Water Quality Assessment in the Bighill Creek Watershed

Integrated Water Management Program, SAIT
Capstone Project, Jan-April 2025

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1. Introduction

The "Water Quality Assessment in the Bighill Creek Watershed" capstone project aims to compile, organize, and perform high-level analysis on historical water quality data from the Bighill Creek watershed, where monitoring efforts have been ongoing since 2017. Its purpose is to assist Wendell Koning (PBiol, Limnologist) in coordinating a State of the Watershed Report, which aims to contribute meaningfully to the long-term health and conservation of the Bighill Creek watershed.

This report focused on two different aspects.

1. Compiling and organising the existing data provided by the Bighill Creek Preservation Society (and subsequent open-source data from Datastream), and the City of Calgary. These datasets contained water quality measurements, including in situ measurements with multimeter devices and grab samples taken to laboratories for analysis.
2. Conducting monthly monitoring of sites with SAIT's equipment during the winter of 2025 (January until early April) to support the volunteer activities performed by the Bighill Creek Preservation Society members, https://bighillcreek.ca/.

1.1 Area Background

The Bighill Creek Watershed is located just northwest of Calgary's city limits. Named after its primary watercourse, Bighill Creek flows roughly 30 km from its headwaters through a glacial valley before joining the Bow River in Cochrane. The watershed includes Big Hill Springs Provincial Park, seen in Figure 1. Big Hill's main spring is ranked among Canada's top four mineral springs based on criteria such as water quality, flow volume, biodiversity, and wildlife habitat (Houseknecht 1984). These springs contribute approximately half of the total flow in Bighill Creek.

The watershed is notable for both its ecological and recreational value. It serves as a key wildlife corridor connecting the Bow River valley to upstream habitats and provides a unique habitat for bird and fish species (BCPS, 2025). Big Hill Springs Provincial Park is also a popular destination for recreation, drawing an estimated 250,000 visitors annually (Fennell, 2021). In addition to its local significance, the watershed contributes to downstream drinking water supplies, including for the City of Calgary, which monitors water quality independently.

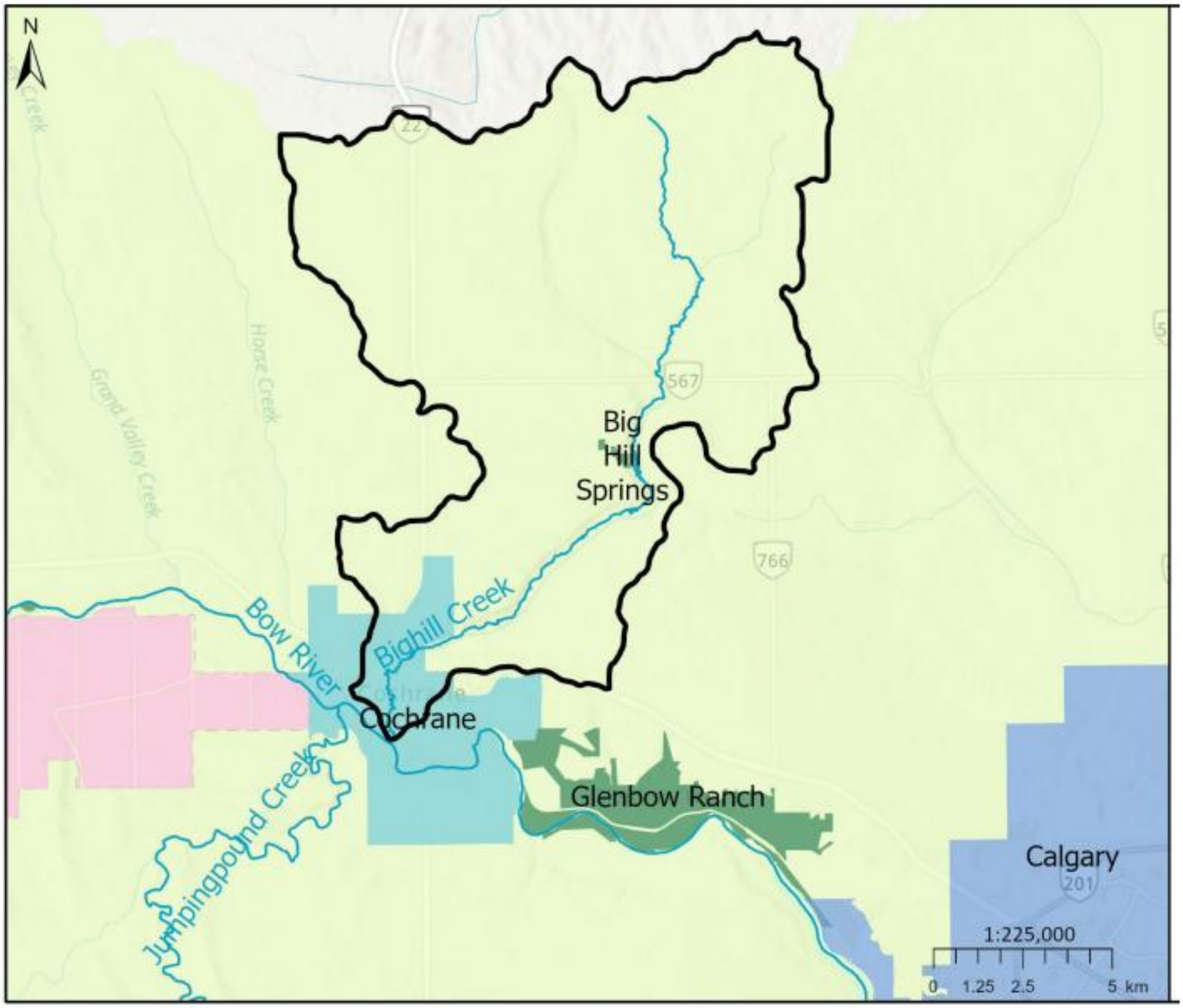

Figure 1- Map showing the boundaries of Bighill Creek watershed alongside the main rivers and municipalities in the area (Koning, 2025) Map from BRBC

The area is also experiencing increasing industrial pressure. Activities such as cattle ranching and oil and gas extraction are widespread, particularly in the stretch between Cochrane and the springs, where adjacent lands are under private ownership (Koning, 2025). However, the most potentially rapidly expanding land use is aggregate mining. The region contains large deposits of high-quality gravel located just 4 m below the surface (Fennell, 2021). One operation has been active for over 20 years, and two additional quarter sections have recently been approved for extraction as seen in Figure 2. Three more companies have acquired adjacent lands for potential development (Fennell, 2021).

These operations are permitted to excavate to within 1 m of the water table, leaving a narrow margin for error. In his 2021 report, Dr. John Fennell noted that the most recently approved site could adversely affect the aquifer and therefore Bighill Creek if developed as proposed (Fennell, 2021).

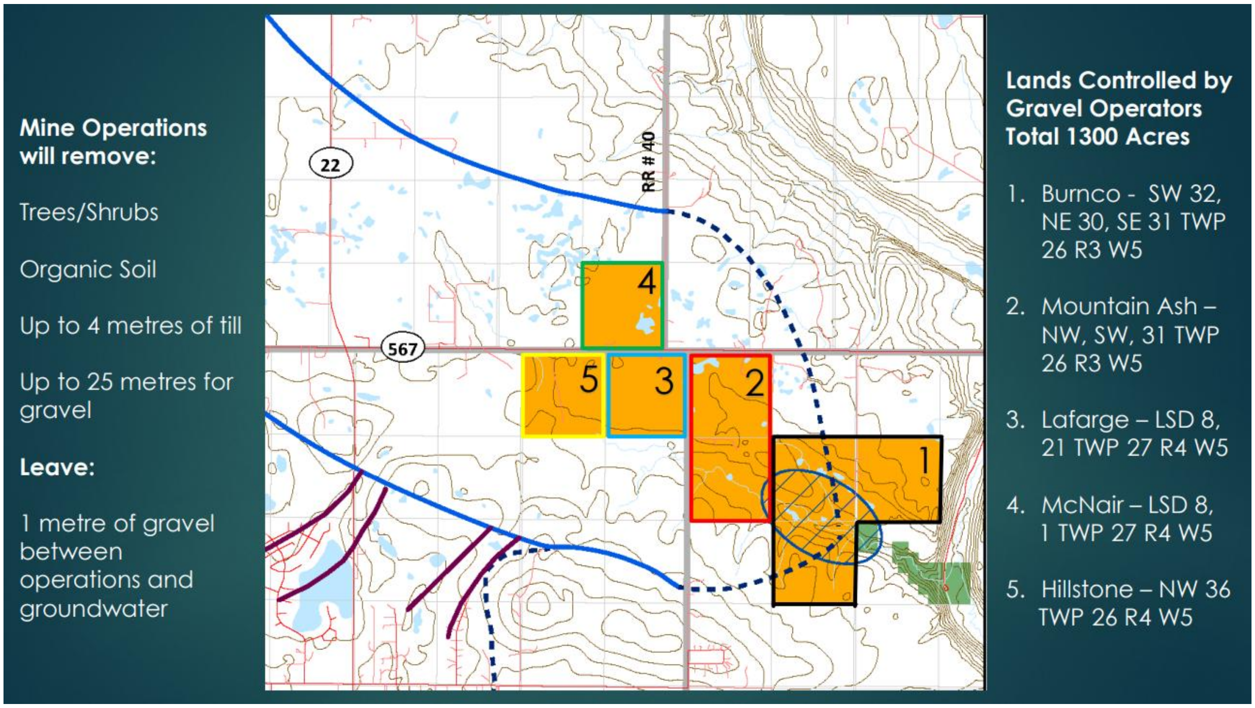

Figure 2 - Location of the gravel mining sites near the Big Hill Springs (discharge zone highlighted in striped blue) (Fennell, 2021) Adapted from U of C Thesis by Poschmann, S. (2007.)

1.2 What is Water Quality?

Water quality is a comprehensive evaluation of a river, lake, surface, or underground water body. This assessment encompasses the analysis of physical, chemical, and biological parameters, as well as the water body's capacity to support aquatic life and suitability for human consumption and use. (Statistics Canada, 2023)

A river is considered to have good or excellent water quality when it meets or exceeds water quality guidelines most of the time. For this report the 2018 *Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life (PAL)* was used as the primary standard for all applicable parameters (GoA, 2018).

2. Methods

2.1 Data Compilation

The Preservation Society provided the datasets in their original formats. The datasets were created by the following authors:

Table 1: Water Quality datasets received from the sponsor.

Author	Contents	Received
City of Calgary	BH Creek measurements 2024	12th January 2025
Hayahi Masaki	Flow measurements BH Creek 2017 2022	3rd February 2025
Wendell Koning	E. coli measurements 2022-23	3rd February 2025
Wendell Koning	BH Creek WQ results 2022	3rd February 2025
Wendell Koning	BH Creek WQ results 2023-24	3rd February 2025
Wendell Koning	BH Creek Major Ions 2022-23	5th February 2025
Ymène Fouli	BH Creek WQ results 2017-18	5th February 2025
Ymène Fouli	BH Creek WQ results 2019-20	5th February 2025
Ymène Fouli	BH Creek Field water results 2017-18	5th February 2025
Ymène Fouli	BH Creek Field water results 2019-20	5th February 2025
Wendell Koning	BH Creek Metals 2022	10th February 2025

Creekwatch	BH Creek WQ 2021-23	17th February 2025
Creekwatch	BH Creek WQ 2024	17th February 2025
Tiago Morais UoC	BH Creek major ions 2022	3rd March 2025
Fabio Ueda & Alex Whale	BH Creek WQ Jan-April 2025	2nd April 2025

2.2 Field Measurements

The team performed field measurements in the study area during 2025 on three different dates:

January 18th, February 21st and April 5th.

The pieces of equipment used were:

Table 2: List of equipment used for field sampling

Type of equipment	**Brand and Model**
Multiparameter Water Quality	YSI Quatro Plus
Turbidimeter	Lovibond TB250WL
Wading rod	Hoskin Science
Flow meter	OTT MF Pro
Handheld GPS	Garmin 64S

2.2.1 Water Analysis

A multiparameter device was used to sample the temperature, dissolved oxygen, specific conductivity, and pH. The YSI Quatro Plus device had its pH, DO and EC calibrated before each field day. As EC depends on temperature, all raw data were standardized to reflect the electrical conductivity at a reference temperature of 25º C.

2.2.2 Turbidity

A Lovibond TB250 WL was used to measure turbidity. The device was calibrated before each field day. Three vials were taken for all locations, each being measured thrice. The final results were the average of all measurements for each location.

2.3 Mapping

The coordinates from the different authors were extracted from the databases and input into a GIS application for spatial analysis. The naming and actual locations were compared to ensure singular naming conventions for each location.

A more straightforward and logical designation, from upstream to downstream sequence, was adopted in consultation with the preservation society.

Table 3: The updated convention adopted for identifying the sampling locations

ID	Name	Distance from the confluence with Bow River (km)
1	Bh Cr d/s of NCC Lake	20.0
2	Bh Cr u/s culvert at Hwy 567	19.7
3	BH Springs Cr at Prov Pk Upper site	17.1
4	BH Springs Cr at Prov Pk Lower site	16.3
5	BH Cr d/s pedestrian br NE of Ranche Rd	5.13
6	BH Cr u/s Ranchehouse Springs Creek	4.41
7	Ranchehouse Springs Creek near mouth	4.40
8	BH Cr d/s Ranchehouse Springs Creek	4.39
9	BH Cr u/s confluence with Bow River	0.04
10	Millennium Cr near mouth	0.03
11	Bow River u/s Bighill Cr confl	0

Figure 3 - Map of the sampling locations in the Bighill Creek Watershed

2.4 Site Information

In agreement with the sponsor, the sampling site locations were determined according to historical records and their importance and representativeness to the watershed.

The selected locations reflect the changes across the watershed, with contributions from the springs, tributaries, culverts, developed urban areas, and cattle ranching.

They also look for isolating possible variations from different sources, sampling immediately upstream and downstream of tributaries, at Ranchehouse Springs Creek and Millennium Creek.

Table 4 lists the numbering conventions for each site, replicated on the master spreadsheet with the historical data. It also indicates the type of measurements made at each site, demonstrating the necessary equipment to be carried to each location. are Table 5 In chronological order, this table lists the parking areas for accessing each location and the expected driving time to and from each location.

Table 4: Site locations, coordinates, and expected working hours for sampling.

ID	Coordinates		Site Name	Water quality measurement	Flow measurements	Time spent on site (h)	Walking time from the parking round-trip (h)
	Easting	North					
1	683051.6	5683602.7	NCC Lake	X	-	0.50	-
2	683390.7	5683234.5	Culvert Hwy 567	X	-	0.75	0.50
3	681795.8	5681286.3	BH Prov. Park Upper	X	X	1.00	0.50
4	682463.8	5680979.3	BH Prov. Park Lower	X	X	1.00	0.50
5	676941.0	5675502.7	BH Creek pedestrian bridge	X	-	0.25	0.25
6	676562.0	5675250.9	BH Creek u/s Ranchehouse Springs Creek	X	X	0.50	0.25
7	676532.4	5675285.6	Ranchehouse Springs Creek	X	X	0.50	-
8	676541.4	5675243.2	BH Creek d/s Ranchehouse Springs Creek	X	-	0.25	-
9	676038.9	5672888.2	BH Creek u/s Millennium Creek	X	-	0.25	-
10	676082.2	5672913.9	Millennium Creek	X	X	0.50	0.25
11	676069.1	5672929.2	Bow River	X	X	0.50	0.25

The parking locations and example times for a day sampling are shown below:

Table 5: Parking locations and example times for a day sampling in the study area.

Parking	Arrival time	Sites sampled	Departure time	Distance (km)	Travel time (min)
SAIT			8:30	40	45
Big Hill Springs Provincial Park	9:15	3	10:15	3	5
Range Road 34 @ NCC Lake	10:30	1	11:00	0.50	3
Range Road 34 @ Hwy 567	11:05	2	11:50	3	5
Ranch Road 35	12:00	4	13:00	18	25
4th Avenue N	13:30	5, 6, 7, 8	15:00	3	10
1 Riverview Drive	15:10	9, 10, 11	16:45	35	35
SAIT	17:20			35	

2.5 Flow

The University of Calgary, through the Department of Earth, Energy, and Environment, led by Professor Masaki Hayashi, has an ongoing long-term flow monitoring program at Bighill Creek near Site 5 from 2011 to the present. This data, among other purposes, can be used to analyze historical water quality measurements in the sections ahead.

Instantaneous flow measurements taken in the field (this SAIT project) were performed at sites 3, 4, 6, 7, 10, and 11. The velocity-area method, using an electromagnetic flow meter, was used. The cross-sections were measured to define the length of the water body, and depth was measured using the staff gauge.

3. Results

This report focuses primarily on three key monitoring locations: Site 2 (Bighill Creek u/s of the culvert at Hwy 567), Site 4 (Big Hill Springs Creek, lower Springs), and Site 9 (Bighill Creek near the confluence with the Bow). These sites were selected to represent the two primary sources of flow into Bighill Creek (the forked streams at the top of the watershed, which meet upstream of the culvert, and the main springs creek itself coming from the Prov Park) and the cumulative effects observed at the watershed's outlet. Analyzing these locations provides a clearer picture of baseline water quality for each source and helps establish reference conditions for future monitoring efforts. Where applicable, additional sites that exhibit noteworthy outliers or deviations from expected conditions are discussed individually by site name. As well, for those who wish to delve further into the data (since 2017 to present), it has been compiled into a database available upon request.

Water quality was assessed using suitable guideline values. In most cases, the *Surface Water Quality Guidelines for the Protection of Freshwater Aquatic* (GoA, 2018) were used. Where PAL guidelines were not available, alternative sources were used.

For water temperature, Brook Trout were selected as a proxy species due to their known presence in Bighill Creek and their relatively low tolerance among local trout species (Trout Unlimited Canada, 2018). *Guidelines for Canadian Recreational Water Quality* (Health Canada, 2024) were used for evaluating E. coli concentrations for contact recreation. In all other cases, expert guidance was provided by Wendell Koning.

3.1 Water Temperature

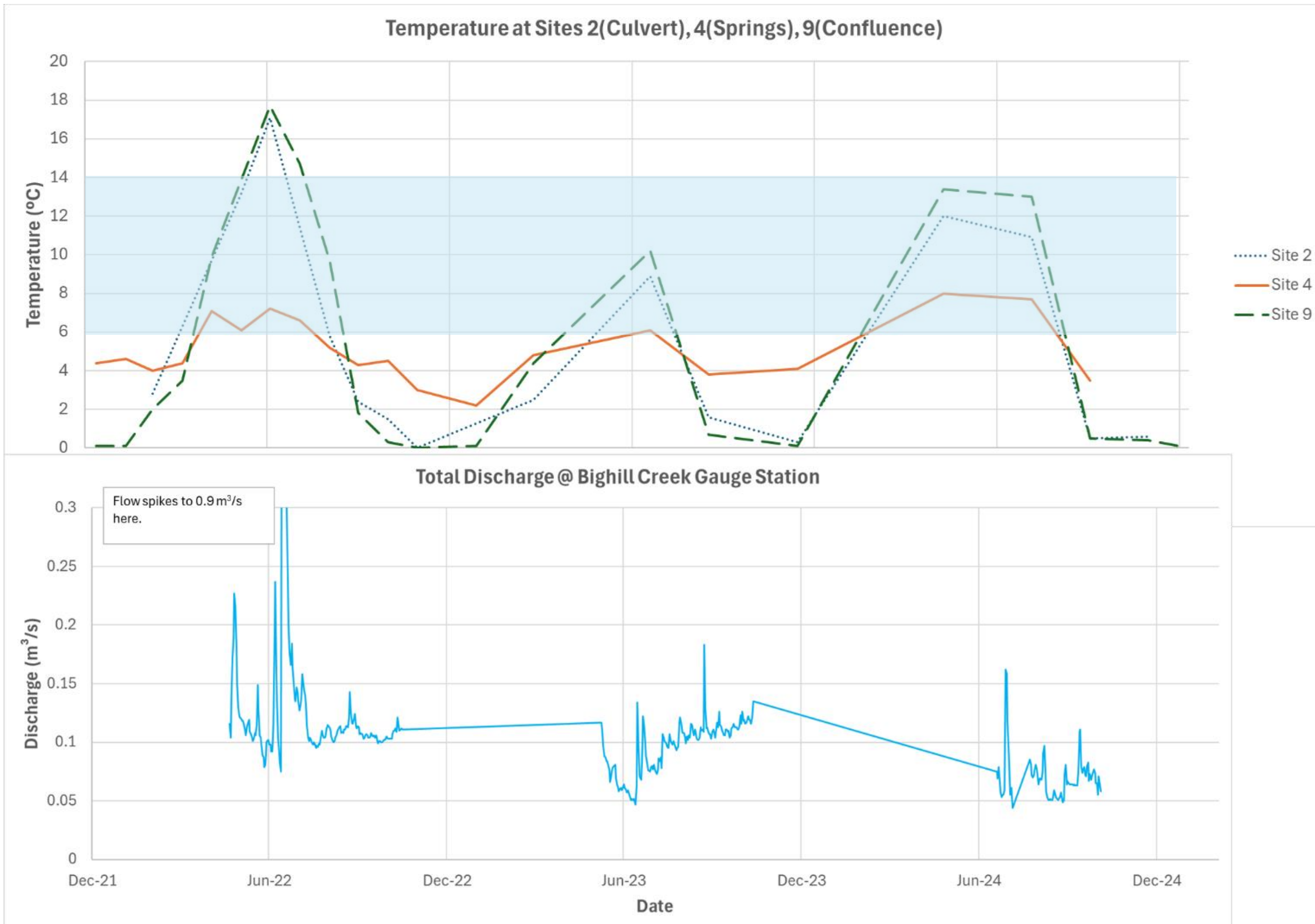

Figure 4 - Water temperature measurements,2022-24, in sites 2, 4 and 9 with ideal temperature range for Brook Trout (light blue), above; flow measurements at Bighill Creek main stem, lower graph (M. Hayashi, flow data).

Overall water temperatures in the creek were consistent and did not deviate much when comparing Sites 2 and 9.

Site 2 (Culvert) recorded a maximum temperature of 17.1 °C, a minimum of 0 °C, and a median of 2.7 °C. Temperatures remained below 1 °C between November and February throughout the four-year dataset. During field visits, Site 2 was occasionally observed to freeze to the bottom, resulting in data gaps during those periods.

Site 4 (Lower Springs) showed more consistent water temperatures, with a maximum temperature of 8.0 °C, a minimum of 2.2 °C, and a median of 4.5 °C. Temperature fluctuation at this site was minimal, with a year-round standard deviation of 1.6 °C. The spring-fed stream remained ice-free and open year-round.

Site 9 (Confluence with the Bow) recorded a maximum temperature of 17.7 °C, a minimum of 0 °C, and a median of 1.9 °C. This site exhibited temperatures below 1 °C from October through February and was consistently ice-covered during winter months.

The highest recorded water temperature was 17.9 °C at Site 5 (Lower Pedestrian Bridge) in July 2022. All sites, except for spring-fed tributaries such as Site 4, were observed to freeze over during winter months. Over the four-year period, temperature trends at Sites 2 and 9 closely mirrored one another.

3.2 Dissolved Oxygen

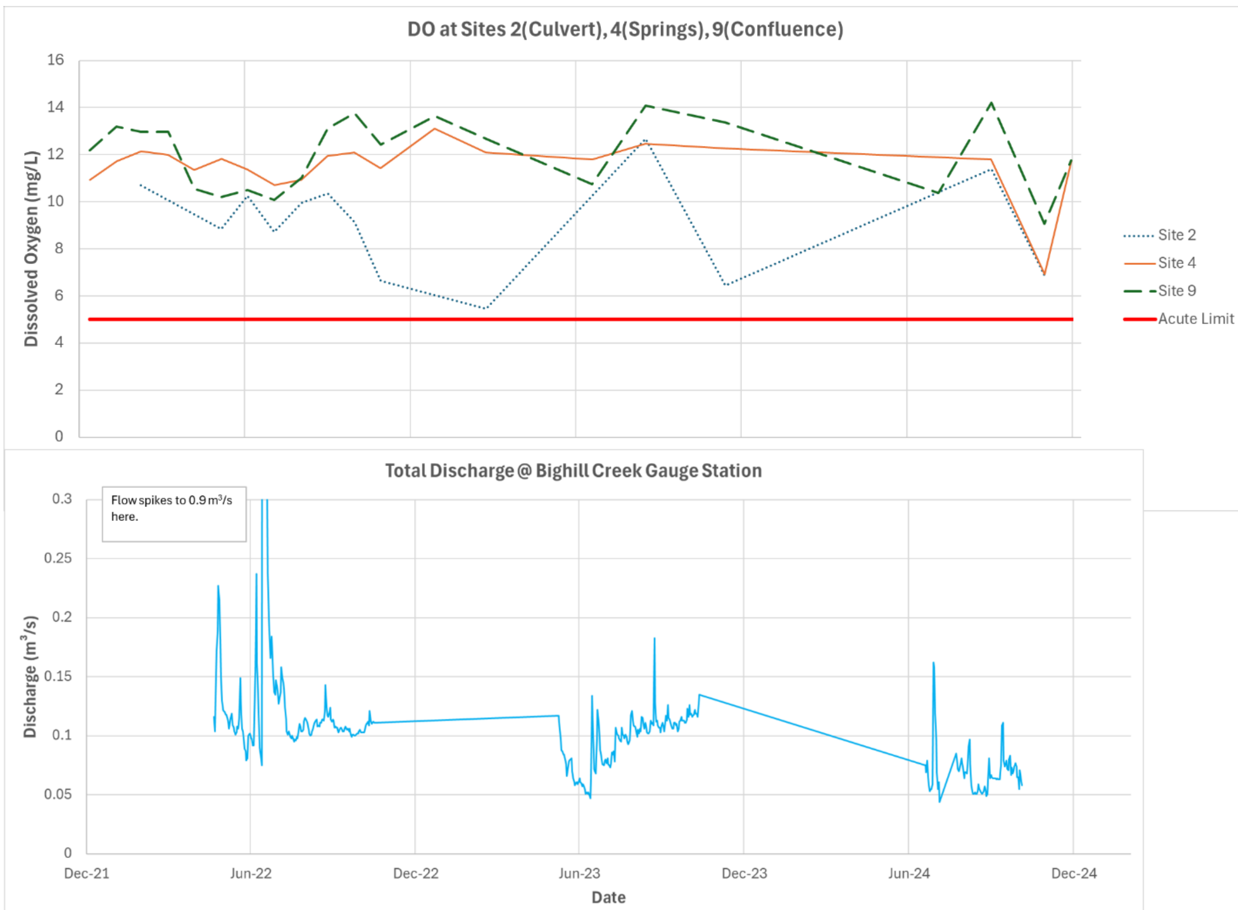

Figure 5 - Dissolved oxygen, 2022-24 in mg/L from Sites 2, 4 and 9, upper graph, showing all data above the 5mg/L acute limit for fish survival, flow measurements at Bighill Creek main stem, lower graph (M. Hayashi, flow data).

Site 2 (Culvert) recorded a maximum dissolved oxygen (DO) concentration of 12.7 mg/L, a minimum of 5.5 mg/L, and a median of 9.5 mg/L.

Site 4 (Lower Springs) showed a maximum DO concentration of 13.1 mg/L, a minimum of 6.9 mg/L, and a median of 11.8 mg/L. A reading of 6.9 mg/L was recorded in January 2025, however the other fifteen all exceeded 10.0 mg/L.

Site 9 (Confluence with the Bow) recorded a maximum DO of 14.2 mg/L, a minimum of 9.1 mg/L, and a median of 12.4 mg/L. All three sites showed relatively stable oxygen levels throughout the four-year monitoring period.

3.3 pH

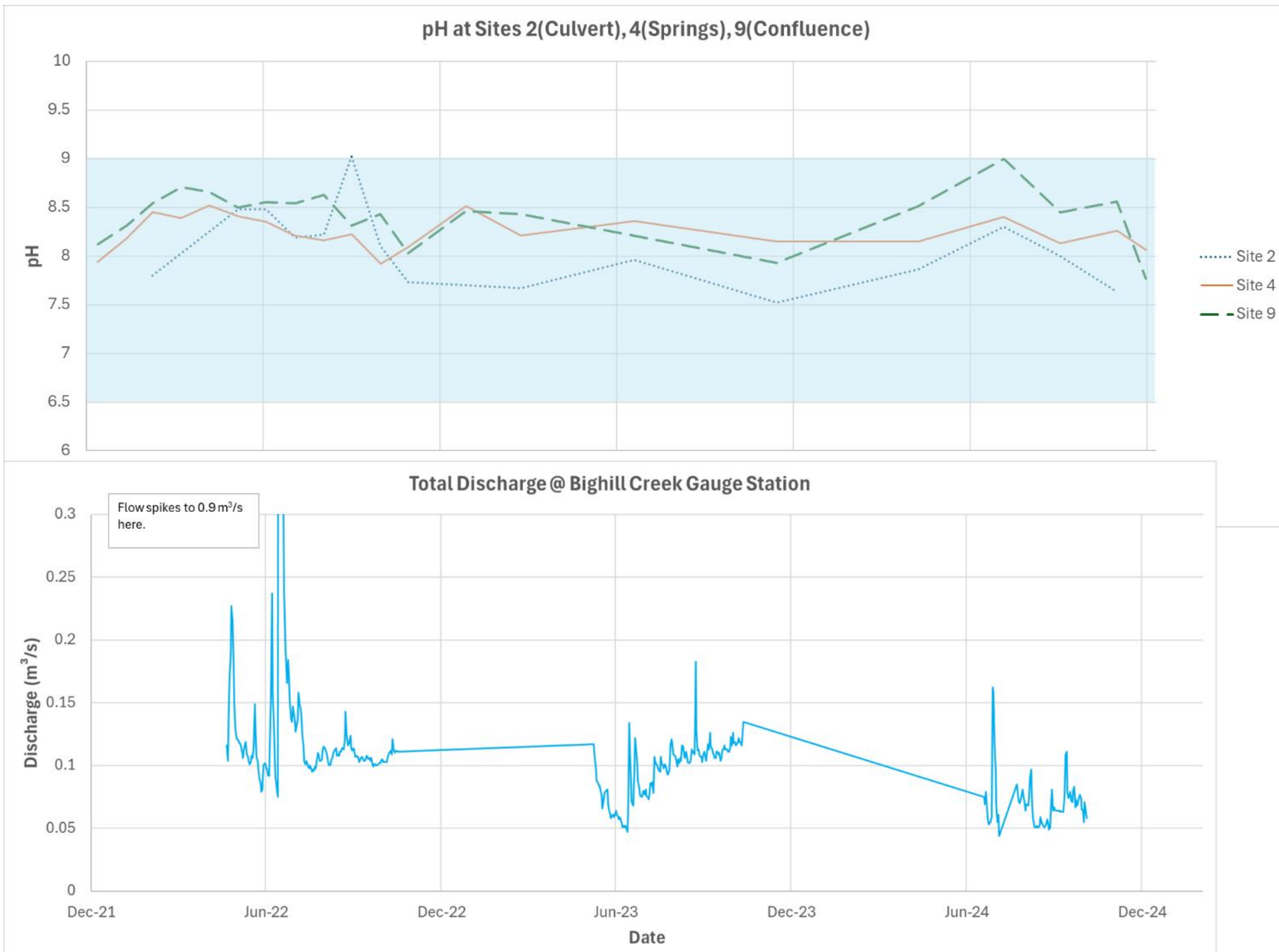

Figure 6 - pH, 2022-24 from Sites 2, 4 and 9, upper graph, showing pH range determined by the Surface Water Quality Guidelines for the Protection of Freshwater Aquatic (light blue), flow measurements at Bighill Creek main stem, lower graph (M. Hayashi, flow data)

pH levels across Bighill Creek remained stable throughout the monitoring period. The lowest recorded value was 7.2 at Site 3 (Upper Springs) in January 2024, while the highest value of 9.0 was observed on multiple occasions at various sites. All recorded pH values fell within the guideline range of 6.5 to 9.0.

3.4 Specific Conductivity

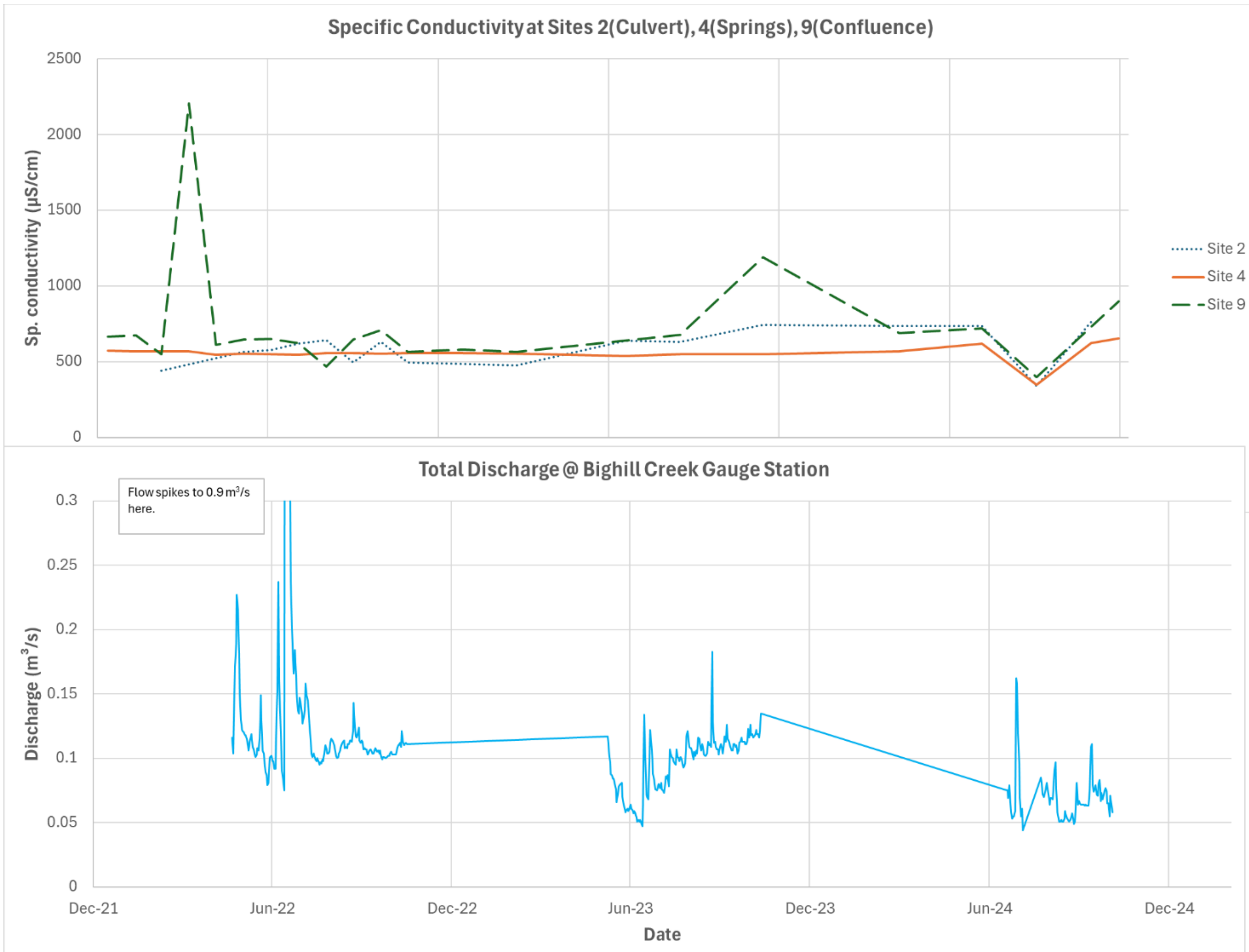

Figure 7 - Specific conductivity 2022-24, at sites 2, 4 and 9 above, flow measurements at Bighill Creek main stem, lower graph (M. Hayashi, flow data.)

Site 2 (Culvert) recorded a maximum specific conductivity (SPC) of 761.0 µS/cm, a minimum of 339.5 µS/cm, and a median of 625.1 µS/cm. Values remained stable throughout the monitoring period.

Site 4 (Lower Springs) showed a maximum SPC of 654.0 µS/cm, a minimum of 349.3 µS/cm, and a median of 556.2 µS/cm. Readings were similarly stable across the four-year dataset.

Site 9 (Confluence with the Bow) recorded a maximum SPC of 2204.0 µS/cm, a minimum of 398.9 µS/cm, and a median of 648.4 µS/cm. This site exhibited the largest variability in conductivity within the study area, with elevated values recorded in April 2022 (2204.0 µS/cm) and January 2024 (1190.0 µS/cm).

Down the length of Bighill Creek, all SPC readings (except for the two elevated events at Site 9) fell within the mid-range conductivity category of 200 to 1,000 µS/cm (Government of NWT, n.d.), typical for many freshwater systems.

3.5 Turbidity

Turbidity across Bighill Creek remained low, with a maximum value of 5.88 NTU recorded at Site 8 (downstream of Ranchehouse Springs Creek) in September 2024. The minimum turbidity value was 0.43 NTU at Site 3 (Upper Springs), with a median of 1.77 NTU across all sites.

Turbidity was lowest at the upstream sites, particularly at Site 3, and increased steadily moving downstream, with the highest values observed in the lower watershed.

3.6 E. coli

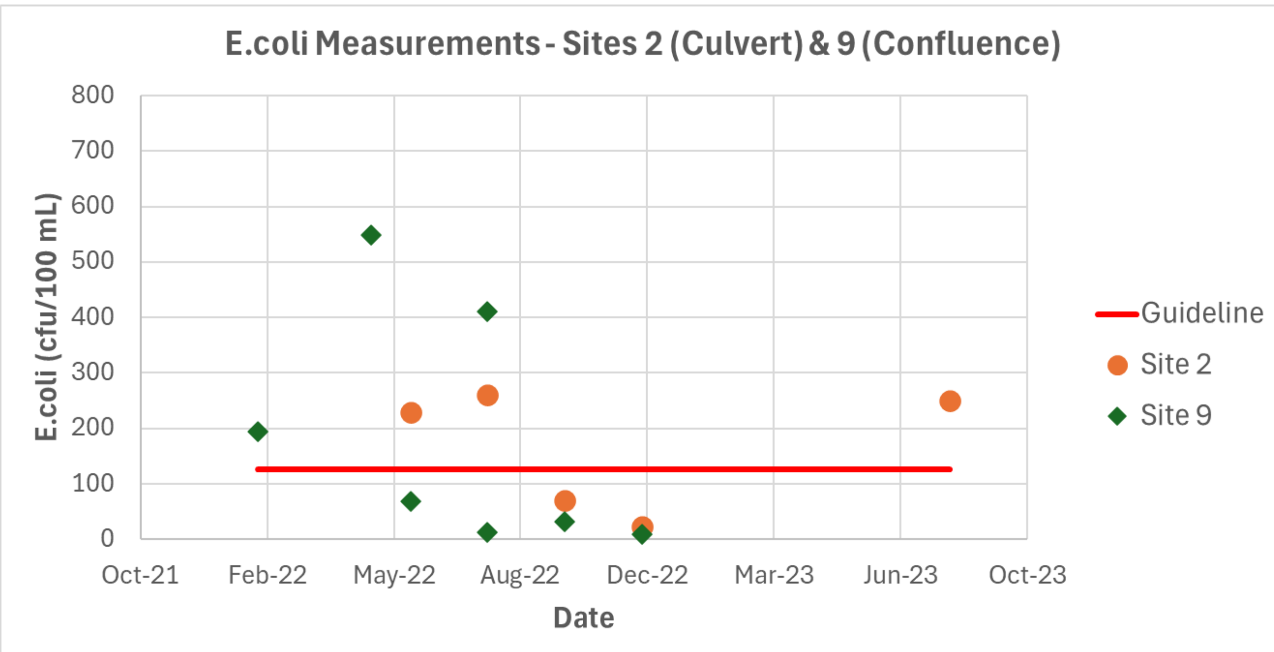

Figure 8 - E. coli levels from 2022 to 2023, showing half of the values above national guideline for contact recreation.

E. coli concentrations varied across the study area, with elevated values observed at Site 2 (Culvert) and Site 9 (Confluence with the Bow).

Site 2 recorded five samples between 2022 and 2023, with a maximum of 261.3 #/100 mL, a minimum of 24.0 cfu/100 mL, and a median of 230.0 cfu/100 mL. Three of the five samples exceeded the contact recreation guideline value of 126 cfu/100 mL. These three values were recorded during summer months, while the two values below the guideline were collected in October and December 2022.

Site 9 recorded seven samples over the same period, with a maximum of 549.3 cfu/100 mL, a minimum of 8.5 cfu/100 mL, and a median of 68 cfu/100 mL. Three of the seven samples exceeded the guideline, recorded between February and August.

All other sites, except one reading of 160.0 cfu/100 mL at Site 5 (Lower Pedestrian Bridge) in August 2023, showed no values which exceeded the guidelines. The August 2023 samples showed elevated E-Coli levels in the upper reaches of Bighill Creek at Sites 2 & 9, however fell to only 12 cfu/100 mL by the time samples were collected at the lower end of the creek at Site 9.

3.7 Major Ions

Grab samples for major ion analysis were collected on three occasions in 2022 (February, May, and August) at six monitoring sites. Results were scatter-plotted to identify spatial groupings and potential outliers among sites.

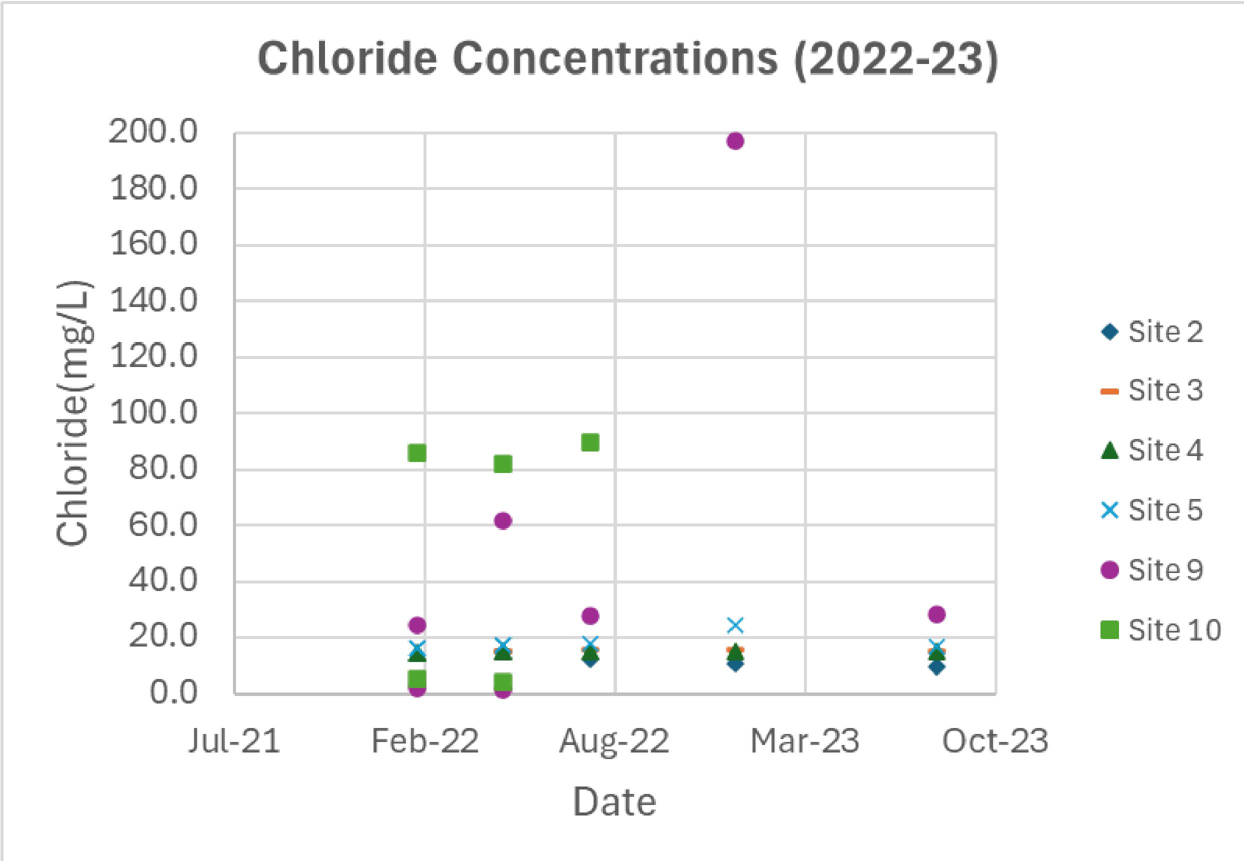

Figure 9 - Chloride concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millennium Creek) showing all but one value below the PAL guideline of 120.0 mg/L

Chloride concentrations remained low across most sites, with values generally below 30.0 mg/L. Site 10 (Millennium Creek) showed elevated concentrations, ranging from 82.0 mg/L to 89.9 mg/L. Site 9 (Confluence with the Bow) also recorded an elevated value of 61.5 mg/L in May, compared to 24.3 mg/L and 28.0 mg/L on the other sampling dates. All chloride measurements except for one (Site 9, March 2023) remained below the PAL guideline of 120.0 mg/L, and the irrigation use guideline of 100-700 mg/L depending on the crop type/sensitivity (GOA, 218.)

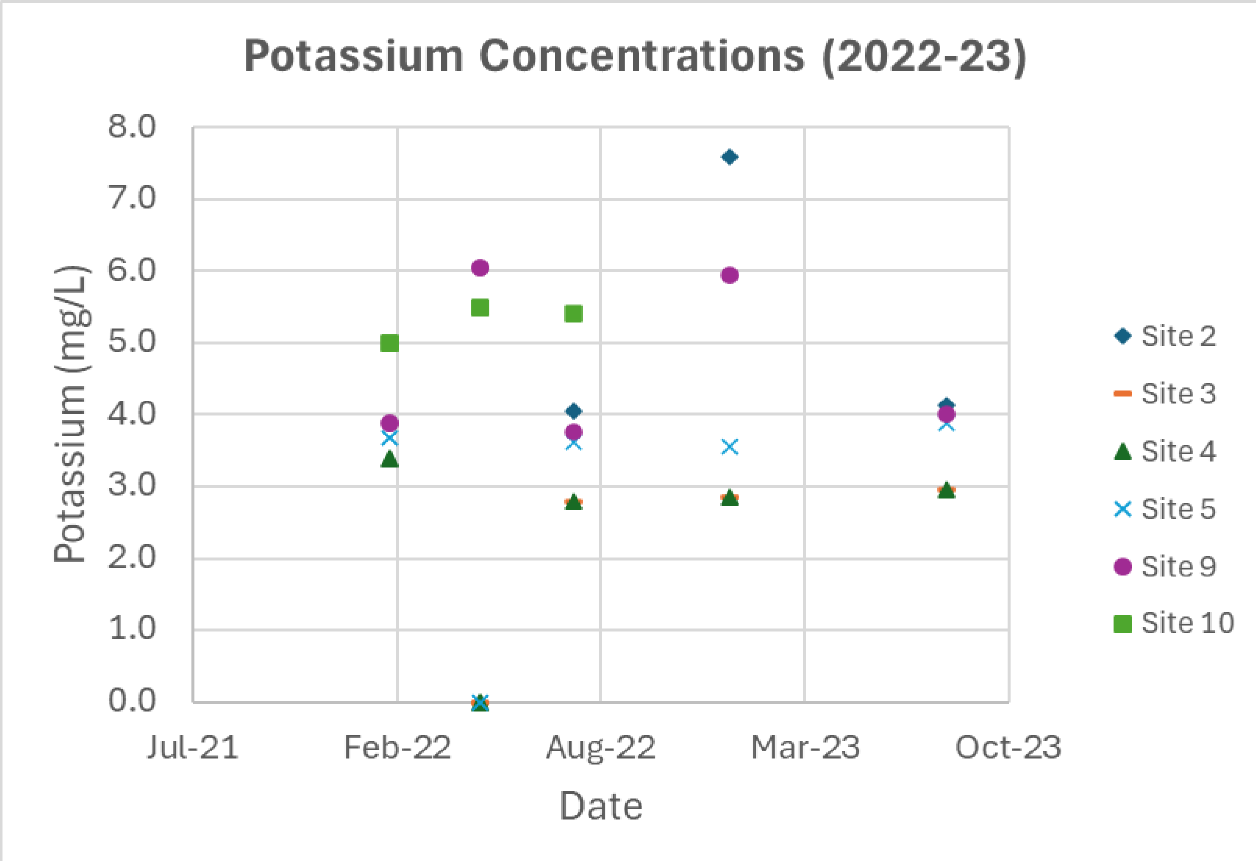

Figure 10 - Potassium concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millennium Creek.)

Potassium concentrations in the main branch of Bighill Creek ranged from 2.8 mg/L to 4.1 mg/L during the February and August sampling dates. Site 10 (Millennium Creek) showed consistently higher levels, ranging from 5.0 mg/L to 5.5 mg/L across all sampling events. The widest range of values was observed in May, with a maximum of 6.0 mg/L at Site 9 and less than the detection limit at Site 5.

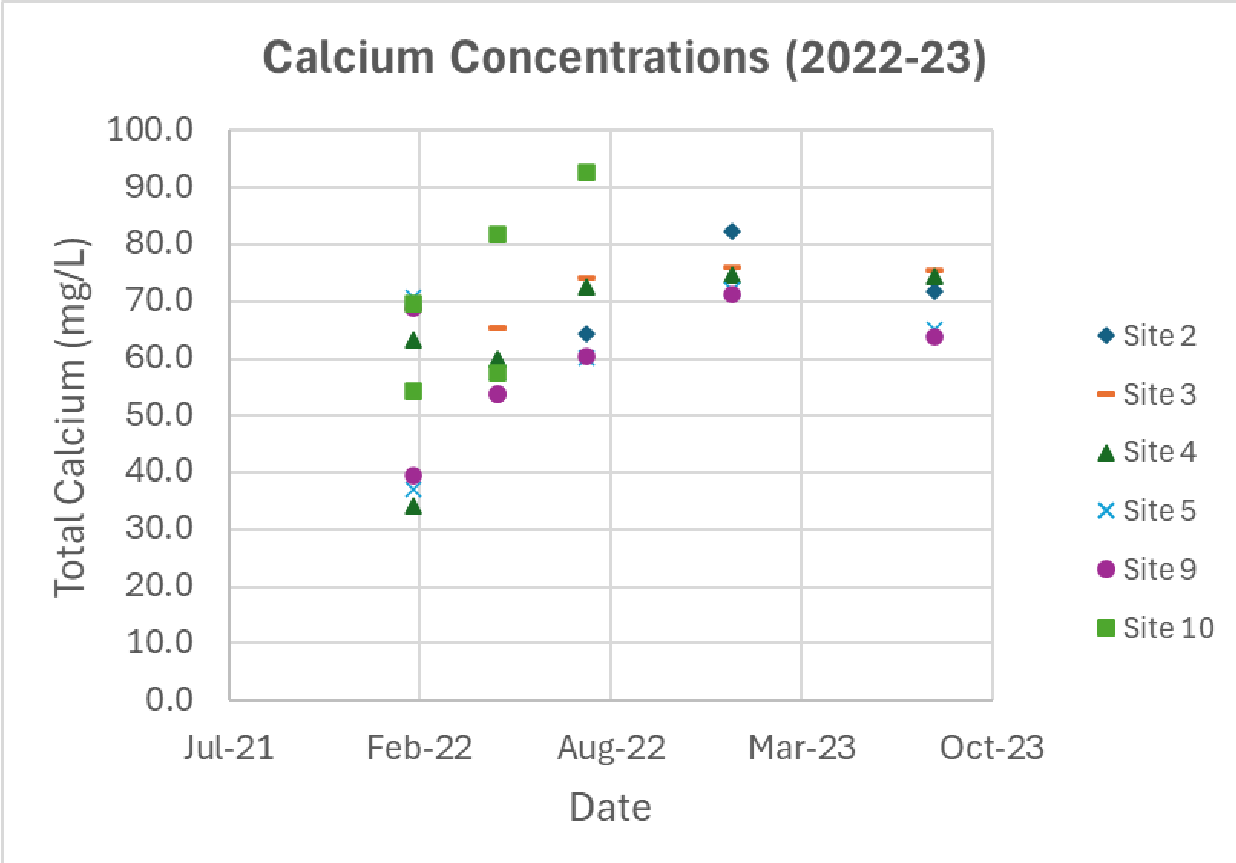

Figure 11 - Calcium concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millennium Creek) showing values below the livestock watering guideline of 1000 mg/L.

In February, calcium concentrations ranged from 37.1 mg/L to 69.6 mg/L across sampled sites. During the May and August sampling events, sites along the main branch of Bighill Creek showed tightly grouped values, while Site 10 (Millennium Creek) remained approximately 15 mg/L higher. Calcium levels increased from February to August, reaching a maximum of 92.7 mg/L at Site 10, with all values below the livestock watering guideline of 1000 mg/L (GOA 2018).

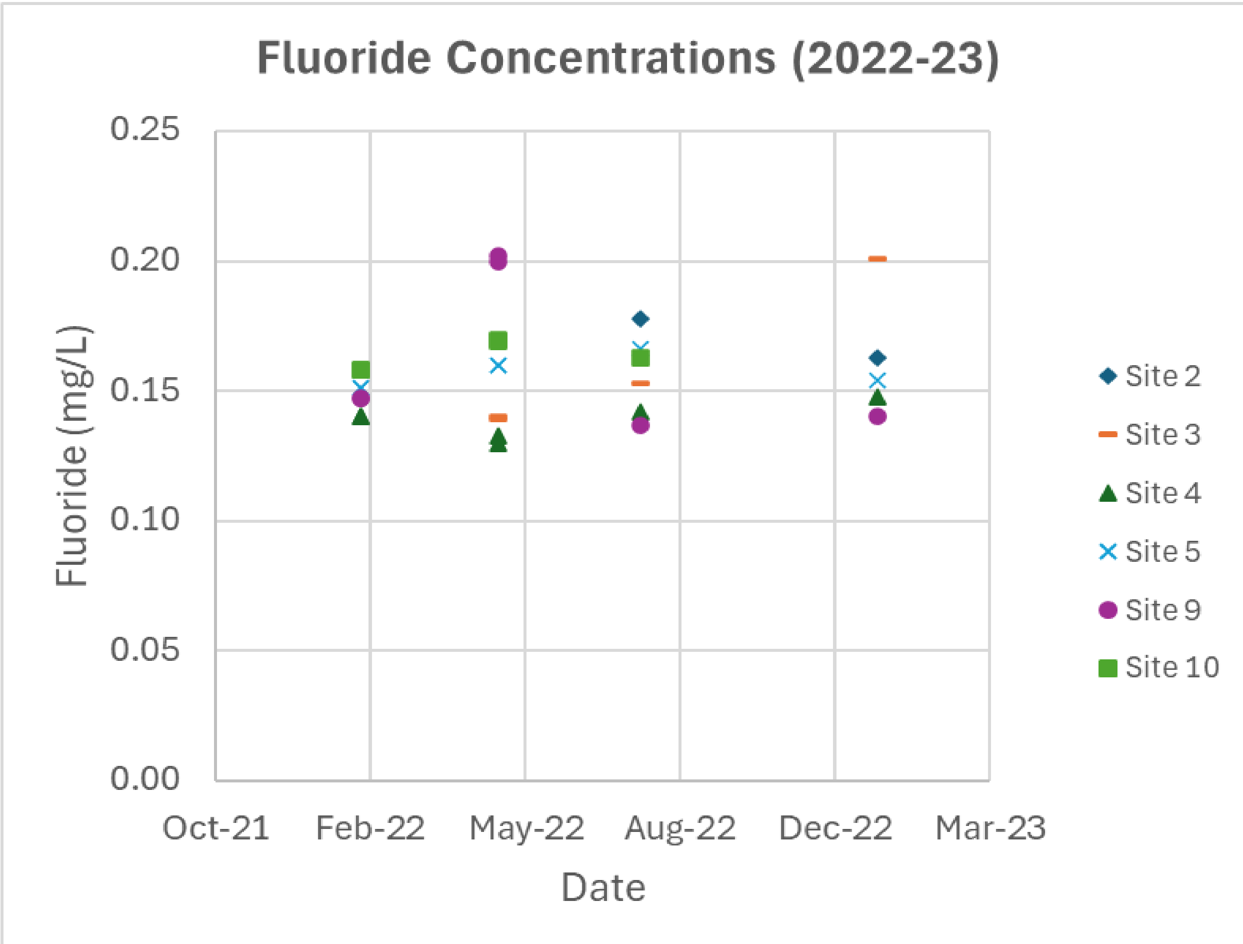

Figure 12 - Calcium concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millennium Creek) showing values below the irrigation use guideline of 1 mg/L and the livestock watering guideline of 1-2 mg/L.

Fluoride concentrations remained consistent across all sites and sampling months. The highest recorded value was 0.20 mg/L at Site 9 in May, and so all values below the irrigation use guideline of 1 mg/L and the livestock watering guideline of 1-2 mg/L (GOA, 2018).

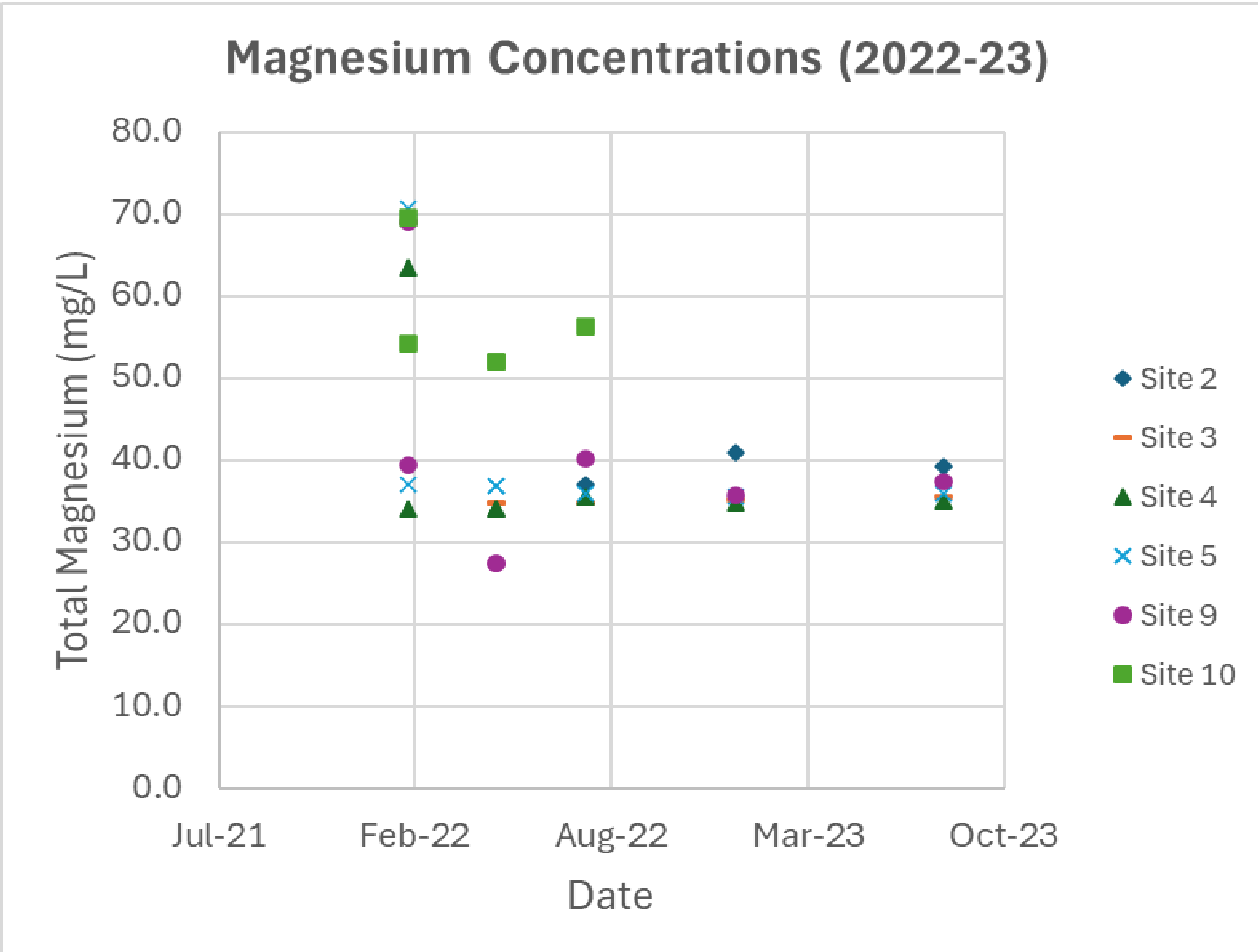

Figure 13 – Magnesium concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millenium Creek.)

Magnesium concentrations were tightly grouped during the May and August sampling events, with slightly elevated values observed at Site 10. February samples showed the highest concentrations across all sites, with a maximum of 71.7 mg/L recorded at Site 5.

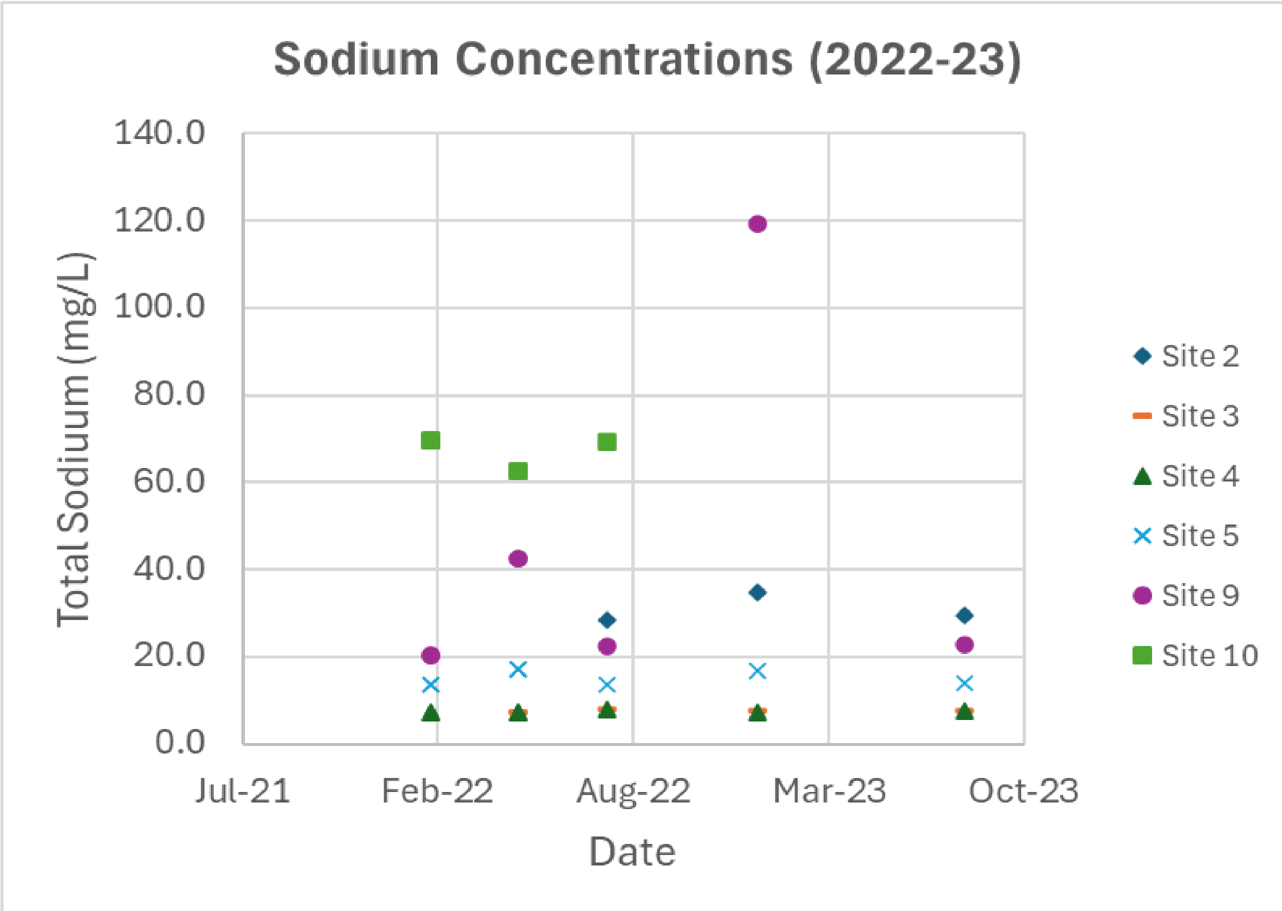

Figure 14 - Magnesium concentrations between 2022 and 2023 at Sites 2(Culvert), 3(Lower Springs), 4(Upper Springs), 5(Lower Ped Bridge), 9(Confluence), and 10(Millenium Creek.)

Sodium concentrations remained consistent across most sites, with values ranging from 7.3 mg/L to 28.4 mg/L. Site 10 (Millennium Creek) recorded elevated levels between 62.6 mg/L and 69.6 mg/L across all sampling dates. In May, Site 9 showed an increase to 42.4 mg/L, approximately 20 mg/L higher than the other two recorded values at that site.

4. Discussion

Note: while monthly sampling provides valuable insight into long-term trends, it leaves considerable time between sampling dates in which contaminants of concern may go undetected. Similarly, single high readings may not fully represent water quality conditions for a given month.

Overall, based on the data set reviewed, water quality in the Bighill Creek Watershed remains within guideline limits and reflects generally healthy conditions. Much of this can be attributed to the consistent inflow of high-quality spring water, which emerges close to the main stem of Bighill Creek. This spring water has lower turbidity and relatively stable temperature, reducing the creek's dependence on runoff for flow, which is often associated with higher turbidity and increased contaminant and nutrient loads from both natural and anthropogenic land uses.

Temperature at the furthest points of the creek (Sites 2 & 9) mirror each other, even though downstream springs introduce different water temperatures. This is notable given that upstream measurements were typically taken in the morning, while downstream sites were sampled in the late afternoon. These observations suggest that the springs help regulate water temperature, maintaining cool conditions even during the summer months. Out of 213 recorded temperature readings, only 14 exceeded 15 °C, indicating conditions suitable for cold-water fish such as trout species, even in the hottest summer months.

Dissolved oxygen (DO) levels remained close to the median year-round, likely due to the creek's constant flow and relatively cool, spring-regulated temperatures. Site 9, located near the confluence with the Bow River, consistently recorded DO concentrations above 9.1 mg/L, making it particularly suitable for fish migrating from the Bow. In September, several upstream sites, including both main stem and spring-fed locations, recorded unusually low DO values. As water temperatures and flow were near median values that day, it is unknown what may have caused this low point in the data that day, potentially a calibration error with the YSI.

pH values consistently remained within the range set by the Surface Water Quality Guidelines for the Protection of Aquatic Life (PAL), though several measurements reached the upper limit of 9.0. Future land use changes, especially increased mineral loads from gravel mining, could affect the pH of the creek, pushing it out of the optimal zone.

Specific conductivity (SPC) was highly stable across most of the watershed, where the graph shows an almost flat line around the 600 µS/cm mark. This is supported by similarly stable readings of ions such as sodium, magnesium, and potassium. Notable spikes in SPC were observed at urban sites within Cochrane, where multiple stormwater outfalls discharge into the creek. The highest recorded value of 2204.0 µS/cm occurred in April, during snowmelt and prior to street sweeping. The second-highest reading of 1190.0 µS/cm was observed in January 2024, during an unseasonably warm period when the air temperature reached 15.5 °C, and so likely increased snow melt and ice runoff from roads.

Turbidity measurements, available only for the most recent year, were consistently low. All but one sample fell below 5 NTU, with a single reading of 5.88 NTU. These levels are considered clear, with water not being considered "cloudy" until turbidity exceeds 55 NTU (Fondriest, 2014). Big Hill Springs exhibited particularly clear water, with turbidity readings well below 1 NTU. Given the presence of industrial activity in the upper watershed and ongoing construction in Cochrane, continued turbidity monitoring is recommended. Sampling immediately following storm events may also be helpful in identifying short-term increases.

Among all measured parameters, E. coli concentrations require the most immediate attention. According to the *Guidelines for Canadian Recreational Water Quality: Summary Document*, concentrations exceeding 126 cfu/100mL may pose a health risk and are considered unsuitable for primary contact recreation (Health Canada, 2024). Values above this threshold were recorded at multiple popular recreation sites, including Big Hill Springs and Riverfront Park in Cochrane, where samples at times exceeded guideline values.

The public perception of spring-fed water as inherently safe may contribute to reduced caution during recreational use, particularly at Big Hill Springs. E. coli contamination in the watershed likely originates from multiple sources, including livestock, wildlife, domestic pets, and human activity.

Nutrient concentrations in Bighill Creek remained low and relatively consistent along the main branch, with no evidence of widespread nutrient loading. Site 10 (Millennium Creek), located 35 m upstream from the confluence with the Bow River, consistently recorded higher nutrient levels than other sites. While these concentrations did not exceed guidelines or pose immediate concern, they were elevated compared to the mainstem. Millennium Creek follows a similar path through urban areas as Bighill Creek but has a lower flow rate, lowering its ability to handle (via dilution) urban runoff from the area. Although the impact of this tributary on the mainstem is limited due to the short distance before it joins the Bow River, it may serve as a potential refuge for fish seeking cooler, slower-moving water, and is likely used for spawning habitat by some trout species. Continued site monitoring is recommended to ensure salt and nutrient levels remain within safe bounds.

In conclusion, this assessment provides a baseline dataset highlighting the current state of water quality in the Bighill Creek watershed. The results indicate generally healthy conditions, with most parameters falling within established guideline ranges. The consistent influence of spring-fed sources supports year-round stability in temperature, dissolved oxygen, conductivity, pH, and turbidity. The data compiled can be referenced for future assessments and can be used to detect changes resulting from increasing anthropogenic pressures in the watershed. Continued monitoring will be essential to preserve the environmental and cultural values of the Bighill Creek watershed for current and future generations.

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List of Acronyms

PAL: Protection of Aquatic Life (used in “Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life”)

u/s: Upstream

d/s: Downstream

DO: Dissolved Oxygen

EC: Electrical Conductivity

GPS: Global Positioning System

μS/cm: Microsiemens per centimeter (unit of conductivity)

mg/L: Milligrams per liter (common concentration unit)

NTU: Nephelometric Turbidity Unit

cfu/100 mL: Number of bacteria colonies per 100 milliliters (used for E. coli measurements)

SPC: Specific Conductivity (equivalent to EC but often used in field reports)

GIS: Geographic Information System

UoC: University of Calgary

SAIT: Southern Alberta Institute of Technology

YSI: Brand name of water quality instrument.

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Appendix

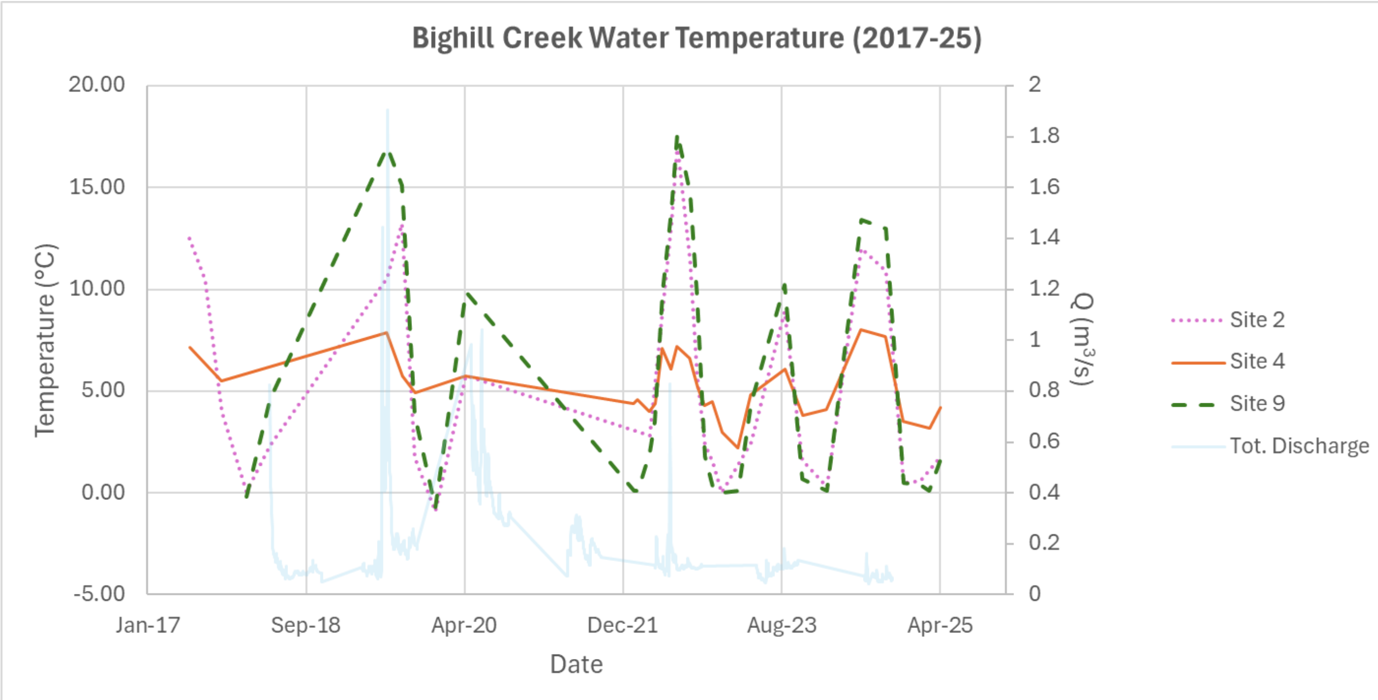

Figure 15: Water temperature trends across Sites 2 (Culvert), 4 (Springs) and 9 (Confluence) shown as stacked line graphs (2017–2025), with total discharge from Bighill Creek main stem (2018-24) plotted on a secondary y-axis to illustrate hydrological context over time (M. Hayashi, flow data.)

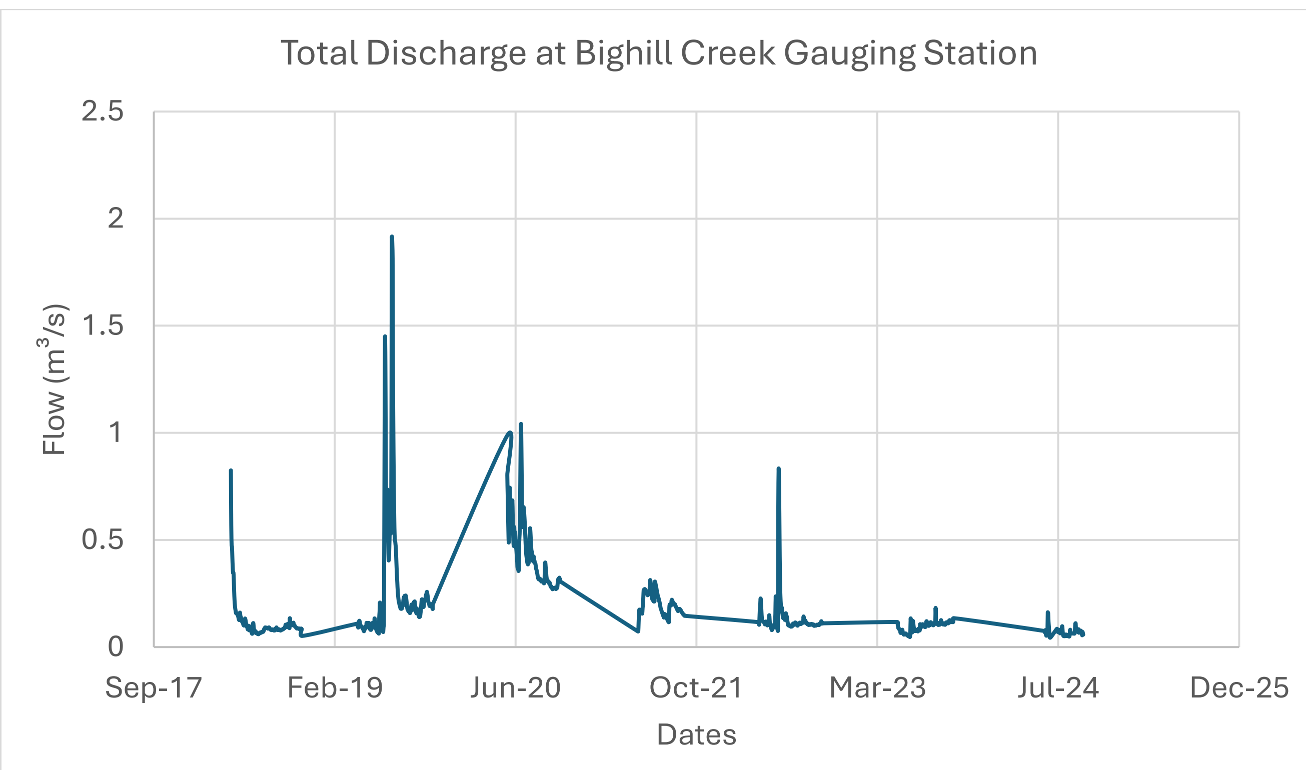

Figure 16 – Yearly discharge, Bighill Creek mainstem, 2018-24 (M. Hayashi, flow data)

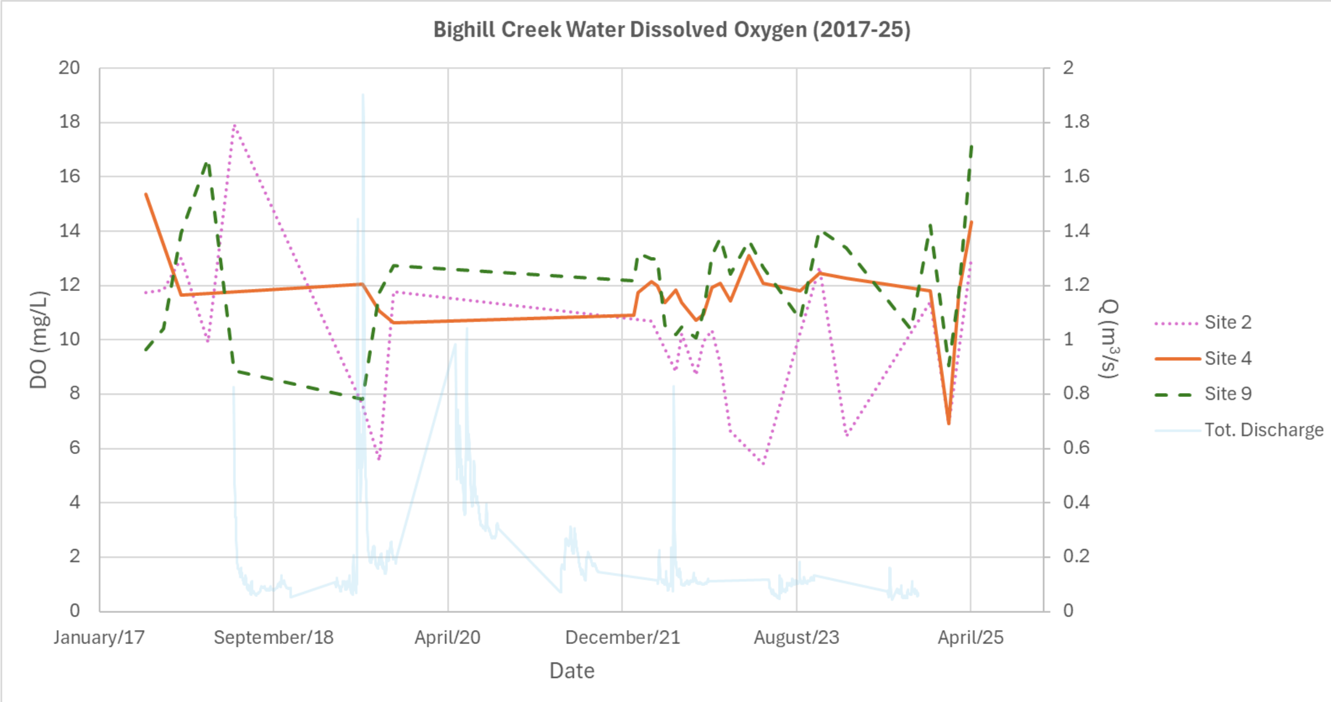

Figure 17: Dissolved oxygen in mg/L across Sites 2 (Culvert), 4 (Springs) and 9 (Confluence) shown as stacked line graphs (2017–2025), with total discharge from Bighill Creek main stem plotted on a secondary y-axis to illustrate hydrological context over time (M. Hayashi, flow data.)

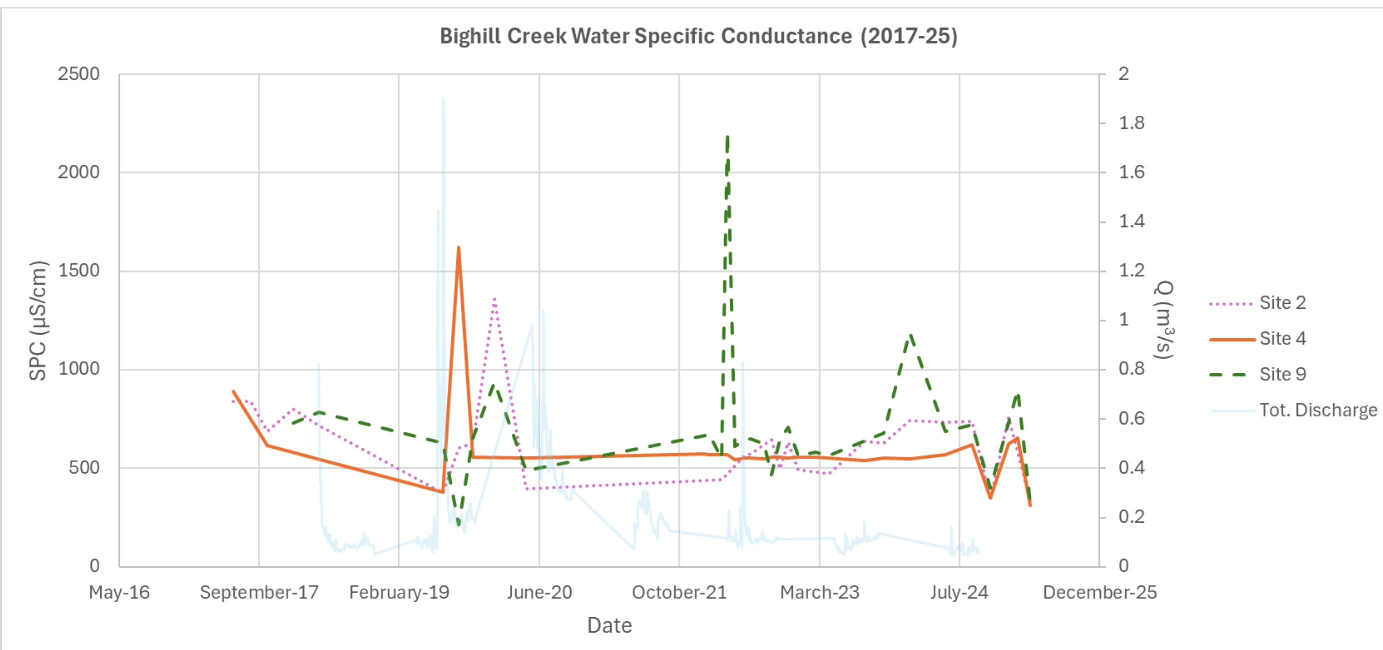

Figure 18: Specific conductivity in microsiemens per centimeter (µS/cm) across Sites 2 (Culvert), 4 (Springs) and 9 (Confluence) shown as stacked line graphs (2017–2025), with total discharge from

Bighill Creek main stem plotted on a secondary y-axis to illustrate hydrological context over time (M. Hayashi, flow data.)

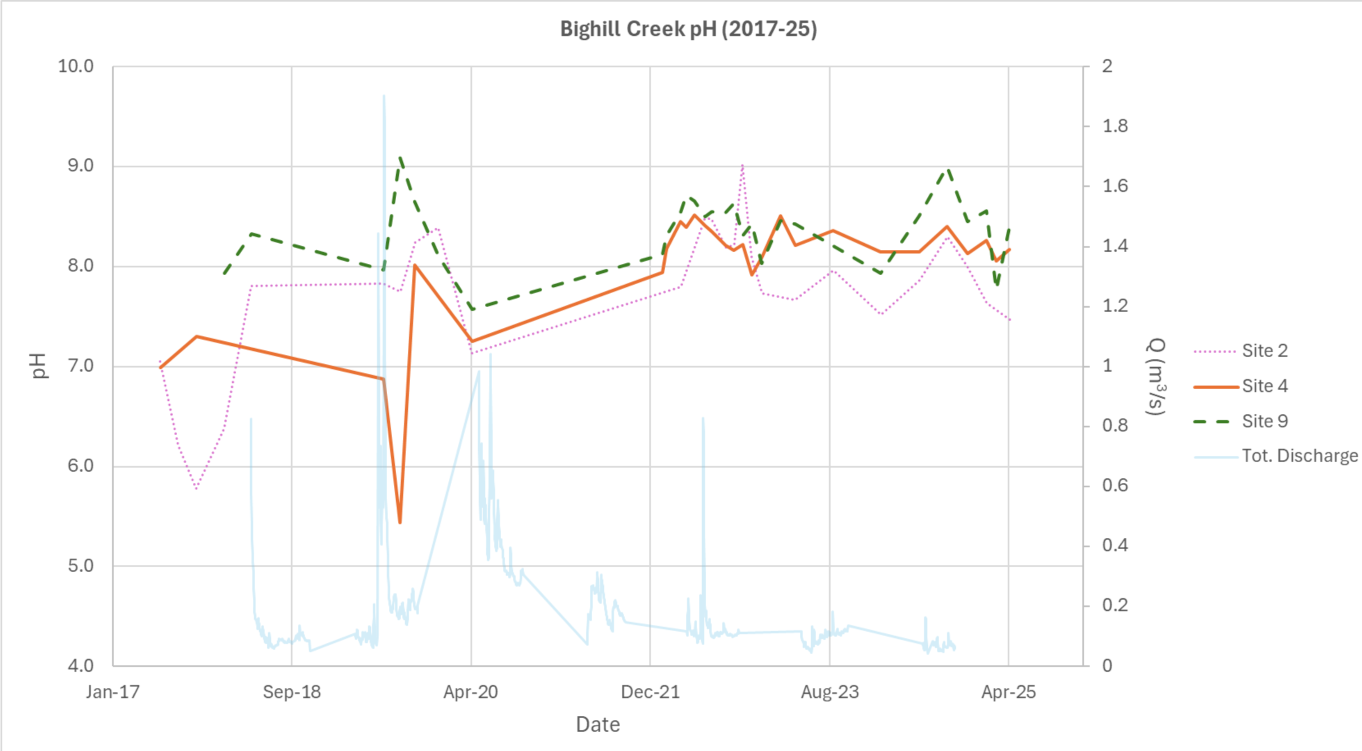

Figure 19: pH across Sites 2 (Culvert), 4 (Springs) and 9 (Confluence) shown as stacked line graphs (2017–2025), with total discharge from Bighill Creek main stem plotted on a secondary y-axis to illustrate hydrological context over time (M. Hayashi, flow data.)