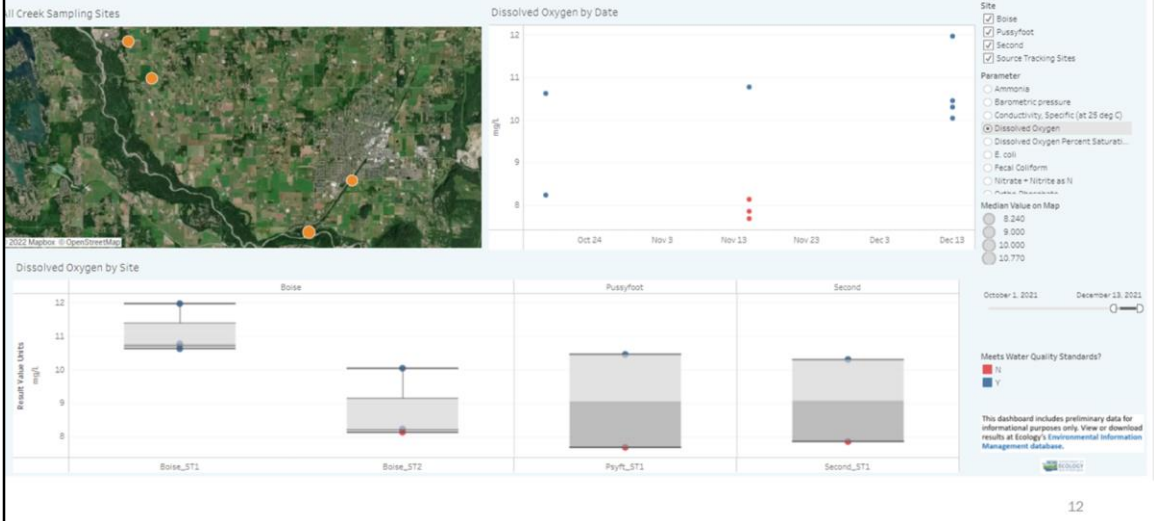
Turbidity by Site



Another factor that can have a harmful impact on salmon, includes turbidity in the stream. There was an uptake in turbidity from the atmospheric rain event. And it's interesting that despite the runoff happening in Enumclaw plateau over, this lower Boise Creek site had the highest turbidity, it is still well below the water quality standard of 50 NTU. Just this past February, it did breach that standard. There currently is ongoing Foothill Trail restoration and construction project just upstream and construction in the developing areas of Enumclaw; these projects and rural runoff could all be contributing to this high turbidity at this site that is a known salmon habitat.

Oct-Dec 2021 Quarters: Dissolved Oxygen

Puyallup River Tributaries Effectiveness Monitoring- Years 2-3 (2020-2022)
Provisional Sampling Results



There was a drop in dissolved oxygen during the November rain event, below criteria of 8.5 mg/L. Increased turbidity can affect dissolved oxygen levels. More suspended particles absorb more heat and increase water temperature. These factors lead to a decrease in dissolved oxygen.

Bacteria

- Lower Boise Creek sites have seen improvement in dry season fecal coliform (FC) levels; however, reductions are still needed to meet TMDL targets.
- Pussyfoot Creek is farthest from FC target capacity goals.

Nutrients

- Second Creek has the highest level of total nitrogen and total phosphorus, followed by Pussyfoot Creek.
- Salmon decomposition in October may have been a natural source of nutrient inputs.

Temperature

- Boise Creek tributary (Boise_ST2) did not meet temperature standards summer of 2021 (July-September).

Dissolved Oxygen

- Boise Creek tributary (Boise_ST2) did not meet dissolved oxygen standards summer of 2021 (July-September).
- November rain event and increased suspended particles may have caused low dissolved oxygen levels.

Turbidity

- All creeks were within standards during this past wet season quarter. The lower Boise Creek site (Boise_ST1) had the highest turbidity during the November rain event.

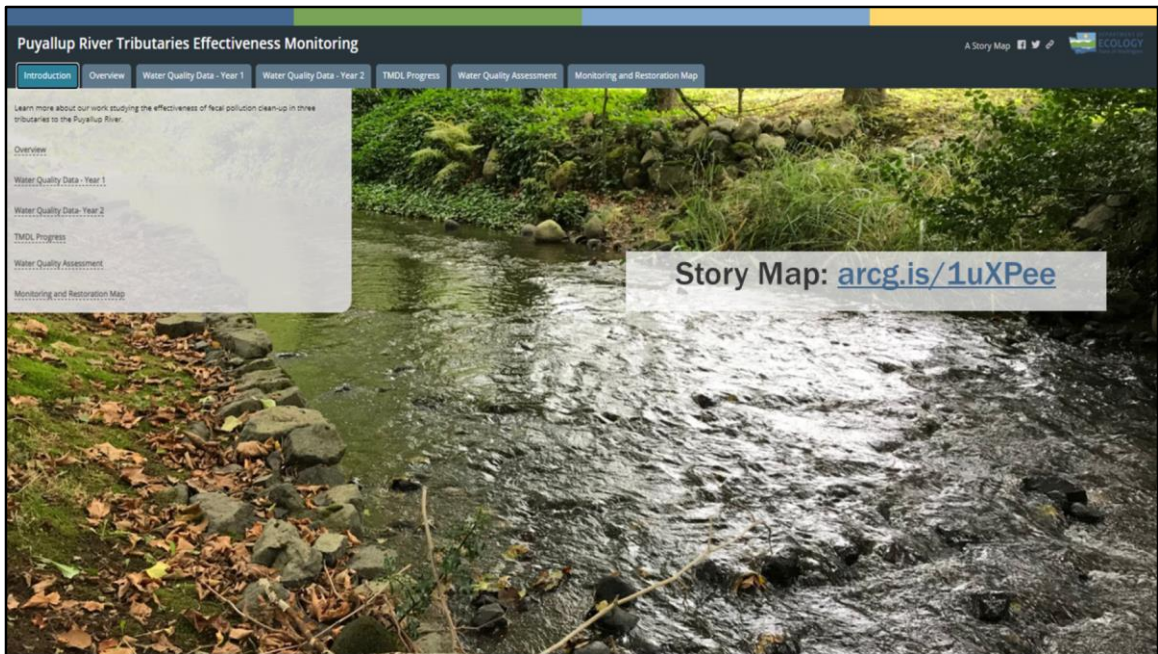
Summary of 2020-21 Data.



Thank You!

Questions?

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Visualization of this data as well as download links are available on this project's **Storymap** (arcg.is/1uXPee).

Citations

Bilby, R.E., B.R. Fransen, and P.A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: Evidence from stable isotopes. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 164-173.

Cederholm, C.J., D.B. Houston, D.L. Cole and W.J. Scarlett. 1989. Fate of Coho salmon (*Oncorhynchus kisutch*) carcasses in spawning streams. *Canadian Journal of Fisheries and Aquatic Sciences* 46(8): 1347-1355.

Cederholm C. J., M.D. Kunze, T. Murota, A. Sibatani. 1999. Pacific salmon carcasses: Essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. *Fisheries* 24: 6-15.

Kline, T.C., J.J. Goering, O.A. Mathisen, P.H. Poe, P.L. Parker. 1990. Recycling of elements transported upstream by runs of Pacific salmon. 1. Delta-N-15 and Delta-C-13 evidence in Sashin Creek, southeastern Alaska. *Canadian Journal of Fisheries and Aquatic Sciences* 47: 136-144.

Mathieu, N. and C. James. 2011. Puyallup River Watershed Fecal Coliform Total Maximum Daily Load. Publication No. 11-10-040. Department of Ecology. Olympia, WA.
<https://apps.ecology.wa.gov/publications/SummaryPages/1110040.html>