SAMMAMISH WATER QUALITY MONITORING
Annual Report 2023

Since 2019, the City of Sammamish has contracted with King County to expand water quality monitoring within the city. This annual report provides a brief overview of activities and results from 2023. It does not include all water quality monitoring within Sammamish, but only covers the activities (described below) that are part of this specific contract.

For more context, please see the 2018 *City of Sammamish Water Quality & Aquatic Habitat Monitoring Plan* (available online at https://m10082.eos-intl.net/M10082/dnrp/Details/Record.aspx?BibCode=5200245). That plan reviewed existing water quality monitoring work in Sammamish, and it recommended adding many of the monitoring activities included in this report.

Annual reports for past years are available through King County at: https://m10082.eos-intl.net/M10082/dnrp/Details/Record.aspx?BibCode=5355428

Changes to Monitoring Activities in 2023

In 2023, we added three new dam-safety gages, on the outlet of Yellow Lake and Trossachs Div 7 and 8 Ponds. We also added a water-level gage on Zackuse Creek at the East Lake Sammamish Parkway culvert.

We discontinued the upstream stream-health monitoring (stream bugs) due to logistical challenges.

Monitoring Activities Overview

- **Ebright Creek watershed:** Stormwater outfalls continued to be monitored for flow and temperature using continuous gages, and sampled monthly for turbidity. Wetland water level also continued to be monitored continuously.
- **George Davis / Allen Lake wetlands:** Water level continued to be monitored continuously in this wetland complex, at the head of the George Davis and Allen Lake watersheds.
- **Rain gage on City Hall:** The rain gage on City Hall continued to provide precipitation data to help understand other monitoring results, and it also provided real-time information to help City staff respond to rain events.
- **Zackuse Creek:** A stream gage monitored streamflow and temperature. Each month, Zackuse was sampled for bacteria, nutrients, suspended solids, and conventionals (conductivity, pH, alkalinity), and once a year was sampled for stream health (stream bug diversity). Starting in 2023, a new gage monitored water level

immediately upstream of the East Lake Sammamish Parkway to help understand how the stream and culvert respond during larger rainstorms.

- **Dam safety gages:** Three new gages monitored water level or flow at high-priority stormwater ponds: Trossachs Div 7 and 8 Ponds and the outlet to Yellow Lake. Ecology's Dam Safety Office requires these to track water elevations and outflows and help maintain dam operation and safety, especially during large rainstorms.
- **Entombment:** Streambeds in Ebright, George Davis, Pine Lake, and Zackuse Creeks were assessed in early June to look for fine sediments capping the gravel, which can entomb and smother kokanee spawning beds.
- **Riparian forest:** Riparian forest canopy cover was mapped for the southern Lake Sammamish shoreline, Yellow Lake, and small streams in the south end of the city, using aerial imagery from 2021. King County staff calculated canopy cover for various stream reaches and shoreline segments, both for the entire 60-m riparian zone as well as for 10-m and 20-m zones closest to streams. These near-stream zones are especially important determinants of stream health because trees closer to the stream provide more shade, large wood, and other important inputs.

Data and Graphing

Most data in this report are available to view or download online. Hydrologic data (streamflow, water level, rainfall) are all available on the King County Hydrologic Information Center website: https://green2.kingcounty.gov/hydrology/GaugeMap.aspx. Stream water-quality data are available on the King County Streams Monitoring website: https://green2.kingcounty.gov/streamsdata/. Other data may be requested from either City of Sammamish or King County staff.

This report contains both discrete and continuous data. Discrete data were collected periodically (e.g., monthly water samples for lab analyses), and are graphed as blue dots connected by a blue line. In contrast, continuous data were collected by automated gages (e.g., flow, precipitation, temperature), usually every 15 minutes. For most continuous data in this report, the daily average is graphed as a blue line, and the daily maximum and minimum are graphed as thinner grey lines (on days with very low variation, the thinner grey lines may be hidden behind the blue line).

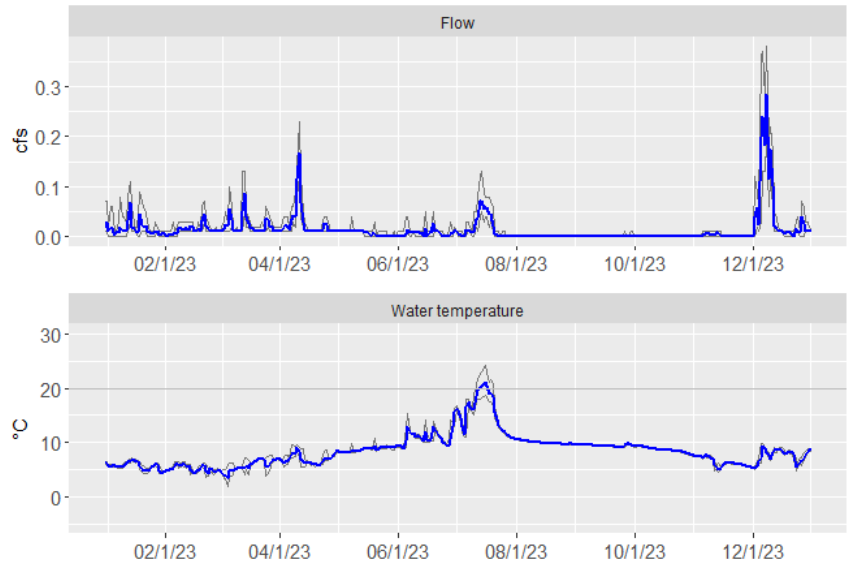
Ebright Creek Watershed

Stormwater outfall flow, temperature, and turbidity continued to be monitored to detect potential impacts to habitat in Ebright Creek. Wetland water level was monitored to detect hydrologic impacts on the wetlands themselves. Flow, temperature, and water level were monitored using continuous gages, and turbidity was measured each month in grab samples.

Outflow and Temperature

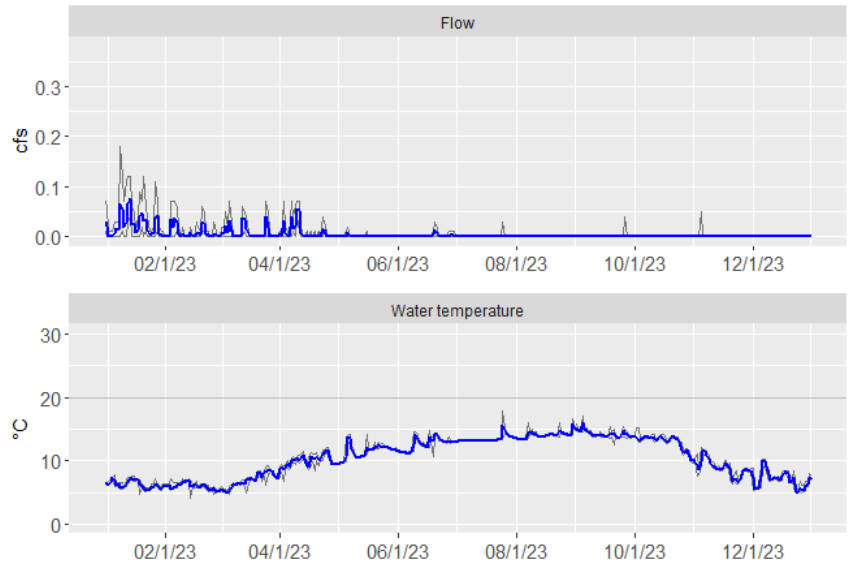
Gages on the outfalls continued to be monitored throughout 2023.

Chestnut Pond



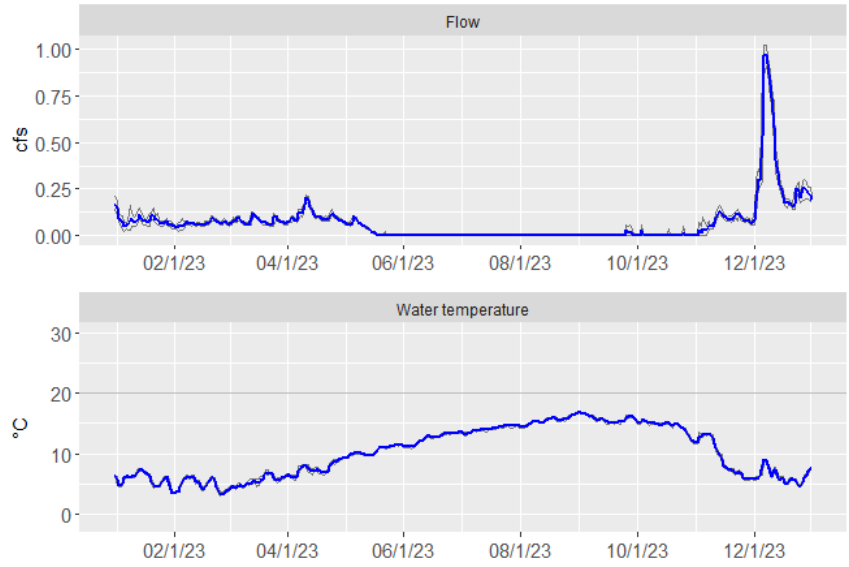
The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Crossings - East pond



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

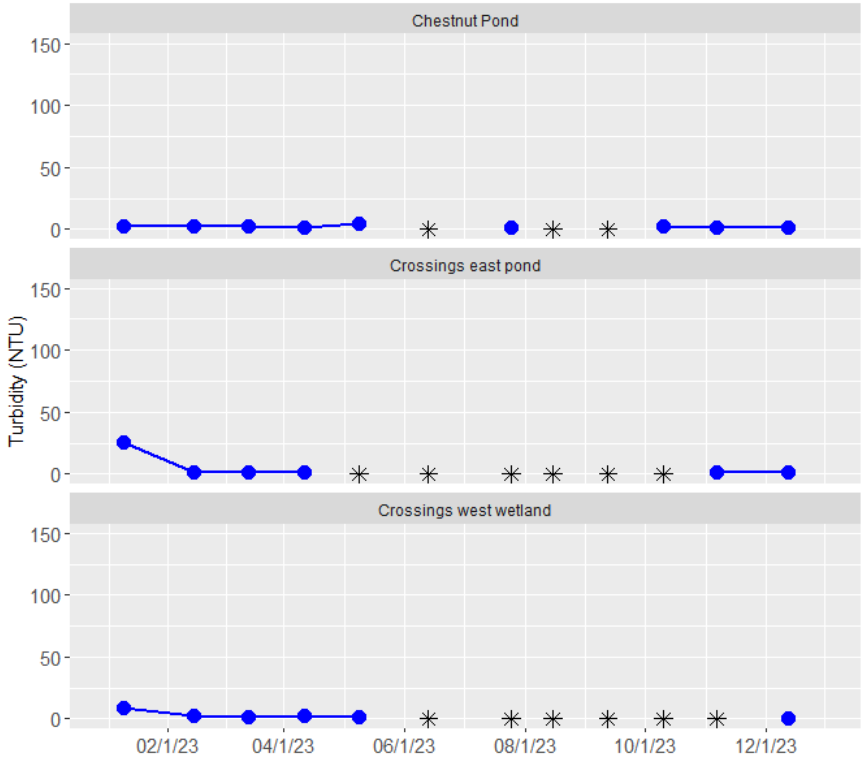
Crossings - West wetland



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

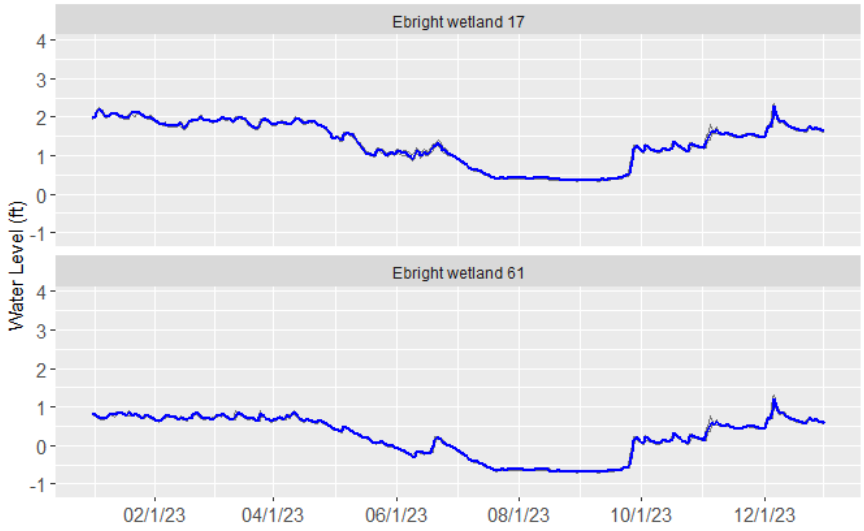
Turbidity

The three stormwater outfalls were visited each month. Unless the outfall was dry, samples were collected for laboratory turbidity analysis. Turbidity was low in all samples in 2023. Note that these samples were collected only once per month and would not necessarily catch brief periods of high turbidity during storms.



Blue dots show turbidity values, and black asterisks at zero turbidity indicate dates when the outfall was dry.

Wetland water level



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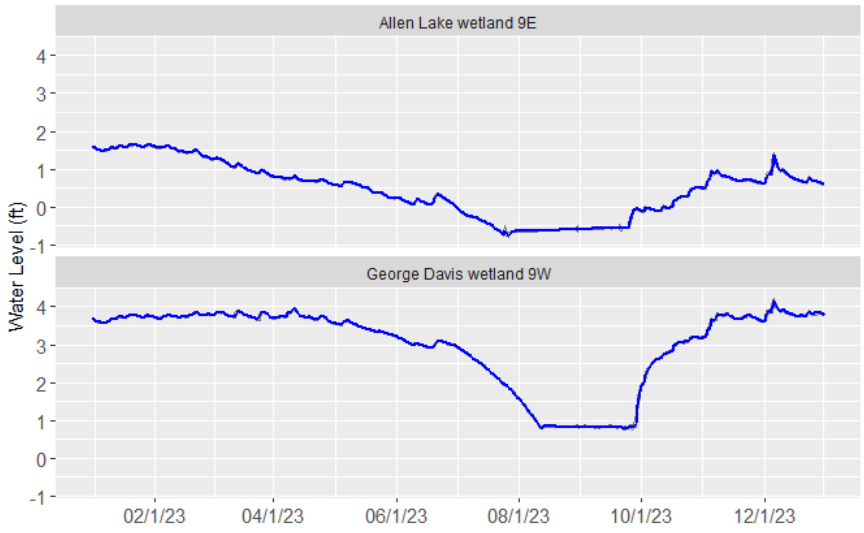
George Davis / Allen Lake Wetlands



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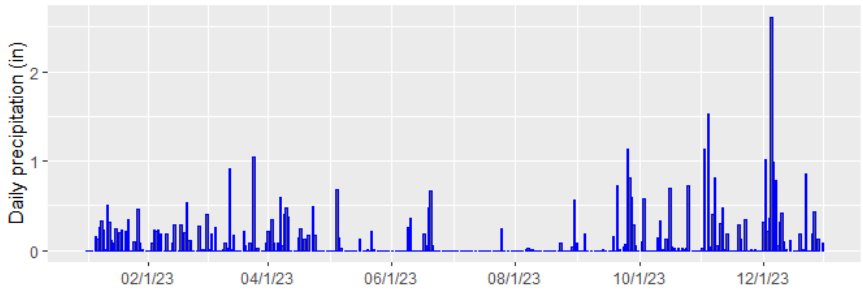
Precipitation

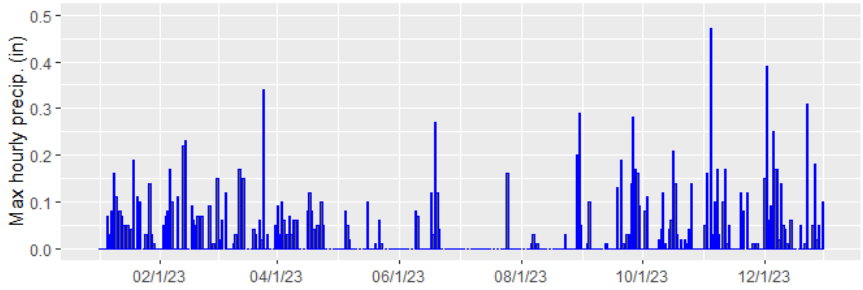
Precipitation (rain and snow) was measured by a rain gage on top of Sammamish City Hall.

Daily totals



Precipitation intensity

In addition to the total amount of precipitation during a rain or snow event, the precipitation intensity (inches per hour) also affects runoff, erosion, and other processes. As a measure of intensity, this graph shows each day's maximum hourly precipitation.



Note that the scale on the y-axis is considerably smaller than on the daily precipitation graph above.

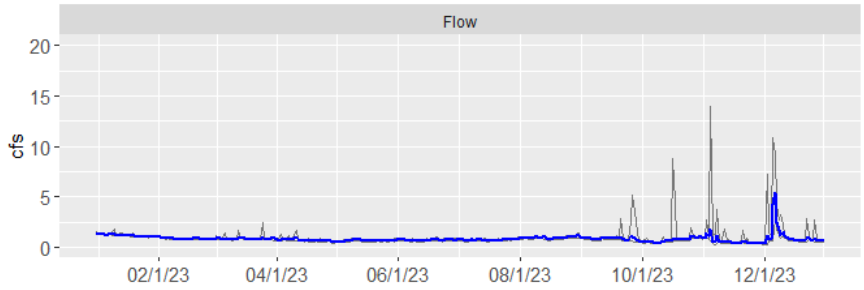
Zackuse Creek

Zackuse Creek was monitored each month for bacteria, nutrients, and conventionals (conductivity, pH, and alkalinity). In addition, a gage measured streamflow and temperature continuously. Zackuse Creek has been monitored annually for stream health by measuring benthic macroinvertebrate ("stream bug") diversity.

Starting in 2023, a second gage measured water level at the East Lake Sammamish Parkway culvert.

Streamflow

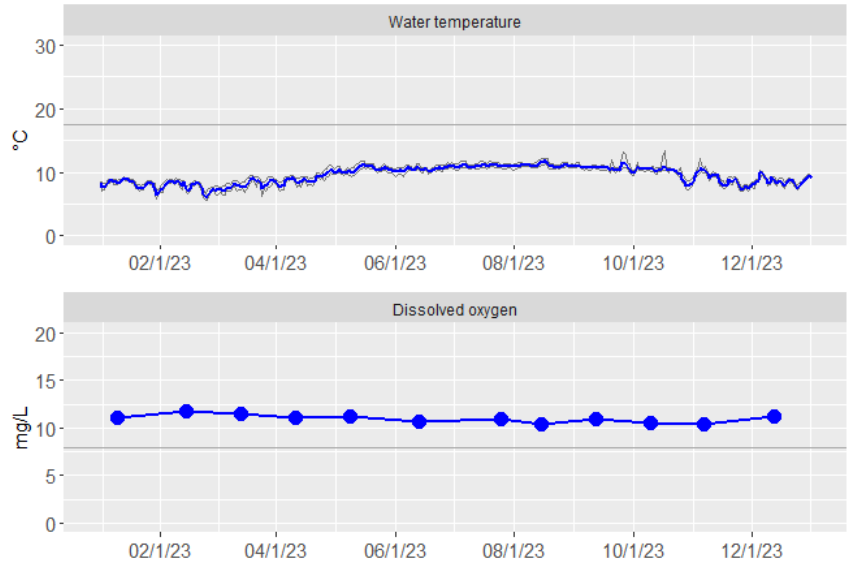
A gage on Zackuse Creek measured streamflow and temperature continuously throughout the year.



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Temperature & Dissolved Oxygen

Good water conditions for salmon survival include temperatures cooler than 17.5°C and dissolved oxygen concentrations of at least 8 mg/L. In 2023, Zackuse Creek stayed cool and well-oxygenated throughout the year.



Horizontal grey lines show the recommended thresholds for salmon survival, as discussed above. On the temperature plot, the blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

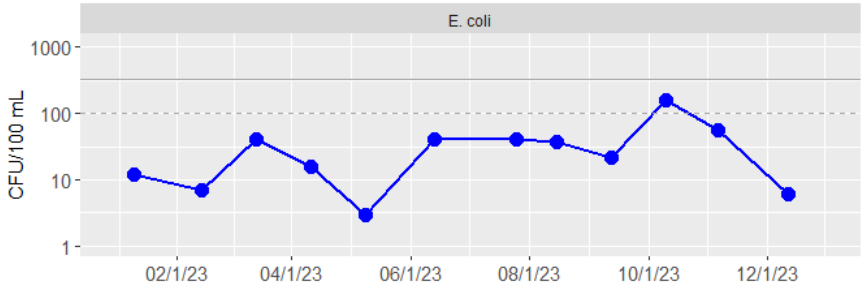
Biotic Stream Health

As an overall measure of stream health, Zackuse Creek was sampled once during the summer for benthic macroinvertebrate ("stream bug") diversity.

Data from 2023 are not yet available from the contract lab that analyzes the samples. Those results will be provided to the City of Sammamish and posted online when we receive them. Results from all years and individual taxon scores for Zackuse Creek are available on the Puget Sound Stream Benthos website at: https://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?k=ZAK

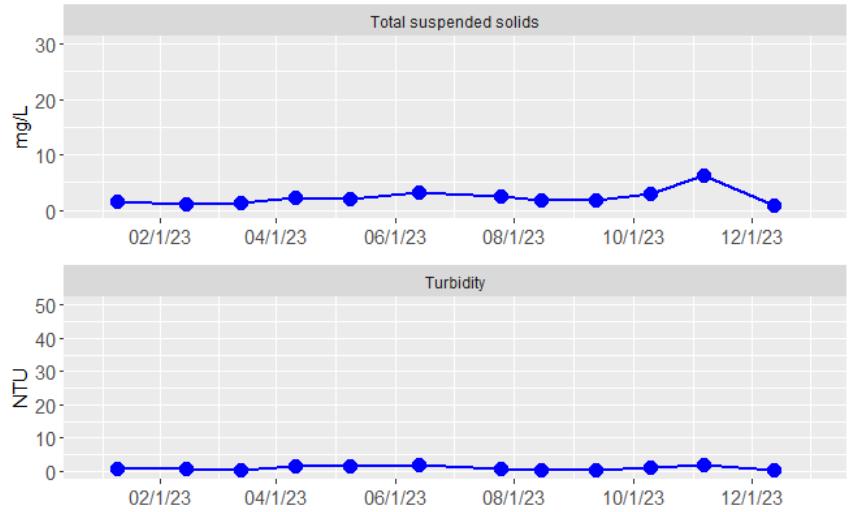
Bacteria

To meet Washington's recreational water-quality criteria, streams should average less than 100 CFU/100 mL of *E. coli* bacteria (dashed horizontal line in the graph below), with no more than 10% of samples above 320 CFU/100 mL (solid horizontal line). Zackuse Creek met this goal in 2023, and all samples had relatively low bacteria concentrations.



Suspended sediment

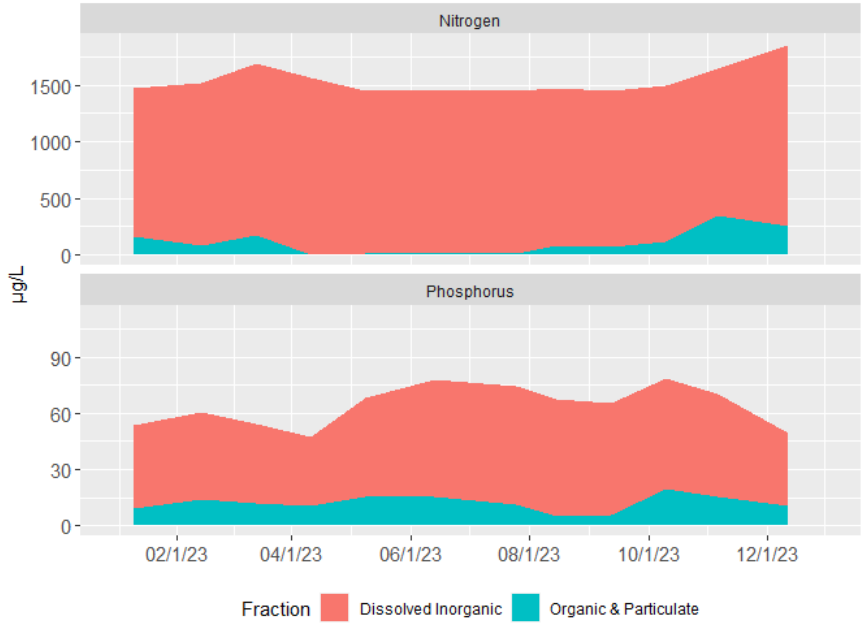
Sediment in the water was measured two ways: as the mass of total suspended solids (TSS), and as turbidity (an optical measurement). In 2023, suspended sediment values were reasonably low in Zackuse Creek. Note that these samples were collected only once per month and would not necessarily catch brief periods of high sediment during high-flow events.



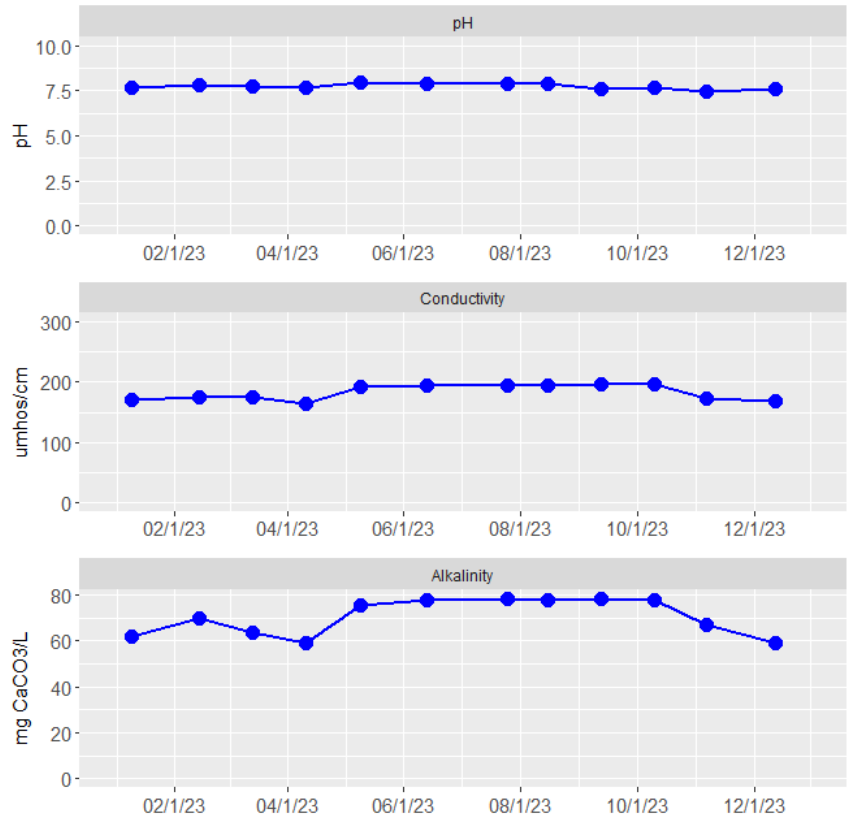
Nutrients

The following graphs show nitrogen and phosphorus concentrations, split out into two fractions: dissolved inorganic, and organic plus particulate. The dissolved-inorganic fraction can be taken up and used more readily by algae (many organic and particulate forms need to be decomposed first). These are stacked-area graphs; the total height of the colored area is the total concentration.

In 2023, Zackuse Creek continued to have fairly high nutrient concentrations. This is typical of streams in Sammamish and is not unique to Zackuse. Continuing to reduce nutrient inputs to these streams, especially phosphorus, would likely benefit Lake Sammamish. Lake Sammamish, designated a Water of Statewide Significance, has had a Lake Management Plan in place since 1994 to reduce phosphorus.

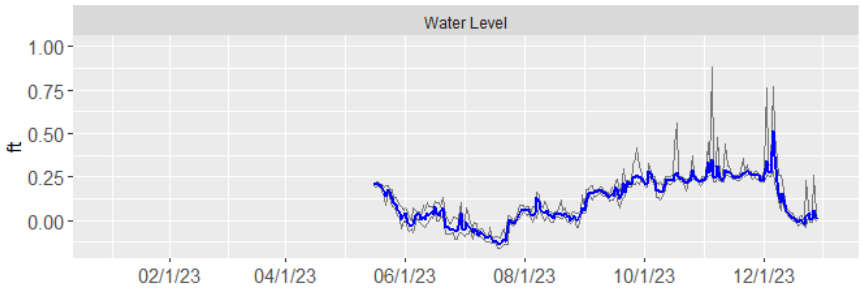


Conventionals



Culvert water level

In 2023, we added a water-level gage at the culvert under East Lake Sammamish Parkway. This site is not suitable for good streamflow measurements, so we have not converted water level into streamflow. Instead, this gage focuses on understanding how the stream and culvert respond to large rainstorms, which can deposit substantial amounts of gravel and sediment in and near the culvert.



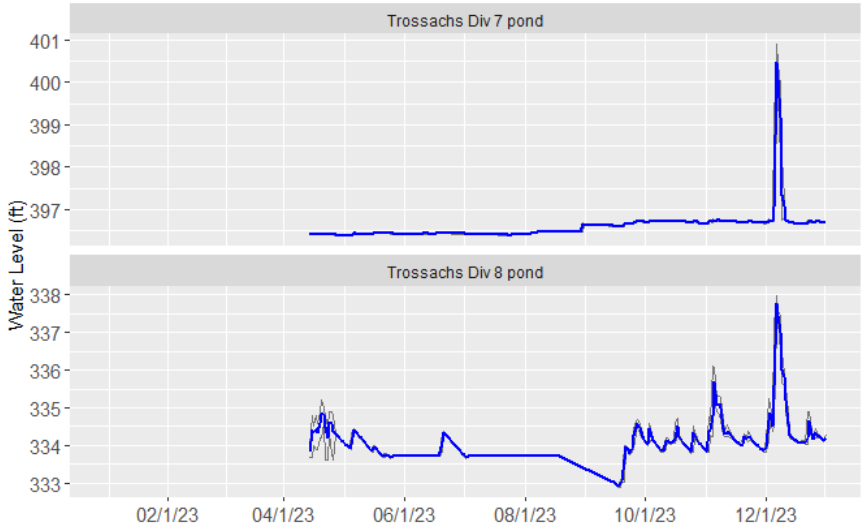
The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Stormwater pond dam safety

In 2023, we installed gages with real-time alerts at three high-priority stormwater ponds. Ecology's Dam Safety Office requires these to track water elevations and outflows and help maintain dam operation and safety, especially during large rainstorms.

Trossachs

At the Trossachs Div 7 and 8 ponds, data are given as water level (ft above sea level).



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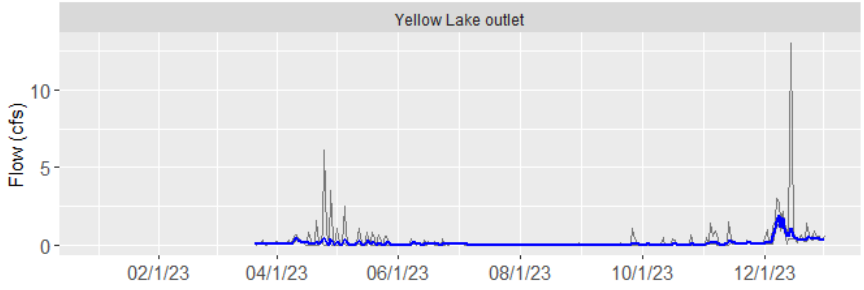
Yellow Lake

At the Yellow Lake outlet, data are given as flow (cfs).



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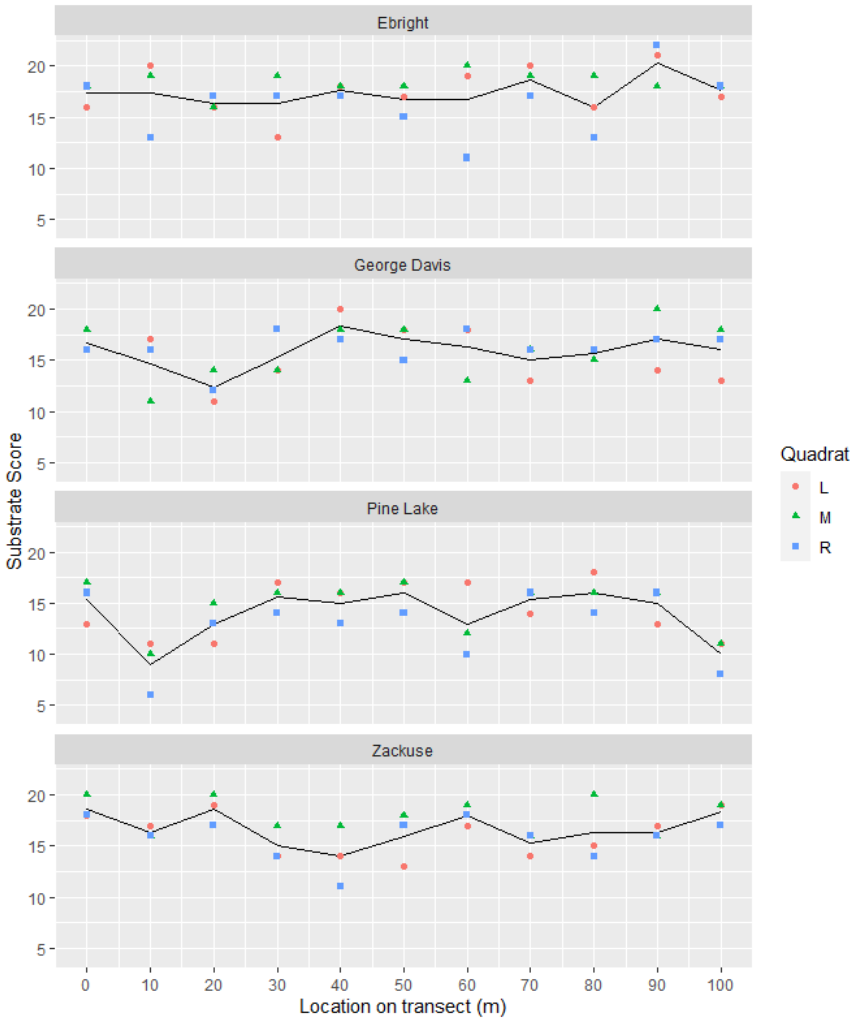
Entombment monitoring 2023

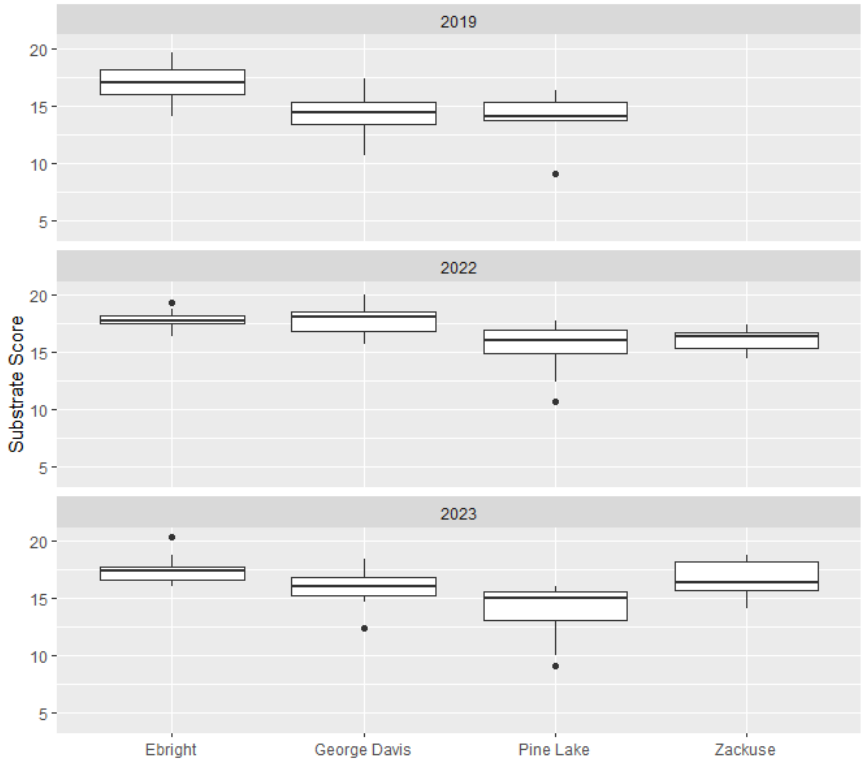
In early June 2023, we assessed the streambed along a 100-m transect in four streams: Ebright, George Davis, Pine Lake, and Zackuse Creek. The transects were located at the bottom of the Sammamish Plateau, where the stream flattens out and slows down. This is where the stream is most likely to drop fine sediment that can cap and entomb gravel spawning beds.

Every 10 meters along the transect, we measured the substrate score in three quadrats in the left, middle, and right of the stream channel (L, M, R in the following graph). The following graph shows the results for 2023, with the black line showing the average substrate score for each location along the transect. Locations go from the downstream end (0 meters) to the upstream end (100 meters) of the transect. Lower substrate scores indicate finer substrates and/or more embeddedness, which are likely to negatively impact salmonid spawning beds.



There was normal variability among quadrats and locations; no stream reaches stood out as having substantially higher or lower substrate scores than other parts of the stream.

The following boxplots summarize the data from each stream for each year, using the average score from each transect location (instead of individual quadrat data). Streambeds were not monitored in 2020 or 2021 due to social distancing requirements. Also note that the 2019 data for Zackuse have been removed. Those data are not comparable with data from later years because they were from a different part of the stream. After 2019, we moved the Zackuse monitoring transect further upstream to a section of stream that had noticeably more fine sediment and served as a better "sentinel" reach.



Substrate scores do not have established interpretations for what constitutes a "good" or "poor" result. These streams all had median scores around 14 to 18, which are high enough to suggest that entombment was unlikely to be a problem in these streams during these winters (J. Bower, pers. comm.). Because we monitored the stream reaches most vulnerable to entombment, other stream reaches likely had similar or higher substrate scores this year.

Riparian canopy cover

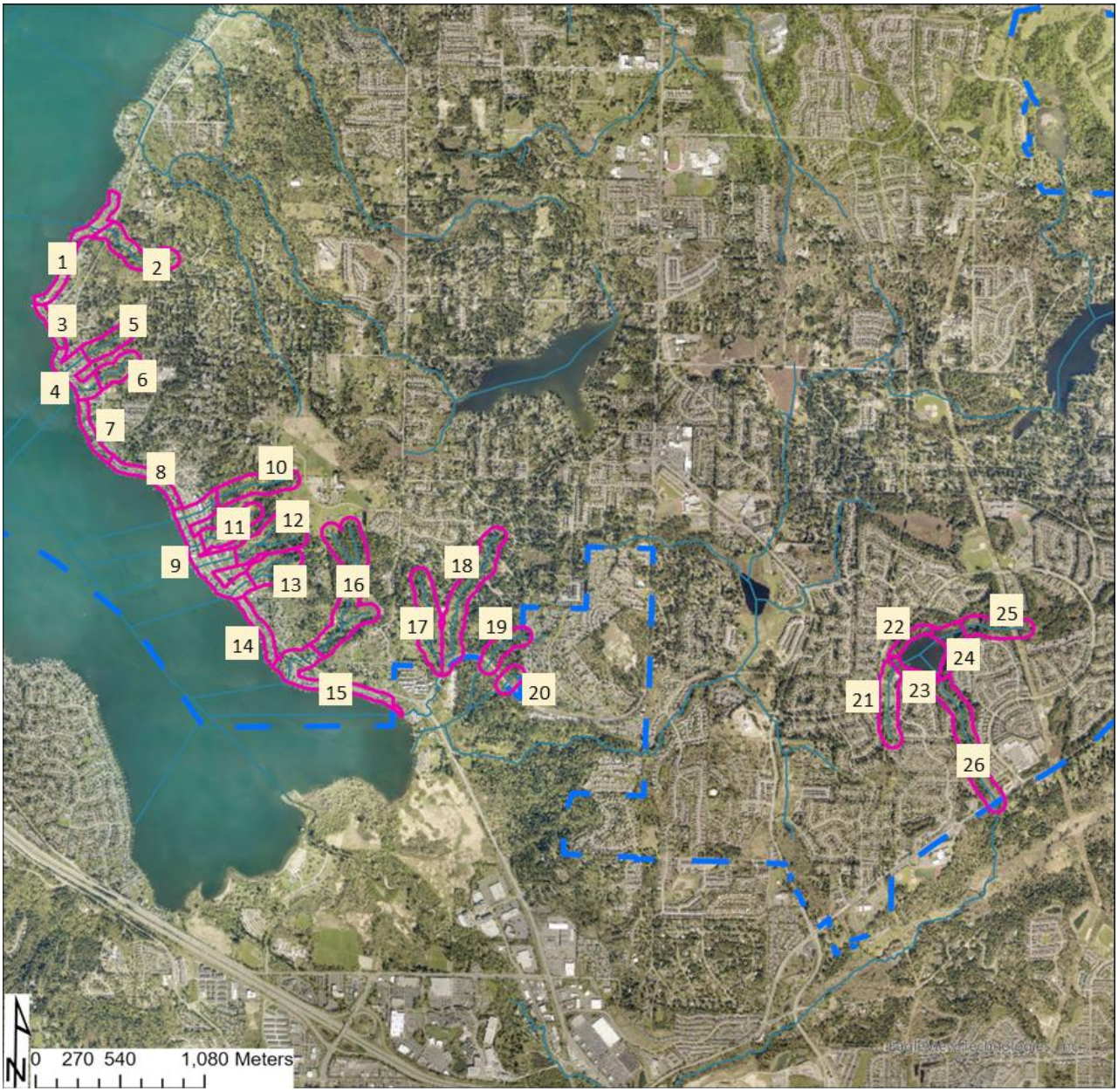
We measured riparian tree canopy cover for the south end of Sammamish, including the Lake Sammamish shoreline and many small streams. This used aerial photos taken in 2021. Tree cover (presence/absence) was mapped within 60 m (200 ft) of streams and shorelines, on a grid of points 5 m apart. Full results are provided separately as a GIS file and high-resolution PDF map.

This was the initial assessment of tree canopy cover in this area. In the future, we plan to revisit these areas approximately every 5 years to track canopy cover gains and losses over time, assess the effectiveness of ordinances and policies, and identify important areas to focus conservation and restoration work.

Total canopy cover in the riparian zone was 61%. We also divided the watershed into multiple reaches; in each reach, we calculated canopy cover for the entire 60-m riparian area plus 20-m and 10-m zones closest to the streams. Canopy cover within 10-20 meters of the stream is especially important for certain ecological functions such as shading and sediment reduction. A map of the reaches is shown below, followed by a table of the canopy cover results for each reach.

Tree canopy cover was variable across this basin. Some reaches were well forested, especially the portions nearest to the stream, while other reaches with lower canopy cover were mostly houses. Wetland areas also had low canopy cover, as expected.

Map of watershed showing individual numbered reaches:



Percent canopy cover for each reach:

Reach	Land Cover	60 m	20 m	10 m
1	lake shoreline	25	11	12
2	trees and few homes	74	72	72
3	lake shoreline	44	NaN	NaN
4	lake shoreline	29	41	46
5	trees and few homes	73	92	97
6	rip buffer near homes	54	83	83
7	lake shoreline	32	NaN	NaN
8	lake shoreline	30	NaN	NaN
9	lake shoreline	20	19	22
10	trees	91	95	93
11	trees and few homes	85	89	87
12	trees	94	91	87
13	trees and few homes	73	82	85
14	lake shoreline	19	NaN	NaN
15	lake shoreline	26	37	42
16	trees and few homes	81	90	91
17	trees and few homes	73	85	85
18	trees and few homes	79	92	94
19	trees and few homes	90	89	85
20	trees and few homes	90	85	87
21	homes and park	39	56	68
22	lake shoreline	79	NaN	NaN
23	lake shoreline	83	66	66
24	lake shoreline	37	13	2
25	wetlands	69	54	49
26	rip buffer near homes	76	56	44
27	wetland	78	70	55
28	homes	31	59	78
29	homes	100	NaN	NaN
30	trees and homes	75	97	99
NA	NA	40	52	38

Note that along the lake shorelines, the 10-m and 20-m zones refer to areas within 10 or 20 m of a stream, respectively, not areas within 10 or 20 m of the lake shoreline. Some reaches along lake shorelines did not contain a stream, so these columns are blank (shown with dashes). In contrast, the 60-m zone is areas within 60 m of either a stream or the lake shoreline.